Career & Technical Education

Laboratory Safety Manual

Colorado

2011
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Introduction

In the summer of 2010 funding was made available through Federal Perkins dollars to assist in the development of a CTE Laboratory Management model. It became apparent in many CTE programs that there was a need for standards for safety, instructional delivery and the management and maintenance of facilities. These are critical factors to establishing the educational environment that protects both the student and teacher from accidents and potential lawsuits that would result from negligence.

This manual is a compilation of many references found from in archives, other states and agencies that have similar goals in the development of standards for a laboratory management and suggestions from many teachers and instructors who are doing the work each and every day in the laboratory. While there is a need in CTE programs in Colorado to have standards for science laboratories, automotive laboratories, school farms and greenhouse facilities, the reality is that this first version is geared and most specific for the school shop facility. We hope that future editions of this manual will be able to encompass these facilities, but to date this is what has been included in this manual.

This manual has been organized with the teacher in mind: organized in a way that is the most efficient for the teacher to get the information sparing the educational or legal jargon as much as possible. Additionally, we have tried to provide many useful tools in this document submitted by teachers: projects, skills cards, shop clean up procedures and the like. We hope that you will find this useful.

The following units are included in this manual: Legal Information, Shop Design and Management and Set-up, Facilitating a Successful Laboratory: Roles/Responsibility of the Teacher, Safety and Emergency Action and finally a bank of resources for your use in your lab facility.

Disclaimer

It is important to note that this manual is not the end all for any given situation which you might encounter in your school laboratory facility. Alternatively, this manual is a compilation of what has worked in many other states, and therefore may or may not be useful for you in your given situation. Colorado is one of a few states that is considered to have local control. What this means is that you have local control of your curriculum and management; nevertheless, you do have the responsibility to deliver a safe learning environment and operate under the auspices of your local school district, the Community College System, the Colorado Self Insurance pool and at times the Department of Public and Environmental Health. While there are many other agencies that provide recommendations as to how a laboratory may be managed, and those are also included in this document (OSHA recommendations, for example), this manual will serve as SUGGESTIONS for you to develop your own policies and procedures. The resources provided
in this document may not protect you from all situations in regards to your liability, although every step was followed to provide you with the best information as we could find.
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A complete list of references from where information was taken can be found in the final appendix to this document with the links to the original resources.

We hope that you find this document a useful tool!

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Legal Information

Colorado
OSHA
Roles and Responsibilities
Negligence
Liability
Due Diligence
Any classroom teacher assumes risk whenever they step into a classroom with students. With teachers in CTE programs involving laboratories, shops, land labs and greenhouses this risk is greatly expanded. As effective educators we must recognize this risk potential and design our facilities, instructional components and student activities to insure the safety of our students and the longevity of our professions. The arrangement of the lab equipment, safety instruction and assessment along with an understanding of the legal aspects of tort liability, and federal guidelines are areas of knowledge and skill that are critical to the programs delivery.

Every state has unique legislation concerning liability of teachers. Colorado is no different. With the passage of the Colorado Governmental Immunity Act in 2006 the state of Colorado has set strict limits on the legal exposure you have in the occurrence of a student injury under your supervision.

The CGIA act states that; a public entity or an employee such entity of shall be immune from liability in all claims for injury which lie in tort (civil court). This sovereign immunity is waived by a public entity in an action for injuries resulting from:

1. Operation of a motor vehicle, owned or leased by such public entity, by a public employee while in the course of employment, except emergency vehicles.
2. Operation of any public hospital, correctional facility or jail.
3. A dangerous condition of any public building.

The Colorado legislature, in a later bill, provided clarification on the third CGIA waiver;

“A dangerous condition of any public building.”

Maintenance is defined as;

“The act or omission of a public entity or public employee in keeping a facility in the same general state of repair or efficiency as initially constructed or preserving a facility from decline or failure.”

**Negligence**

The legal definition of “negligence” is important for every teacher to know. Negligence, as defined by the courts today, is conduct that falls below a standard of care established by law or profession to protect others from an unreasonable risk of harm, or the failure to exercise due care. It should be noted that in the absence of specific laws or local policies, the profession sets the standard of care expected.

The career & technology education teacher has three basic duties relating to the modern concept of negligence:

- Duty of instruction.
- Duty of supervision.
- Duty to properly maintain facilities and equipment.

Failure to perform any duty may result in a finding that a teacher and/or administrator within a school system is/are negligent and may lose the immunity granted by the CGIA.

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DUTY OF INSTRUCTION includes adequate instruction before a laboratory activity (preferably in writing) that:

- Is accurate, is appropriate to the situation, setting, and maturity of the audience, and addresses reasonably foreseeable dangers.
  - Identifies and clarifies any specific risk involved, explains proper procedures/techniques to be used, and presents comments concerning appropriate/inappropriate conduct in the lab. Instruction must follow professional and district guidelines. A teacher who sets a bad example by not following proper laboratory procedures lose their immunity if injury results from students following the teachers’ bad example.

DUTY OF SUPERVISION includes adequate supervision as defined by professional, legal and district guidelines to ensure students behave properly in light of any foreseeable dangers. Points to remember:

- Misbehavior of any type must not be tolerated.
- Failure to act or improper action is grounds for liability.
- The greater the degree of danger, the higher the level of supervision should be.
- The younger the age of students or the greater the degree of inclusion of special population students the greater the level of supervision should be.
- Students must never be left unattended, except in an emergency where the potential harm is greater than the perceived risk to students. Even then, risk should be minimized or responsibility transferred to another authorized person if the situation allows.

DUTY OF MAINTENANCE includes ensuring a safe environment for students and teachers.¹

- Never use defective equipment for any reason.
- File written reports for maintenance-and correction of hazardous conditions or defective equipment with responsible administrators.
- Establish regular inspection schedules and procedures for checking safety and first aid equipment.
- Follow all safety guidelines concerning proper labeling, storage and disposal of chemicals.

By keeping files of all hazard notifications and maintenance inspections, liability in the event of an accident maybe minimized in cases where no corrective actions were subsequently made if the correction was outside the ability or responsibility of the teacher to accomplish.

Failure to meet these three areas of duty can be an indication that the teacher failed to exercise the degree of care which a prudent a professional would exercise in a similar condition.

Colorado

The following information is from the Colorado Department of Public Health and Environment, Consumer Protection Division. These are some rules and regulations governing schools as set by the State Board of Health. This is not a complete list but the entire document can be found at: http://www.cdphe.state.co.us/regulations/consumer/101006schools.pdf

"1-101 Purpose: The purpose of these "Rules and Regulations" is to provide minimum sanitation requirements for the operation and maintenance of schools and minimum standards for exposure to toxic materials and environmental conditions in order to safeguard the health of the school occupants and the general public.

1-102 Application: These "Rules and Regulations" shall apply to all schools, kindergarten through grade twelve, in the State of Colorado.

1-103 The Department recommends that all schools with laboratories, and/or engaging in industrial arts or hazardous vocational activities should be inspected a minimum of once per year.

2-102 Livestock or poultry shall be located more than fifty (50) feet from food service areas, offices, or classrooms except those offices and classrooms associated with animal husbandry activities.

3-402 Animals used for instructional purposes shall be maintained in a sanitary condition and in a manner to prevent health hazards or nuisance conditions. Their enclosures or pens shall be provided with easily cleanable surfaces and maintained in good repair.

3-403 All pesticides shall be used in accordance with registered label directions and stored in a safe manner in an area accessible only to authorized personnel. Application of "restricted use pesticides" shall be performed only by a certified pesticide applicator.

4-101 The school plant and accessory buildings shall be maintained in good repair and in a clean sanitary condition.

4-102 Adequate space shall be provided for each person in classrooms, libraries, shops, laboratories, vocational training rooms, dining rooms, and other related activity rooms or areas to lessen the possibility of health hazards, and disease transmission. In the absence of more stringent guidelines the 1997 Uniform Building Code shall be used as a guideline for determining adequacy of space.

4-103 Where necessary, classroom windows shall be equipped with blinds, shades of translucent material, or other effective means to prevent glare and to control natural light.

4-104 Windows, when opened, shall not create a hazard.
4-105  Exposure to noise, dusts, toxic chemicals, or other hazards shall be controlled when the building or portion thereof is occupied during construction or remodeling.

4-106  When there is a change in classroom use, the design and construction of the classroom facilities shall be appropriate for the new use.

6-101  Instructional, athletic, recreational or other equipment used in or out of the classroom shall be maintained in a clean, safe condition.

6-106  Cleaning materials, tools, and maintenance equipment shall be provided and shall be safely stored and secured in a locked area.

6-107  Pesticides, toxic or hazardous cleaning and maintenance chemicals and materials shall be stored separately in a ventilated and locked cabinet or area accessible only to authorized personnel. The ventilation requirement of this section may not be required in areas where minimum quantities of the above mentioned materials are stored for daily use. In the absence of more stringent guidelines flammable or combustible materials shall be stored in accordance with the 2000 National Fire Protection Association Code 30 Flammable and Combustible Liquids Code.

8-101  Provisions shall be made for the protection of students engaging in arts, crafts, industrial arts, physical sciences, vocational, educational or any activities where hazardous chemicals, hazardous devices or hazardous equipment are used. These provisions include the development and posting of operating instructions, regulations and procedures.

8-102  Toxic or hazardous materials shall be stored in approved laboratory containers, separated by reactive group and stored in a ventilated, locked, fire-resistant area or cabinet. The ventilation requirement of this section may not be required where minimum quantities of such materials are stored for daily use.

8-103  Containers of chemicals, poisons, corrosive substances and flammable liquids shall be clearly labeled with the name of the material and the date the material entered the school.

8-104  Prohibited chemicals are those chemicals that pose an inherent, immediate and potentially life threatening risk, injury or impairment due to toxicity or other chemical properties to the students, staff or other occupants of the school. These chemicals are prohibited from use and/or storage at the school and the school is prohibited from purchasing or accepting donations of such chemicals. Prohibited chemicals are listed in Appendix A to this regulation.

8-105  Restricted chemicals are those chemicals that are restricted by use, and/or quantities. If restricted chemicals are present at the school, each chemical shall be addressed in...
the school’s written emergency plan as addressed in sections 8-112 and 8-113 of these regulations. Restricted chemicals are listed in Appendix B to this regulation.

8-106 Restricted chemicals (demonstration use only) are a subclass in the restricted chemical lists that are limited to instructor demonstration. Students may not participate in the handling or preparation of restricted chemicals as part of a demonstration. If restricted chemicals (demonstration use only) are present at the school, each chemical shall be addressed in the school’s written emergency plan as addressed in sections 8-112 and 8-113 of these regulations. Demonstration only chemicals are listed in Appendix B2 to this regulation.

8-107 Exposure to noise, or toxic liquids, dusts, gases, mists, fumes or vapors or other hazards shall be controlled to avoid health hazards.

8-108 All chemicals, solvents, and hazardous substances shall be inventoried by the school a minimum of once a year. The inventory shall include the name of the compound, the amount, and the date it entered the school. A copy of the inventory shall be kept on file in a location away from the areas where the aforementioned materials are stored.

8-109 A current material safety data sheet shall be provided for all poisonous, toxic, or hazardous substances and shall be available for review upon request.

8-111 Refrigerators used for flammable compounds shall be prominently marked to indicate they meet the appropriate design requirements for safe storage of flammable liquids.

8-112 A written plan for response to and cleanup of chemical spills shall be provided by the school. A copy of the plan shall be kept on file in a location away from the areas where chemicals are stored.

8-114 A list of first aid procedures for accidental poisoning shall be posted. The telephone number and location of the nearest poison control center shall be posted near the telephone.

8-115 The storage, preparation, and consumption of food and drink is prohibited in any area where there are poisonous, toxic or hazardous substances.

8-118 Eye protection, that meet the American National Standards Institute 1989 Z87.1 Standard – Practice for Occupational/Education Eye and Face Protection must be worn by all students participating in, observing, or in close proximity to any experiment or activity which could result in eye injury. Eye protection glasses, goggles, face shields, and similar eye protection devices shall be issued clean and properly sanitized and stored in a protected place.

8-119 An easily accessible fire blanket must be provided in each laboratory or other area where an open flame is used.

8-120 Where there is exposure to skin contamination with poisonous, infectious or irritating
materials, a hand washing facility shall be available.

8-121 An easily accessible operational eye wash fountain must be provided in each laboratory or other areas where corrosives or irritating chemicals are used. The eye wash fountain shall be clean and must be tested annually. The use of portable eye wash bottles as substitutes is not permitted.

8-122 An easily accessible operational safety shower, capable of providing continuous flowing water, shall be provided for each laboratory or other areas where corrosive or irritating chemicals are used. The safety shower can be centrally located so as to serve more than one area if doors are not locked, and convenient prompt access is available.

8-123 Master gas valves and electric shut-off switches shall be provided for each laboratory or areas where power equipment is used.

8-124 All emergency and safety equipment including master valves, shut off switches, eye wash fountains, safety showers, fire extinguishers (appropriate for the intended use), and fire-alarm pull stations and other similar equipment shall be tested at least once annually and labeled for high visibility.

8-201 All areas shall be adequately ventilated so that exposures to hazardous or toxic materials are maintained to a safe level. In the absence of more stringent guidelines the American Conference of Governmental Industrial Hygienists 1989 Threshold Limit Values and Biological Exposures Indices shall be used as a guideline to determine safe levels.

8-202 Local exhaust ventilation shall be provided so that contaminants are exhausted away from the student and not through the breathing zone.

8-203 Sufficient fume hood capacity ventilation shall be provided and shall be used for any activity producing hazardous toxic or noxious gases, mists, vapors, or dusts.

   a. Hoods must exhaust directly to the outside and shall be located a minimum of 10 feet from any building air-intakes or building openings.

   b. Discharges from any exhaust hood must meet applicable Colorado Air Pollution Standards.

   c. A minimum face velocity of 100 feet/minute for general laboratory hoods must be provided.

   d. Air flow of fume hoods must be tested at least once a school year.

9-101 Basic first aid equipment and medical supplies including: gauze pads and roller gauze, adhesive tape, cold pack, plastic bags, disposable gloves, band-aids, hand cleaner, small flashlight and extra batteries, scissors, tweezers, blanket and a triangular bandage shall be provided and kept conveniently available for emergency
use.

a. The administration of syrup of ipecac and/or activated charcoal is prohibited without first consulting with a licensed physician or a poison control center.

b. First aid supplies and equipment with an expiration date shall be discarded and replaced once that date has past.

10-104 The school plant shall be maintained and used in a safe manner to minimize health, safety and fire hazards. Fire control methods shall conform to state and local fire prevention regulations.”

Occupational Safety and Health Act

The following excerpts (see footnotes) are from several different states who utilize OSHA standards in various degrees for established guidelines. They are included here as an introduction to the Act and specific details which may pertain to school laboratories or as representative of standards that our industry employers must meet. These federal guidelines are considered to be the most rigorous – and hence a background of information on OSHA is included.

The Federal Act called the “Occupational Safety and Health Act of 1970” is intended to “assure, so far as possible, every working man and woman in the nation safe and healthful working conditions and to preserve our human resources.”

The Act applies to every employer engaged in a business affecting commerce who has employees. The law applies in all fifty states and all territories of the United States. Federal, State and local employees are specifically excluded from coverage, but they may be covered by equally effective requirements.

Each employer under the Act has the general duty to furnish each of their employees places of employment, free from recognized hazards causing or likely to cause death or serious physical harm and the employer has the specific duty of complying with the safety and health standards under the Act. Each employee has the duty to comply with these safety and health standards and all rules, regulations, and orders issued pursuant to the act which are applicable to their own conduct and actions.

How OSHA Relates to Teachers

Regulations promulgated under the authority of OSHA set forth detailed standards in respect to almost every conceivably activity. Some of the standards apply only to certain stated industries and are generally referred to as “vertical” standards. As an example, the construction industry has a specific set of standards with which it must comply. A school or its faculty would not normally be concerned with these special “vertical” standards. However, the Act does regulate a myriad of activities and situations which apply to all industries or occupations generally. These regulations are often referred to as “horizontal” standards, and are equally applicable to the activities of colleges, universities, school, and other professions and industries.

Until this point the penalties provided are for violations by an employer, and the logical question arises as to whether a member of the faculty of an educational institution is considered under any circumstances as an employer.
Unfortunately, procedures under the act have not been sufficiently developed so that an exact determination of who the responsible party would be in a criminal prosecution cannot be forecast. The imminent danger section of the Act refers to a “work place under your ownership, operation or control.” Conceivably, therefore, the act could be interpreted to provide sanctions against a faculty member where the violation occurs in an area under the control of that faculty member.

An equally unanswerable question is whether an injury to a student could result in criminal sanctions under the Act. By its terms the Act is designed for the protection of employees and a strict construction would not include students in that category. However, under further judicial interpretation of that Act is made, these questions must, at the present, remain unanswered.

The greatest significance of OSHA regulations for faculty members is in the area of civil actions for personal injuries where it is alleged that failure to comply with OSHA regulations constitute negligence. Cases of this nature may arise where required protective devices are not provided on machinery used by students, or others, under the supervision of a faculty member. Other situations of potential liability may arise from failure to comply with standards as to individual protective equipment, chemicals, electrical apparatus or conceivably even as to housekeeping in classrooms or laboratories. It seems, therefore, that it would be to the advantage of teachers to familiarize themselves with OSHA as well as other state and municipal regulations pertaining to instrumentalities and activities under their control.

In summary, the faculty immunities of yesterday are fast disappearing and the general rules of liability are increasingly applicable to members of the academic community. Teachers must be aware of the fact that they maybe held liable not only for their acts or failure to act, but in some cases may be held personally responsible for the acts of others who are under their control or supervision (Cropley & Sloan, 1990).

The General Duty Clause

The General Duty Clause found in OSHA are big picture guidelines to be followed by industry and also may be the most critical issues when negligence and occupational fines. The following is the General Duty Clause as it is taken from the reference material for the National Center for Construction Education and Research reference material for safety orientations:

The General Duty Clause (Section 5 of the OSH Act) is an important clause that employers and employees must be aware of as large fines can be given to the employer if it is not followed. It states:
“In practice, OSHA, court precedent, and the review commission have established that if the following elements are present, a General Duty Clause citation maybe issued:

1. The Employers failed to keep the workplace free of a hazard to which employees of the employer were exposed.
2. The hazard was recognized. (Examples might include: through your safety personnel, employees, organization, trade organization, or industry customs.)
3. The hazard was causing or was likely to cause death or serious physical harm.
4. There was a feasible and useful method to correct the hazard.

Teacher Tips & Responsibilities

Role in the Setup of a Shop/Laboratory
Maintenance
Teaching/Instruction
Developing a Plan/Course of Study
Demonstration
Teaching/Safety Instruction
Assessments
Student Record Keeping
Responsibilities of the Instructor\(^1\)

The major responsibility for laboratory safety instruction and accident prevention falls on the teacher. The following are considered to be part of the responsibilities of the teacher in a comprehensive accident prevention program in school laboratories.

1. NOTE: DO NOT LEAVE THE CLASSROOM UNSUPERVISED AT ANY TIME WHEN STUDENTS ARE PRESENT.
2. The teacher should emulate safe practices and techniques at all times.
3. Incorporate safety instruction in the course of study and maintain documentation as to who received instruction and when instruction was given.
4. Present instruction on potential hazards and accident prevention specific to the particular school laboratory.
5. Instigate a comprehensive safety program for your particular school laboratory.
6. Develop specific safe practices, rules and regulations relating to your facilities and provide for their enforcement.
8. Provide proper instruction for the use of all tools, machines and equipment.
9. Keep a record of each student’s attendance, safety training and safety evaluation.
10. Require that a student be enrolled in the technology education program and receive the required safety instruction prior to working in the laboratory.
11. Insist that adequate eye protection be worn in all technology education laboratories at all times in accordance with Act 116 as found in this document.
12. Insist on proper protective equipment in all laboratory areas and require students to wear proper clothing, eye protection and adequate hair guards while working in the laboratory.
13. Remove and/or secure all jewelry while working in the laboratory.
14. Devise and enforce safe housekeeping procedures.
15. Insist that guards meeting accepted standards be provided and used whenever a machine is operated.
16. Establish and maintain the safest possible working environment.
17. Have set, pre-planned procedures in case of an accident or emergency.
18. Provide prompt and thorough reports of accidents including:
   a. Written report by instructor.
   b. Written accounts by witnesses.
   c. Photographs of accident scene and conditions.
19. Always provide for the supervision of students in the classroom or laboratory in accordance with legal requirements.

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20. Regularly review laboratory facilities to maintain safe conditions. Give special attention to these items:
   a. Layout
   b. Utilities and building services
   c. Equipment guarding
   d. Storage and conditions of tools
   e. Storage, labeling and handling of materials
21. Submit written recommendations to the administration for improving safety conditions.
22. Review all IEP’s on a regular basis to address the needs of all students enrolled in all technology education classes.
23. Criteria for scheduling special needs students into laboratory classes should be established by a team of counselors, technology education teachers, special education teachers and school administrators. Aides or special equipment should be made available to the technology education teacher. This should also include the appropriateness of placement of the student.

The Ability to Motivate

What moves us into action? What drives us to succeed? Motivation is an important part of the learning process. When students are motivated, there are fewer behavior problems.

Teachers at the high school level sometimes encounter students who arrive with negative attitudes based on prior experience. It is particularly important, therefore, to help students replace their preconceptions with a new enthusiasm for learning. What drives a student to succeed can be personal and individual, but there are also a number of conditions that you can create to raise student motivation levels. Let’s look at some of the major motivators that determine student achievement.

Strategies for Motivating the High School Student

1. Personal Involvement. What meaning does the learning have for students? How is it relevant? Why should they be interested in the concepts and ideas?

2. A Positive Environment. You, the teacher, set the tone. Your shop is one in which all students and staff are respected. Your demeanor, attitude and body language all create an environment conducive to learning.

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3. **Security.** When students have concerns about being harassed or humiliated they become anxious and defensive. When students feel safe they can focus on learning.

4. **Minimize Fear.** When students are fearful they are less likely to take good risks and attempt new learning.

5. **Teacher Approval.** Show that you are pleased, that you care, and that you are invested in teaching.

6. **Clarity.** If there are clear signals, students can make the effort. If there is confusion, students will shut down. Communicate clearly and listen carefully to student responses.

7. **Pleasure.** Is it fun? Is there humor? Your enthusiasm is contagious and your students will enjoy your class or shop.

8. **Novelty.** Is there anything new in your teaching/learning strategies or is it just a repetition of the tried and true?

9. **Success Seminars.** Everyone feels better when success is evident. The level and kind of success may vary, but the effect is the same. Share student success stories with the class, with other teachers and with parents.

10. **Win/Win.** Teacher motivation is tied to student motivation. When students are successful, we succeed as well.

The specific ingredients that motivate individual students may not always be apparent. However, with a desire to problem-solve and a sincere effort to implement a ‘motivation plan’ your chances of success are virtually assured.

1 See “First Year Teachers Survival Kit” by Julia Thompson; p. 251, “Motivate Your Students to Succeed”

**Other Ideas to Get Unmotivated Students Working**

**Question of the day**

Create a question of the day i.e., situations to solve, trivia questions, opinion of a current event.
Give students points for their correct answers.

**What I Know, What I Think I Know, What I Want to Know...**

Have students fold a piece of paper in thirds. In the first column, write what you know about a topic. In the second column, write what you think you know about a topic. In the third column, write what you want to know about a topic. You can also do this exercise on the board.

**Current events or quotes...**

Place a quote or a headline on the board. Have students reflect on the quote in a journal, notebook, or discuss it in class.

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**Incomplete sentences...**

Write out sentence stems and have students complete them. This can be content driven or statements like the following:

I realize that...

I’m surprised that...

I am disappointed that...

I could change if...

If I were to think more positively...

**Stump the Teacher...**

The class comes up with questions for the teacher on the topic/unit of study. The teacher gives the answer (may or may not be correct). The class has to decide if the teacher’s answer is correct. If the students decide correctly, they get a prize.
Question Mark...

On a large poster board or piece of paper, draw a huge question mark. Have the class brainstorm what they know and place it in the “dot” part of the question mark. Next, have them brainstorm questions and write them in the “question mark” area. At the end of the unit, go back to the question mark, and review the questions.

Word Splash...

Write a word on the board. Have students come up and write the first thing they think of when they see/hear that word. You may want to remind students of discipline codes, including no vulgar or inappropriate language.

Focusing on the Needs of Students

Promoting Equity

Teachers must make every effort to assure that all students receive equal opportunity to learn and to succeed in school. It is not enough to teach to the “middle of the road.” Teachers are expected to make every effort to reach all of their students and to offer appropriate support and encouragement to those students who, for a variety of reasons, are a challenge to teach.

To attend to students equally, teachers must continually reflect on their practice. Some questions that teachers might ask themselves in order to assess fair treatment appear below.

- Do I spend enough time and give enough attention to students who do not ask for help?
- Do I interact or call on one gender group more than another?
- Do I react to poor behavior more quietly with some students than others?
- Do I predict performance or award grades subjectively?
- Do I solicit responses from all students, just a few, or just those who volunteer answers?
- Do I reprimand certain types of students (boys, girls, minorities) more than others?
- Do I afford all students the opportunity to develop skills that require leadership, organization, self-discipline, independence and maturity?
• Do I provide positive reinforcement equally?
• Do I hold all students accountable for abiding by school rules?
• Do I grade students objectively?
• Do I apply standards for performance consistently?
• Am I consistent in applying consequences for misbehavior?
• Am I consistent in applying consequences for non-performance?
• Do I afford consideration for extenuating circumstances equally?

**Accident Reduction³**

Career and technical education teachers should design and implement their curriculum to include the following:

1. Teach thoroughly the proper and safe use of all machines before letting students use them.

   Demonstration is by far the best method to accomplish safety instruction. However, other teaching methods such as audio-visual, safety articles, posters, etc., should be used to supplement the initial demonstrations and continuously kept students aware of their safety responsibilities.

2. Repeat demonstrations frequently

3. Document all safety instruction in lesson plans and grade books.

4. Check frequently to see that students are properly following safety procedures. Tests, both written and “hands on,” will aid in checking competency and will also assist students to recall safety methods. Keep a file of students’ test results.

5. Insure that all machines are properly guarded.

6. Post safety rules at each machine.

7. Post general safety rules in the laboratory.

8. Supervise personally the student’s first attempt to operate a machine at any given time.

9. Insure that no more than one student operates a machine at any given time.

10. Maintain machines and equipment in good mechanical condition.

11. Assist in preventing students from operating equipment while under the influence of any mind-altering drugs (prescription or non-prescription).

Supervisor (Shop Teacher)  
☐ instruct new students in safe work procedures  
☐ train students for all tasks assigned to them and check their progress  
☐ ensure that only authorized, adequately trained students operate tools and equipment  
☐ enforce safety regulations  
☐ correct unsafe acts and conditions  
☐ identify students with problems such as drugs or alcohol that could affect their safety and the safety of others; follow up with interviews and referrals where necessary  
☐ formulate safety rules and inspect for hazards in your own area  
☐ keep accurate safety and training records  
☐ complete a Schools Protection Program Incident Report each time an accident occurs

Employee (Student)  

☐ know and follow safety and health procedures affecting your work
☐ if you don’t know, ask for training before you begin work
☐ work safely and encourage your classmates to do the same
☐ correct or immediately report any unsafe conditions to your teacher
☐ take the initiative—make suggestions for improved safety conditions

Note: Students are not employees and, therefore, if injured, are not entitled to Workers’ Compensation Benefits.

Implementation Procedures

The following are suggested procedures for the implementation of the safety program.

1. Select those rules and tests form this manual that apply to your vocational programs. Make up a set of safety rules booklets and a set of safety test booklets with all of the rules you have selected in one and the tests in the other. Make enough for one for each student in a class (a class set).

2. Duplicate the answer sheet found in Appendix C.

3. Duplicate enough of the parent letters (Appendix A) for each of your students. There is room at the top of the sample letter to include the name of the school or the school letterhead.

4. Post a copy of the safety pledge (Appendix B), and a copy of the general safety rules near the entrance of the shop.

5. Post a copy of the safety rules for each machine tool at or near that machine. (Paste the rules to a piece of heavy cardboard or Masonite, coat it with varnish, and fasten it to the machine near the on-off switch.

6. At the start of the school year, and with each new student that enters the class:
   a. Review the general shop pledge (Appendix B) and have the student sign it.
   b. Review the parent letter (Appendix A) and have students take it home and review it with their parent(s) or guardian(s); have them sign and return it to the school.
   c. File both of those documents and indicate in the record book that they have been received.

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d. Review the general safety instructions with each class and administer the general safety test.

e. File the completed tests after they have reviewed the rules on their own.

7. As new machine tools are introduced to students:

a. Review the safety rules for that machine.

b. Demonstrate the safe use of the machine.

c. Administer the test for that machine.

d. File and record the names of all those who score 100%.

e. Re-test those who failed after they have reviewed the safety rules for that machine.

f. Have the students demonstrate that they know how to operate the machine.
MSDS

When working with any type of chemical the Material Safety Data Sheet (MSDS) should be posted in a conspicuous place in the work area. MSDS binders are available for this purpose. Teachers should review the MSDS 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.

Common materials that require MSDS sheets are:
- Welding rod
- Welding gases
- Paint
- Solvents
- Fertilizer
- Pesticides
- Cleaners
- Other petroleum products
- Adhesives (e.g. PVC Cement)
- Portland Cement

MSDS are available from product manufacturers (see their web sites) and also can be found at:
http://www.msds.com/
http://www.ilpi.com/msds/

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Shop Management

Facility Design
Storage of Materials
  Tools
  Hazardous Materials
  Hazardous Chemicals
  Welding Gases
  Other Materials
Floor & Safety Lines
  Safety Colors
  Housekeeping
  Shop Cleanup
Facility Design

When designing, equipping or remodeling a technology education facility, there are a great many situations and details that should be anticipated as the planning proceeds. Consider the moral, financial and legal aspects of a sound safety program. It is prudent to give safety a dominant and controlling role in the planning process.

The placement of machines and equipment in a given work area is critical and should allow for the normal flow of machines through the operational process. There should be a minimum of cross traffic of both material and/or students.

The planner or the specification writer normally considers the following factors:

1. Flow of materials
2. Flow of students
3. Tool and equipment arrangement
4. Electrical and other utilities
5. Dust collection
6. Color
7. Lighting
8. Storage
9. Costs
10. Ventilation
11. Noise and
12. Tool and equipment specifications.

Aisle and Machine Placement

All machines and equipment must comply with existing state and federal regulations. Although OSHA does not have direct authority over schools it is strongly recommended that schools consider adopting these requirements. Where hazards exist around a machine, the machine should be placed so students in the area are not in the line of danger.

Machines such as table saws, jointers and planers are capable of violent kickback of the stock. They should be arranged so that the stock will not be accidentally thrown into areas where other students will be working. Painted lines on the floor should also designate the hazard areas. The aisles should provide adequate travel space between benches and machines; they should also provide adequate space areas in front of tool panels and storage lockers and other areas where students may either congregate or are working. Special consideration should be given to those areas that present potentially dangerous operations.

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Noise

Physical technology laboratories produce a higher level of noise than other types of laboratories. The level, in conjunction with the time of exposure, must be kept below permissible exposure levels. This may be accomplished through the use of sharp tooling, proper maintenance and correct alignment of machinery, the use of energy and noise absorbing materials, or the substitution of quieter procedures and equipment. Personal ear protection is necessary when noise levels and the time of exposure exceed OSHA standards. If a normal speaking voice cannot be understood from two feet away, the noise level is probably excessive.

Dust Collection

Control or collection of dust is necessary, particularly in the materials areas. This may be accomplished by the installation of a dust collection system or by individual (localized) dust collectors attached to specific machines or incorporated into the design of portable power tools. General cleanliness in the laboratory may contribute greatly to dirt and dust control. If the laboratory is to be air conditioned, a central dust collection system is imperative. Additional protection could be offered by supplying every student with a disposable dust mask.

Ventilation

Mechanical exhaust ventilation is, in most cases, the first choice for control of air contaminants, which are potential health and/or fire hazards. A properly designed and maintained localized exhaust or general dilution ventilation system will either remove air contaminants which may be present or lower the concentration of fumes, vapors, dusts, mists or other contaminates generated in the working environment.

Local exhaust ventilation removes the hazardous materials at or near their point of origin and prohibits them from being drawn through the breathing zone of the student. Local exhaust ventilation is the preferred type, as it usually performs most efficiently and prevents air contaminates from circulating through the entire laboratory area or school building. There are three basic types of localized exhaust systems: a) down draft, b) lateral flow and c) suspended canopy. The suspended canopy is the least desirable type of localized ventilation because the hazardous material contaminates are drawn through the person’s breathing zone.

Local exhaust ventilation systems should be installed whenever a large volume of air contaminant is generated or where a particularly hazardous substance is used. Some operations requiring the use of local exhaust ventilation are welding, spray painting, woodworking and processes involving the use of resins, solvents and flammable liquids. Processes involving the use of asbestos, lead, mercury, chromium and zinc should not be performed in technology education laboratories.

General dilution ventilation depends upon a sufficient volume of air passing through the laboratory area to dilute the contamination to a recommended non-hazardous level. Dilution ventilation works best with low toxicity contaminates and
requires a greater volume of air movement for efficient operation. General dilution ventilation may be an effective control for areas generating low concentrations of relatively non-hazardous substances.

The design of ventilation systems is somewhat detailed, involving determination of the volume of air, which needs to be moved, the type of fan, which will adequately exhaust the air volume, the placement of the exhausts, make-up air and the positioning of the system. A mechanical engineer or industrial hygienist should be consulted to assist in providing an effective environmental control through the use of a ventilation system.

In addition, filters need to be cleaned and changed regularly, and qualified personnel should check all ventilation systems at the beginning of each school year in order to confirm continued effectiveness. As a word of caution, it is recommended that teachers do not modify existing systems as this may create an environment with negative health results.
Lighting

The shop planner must consider that quantity and quality of illumination required for various tasks, the problem of glare and the replacement of specialized lighting equipment in hazardous areas. The current minimum levels of illumination for industrial areas as recommended by the Illuminating Engineer Society (IES) are given in ANSI/ES RP-7-1979. The following table illustrates the quantity of illumination required for various tasks likely to be performed in industrial/vocational education shops.

<table>
<thead>
<tr>
<th>Task</th>
<th>Footcandles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forging</td>
<td>50</td>
</tr>
<tr>
<td>Foundry work</td>
<td></td>
</tr>
<tr>
<td>Annealing (furnaces)</td>
<td>30</td>
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<tr>
<td>Core making</td>
<td></td>
</tr>
<tr>
<td>Fine</td>
<td>100</td>
</tr>
<tr>
<td>Medium</td>
<td>50</td>
</tr>
<tr>
<td>Pouring</td>
<td>50</td>
</tr>
<tr>
<td>Garages (auto shop)</td>
<td></td>
</tr>
<tr>
<td>Repairs</td>
<td>100</td>
</tr>
<tr>
<td>Active traffic areas</td>
<td>20</td>
</tr>
<tr>
<td>Machine Shops</td>
<td></td>
</tr>
<tr>
<td>Rough bench and machine work</td>
<td>50</td>
</tr>
<tr>
<td>Medium bench and machine work</td>
<td></td>
</tr>
<tr>
<td>Ordinary automatic machines</td>
<td>100</td>
</tr>
<tr>
<td>Rough grinding, medium buffing</td>
<td></td>
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<tr>
<td>and polishing</td>
<td></td>
</tr>
<tr>
<td>Fine bench and machine work</td>
<td></td>
</tr>
<tr>
<td>Fine automatic machines</td>
<td>500*</td>
</tr>
<tr>
<td>Medium grinding, fine buffing</td>
<td></td>
</tr>
<tr>
<td>and polishing</td>
<td>1000*</td>
</tr>
<tr>
<td>Extra-fine bench and machine</td>
<td></td>
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<tr>
<td>work, grinding, fine work</td>
<td></td>
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<tr>
<td>Paint shops</td>
<td></td>
</tr>
<tr>
<td>Dipping, simple spraying,</td>
<td>50</td>
</tr>
<tr>
<td>firing</td>
<td></td>
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<tr>
<td>Rubbing, ordinary hand</td>
<td></td>
</tr>
<tr>
<td>painting and finishing art,</td>
<td>50</td>
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<tr>
<td>stencil and special spraying</td>
<td></td>
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<tr>
<td>Fine hand painting and</td>
<td>100</td>
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<tr>
<td>finishing</td>
<td></td>
</tr>
<tr>
<td>Extra-fine hand painting and</td>
<td>300*</td>
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<tr>
<td>finishing</td>
<td></td>
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<tr>
<td>Printing and photoengraving</td>
<td></td>
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<tr>
<td>Printing</td>
<td></td>
</tr>
<tr>
<td>Color inspection and appraisal</td>
<td>200*</td>
</tr>
<tr>
<td>Machine composition</td>
<td>100</td>
</tr>
<tr>
<td>Composing</td>
<td>100</td>
</tr>
<tr>
<td>Presses</td>
<td>70</td>
</tr>
<tr>
<td>Proofreading</td>
<td>100</td>
</tr>
<tr>
<td>Photoengraving</td>
<td></td>
</tr>
<tr>
<td>Etching, staking, blocking</td>
<td>50</td>
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<tr>
<td>Routling, finishing,</td>
<td>100</td>
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<tr>
<td>proofing</td>
<td></td>
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<tr>
<td>Sheet metal shops</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous machines,</td>
<td>50</td>
</tr>
<tr>
<td>ordinary bench work</td>
<td></td>
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<tr>
<td>Presses, shears, stamps,</td>
<td>50</td>
</tr>
<tr>
<td>medium bench work, spinning</td>
<td></td>
</tr>
<tr>
<td>Punches</td>
<td>50</td>
</tr>
<tr>
<td>Tin plate inspection (galvanized)</td>
<td>200 **</td>
</tr>
<tr>
<td>Surging</td>
<td>200 **</td>
</tr>
<tr>
<td>Welding</td>
<td></td>
</tr>
<tr>
<td>General illumination</td>
<td>1000*</td>
</tr>
<tr>
<td>Precision manual arc welding</td>
<td></td>
</tr>
<tr>
<td>Woodworking</td>
<td></td>
</tr>
<tr>
<td>Rough sawing and bench work</td>
<td>30</td>
</tr>
<tr>
<td>Sizing, planning, rough</td>
<td></td>
</tr>
<tr>
<td>sawing, medium quality</td>
<td>100</td>
</tr>
<tr>
<td>machine and bench</td>
<td></td>
</tr>
<tr>
<td>Work, gluing veneering,</td>
<td>50</td>
</tr>
<tr>
<td>coopering</td>
<td></td>
</tr>
<tr>
<td>Fine bench and machine work,</td>
<td>50</td>
</tr>
<tr>
<td>fine sanding and finishing</td>
<td></td>
</tr>
</tbody>
</table>

* The recommended footcandles may be obtained by a combination of general lighting plus special supplementary lighting. Care must be taken to design and install a system which not only provides sufficient light but directly and diffuses the light and protects the eyes. Insofar as it is possible, glare (both direct and reflected) and objectionable shadows should be eliminated.

** In rough task, the mirror-like surface of the material means that special care must be taken in selecting and placing lighting equipment and/or orienting the work to reduce glare.

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Electrical Requirements

Fuses:
Before removing any fuse from a circuit, be sure the switch for the circuit is open or disconnected. When removing fuses, use an approved fuse puller and break contact on the hot side of the circuit first. When replacing fuses, install the fuse first into the load side of the fuse clip, then into the line side.

GFCIs:
A Ground Fault Circuit Interrupter (GFCI) is an electrical device which protects personnel by detecting potentially hazardous ground faults and quickly disconnecting power from the circuit. A potentially dangerous ground fault is any amount of current above the level that may deliver a dangerous shock. Any current over 8 mA is considered potentially dangerous depending on the path the current takes, the amount of time exposed to the shock, and the physical condition of the person receiving the shock.

Therefore, GFCIs are required in such places as dwellings, hotels, motels, construction sites, marinas, receptacles near swimming pools and hot tubs, underwater lighting, fountains, and other areas in which a person may experience a ground fault.

A GFCI compares the amount of current in the ungrounded (hot) conductor with the amount of current in the neutral conductor. If the current in the neutral conductor becomes less than the current in the hot conductor, a ground fault condition exists. The amount of current that is missing is returned to the source by some path other than the intended path (fault current). A fault current as low as 4 mA to 6 mA activates the GFCI and interrupts the circuit. Once activated, the fault condition is cleared and the GFCI manually resets before power may be restored to the circuit. See Figure 1-22.

Figure 1-22. A GFCI compares the amount of current in the ungrounded (hot) conductor with the amount of current in the neutral conductor.

GFCI protection may be installed at different locations within a circuit. Direct-wired GFCI receptacles provide a ground fault protection at the point of installation. GFCI receptacles may also be connected to provide GFCI protection at all other receptacles installed downstream on the same circuit. GFCI CBs, when installed in a load center or panelboard, provide GFCI protection and conventional circuit overcurrent protection for all branch-circuit components connected to the CB.

Plug-in GFCIs provide ground fault protection for devices plugged into them. These plug-in devices are often used by personnel working with power tools in an area that does not include GFCI receptacles.

**Lockout/Tagout**

Electrical power must be removed when electrical equipment is inspected, serviced, or repaired. To ensure the safety of personnel working with the equipment, power is removed and the equipment must be locked out and tagged out before any preventive maintenance or servicing is performed. Lockout is the process of removing the source of electrical power and installing a lock which prevents the power from being turned ON. Tagout is the process of placing a danger tag on the source of electrical power which indicates that the equipment may not be operated until the danger tag is removed. See Figure 1-23.

A danger tag has the same importance and purpose as a lock and is used alone only when a lock does not fit the disconnect device. The danger tag shall be attached at the disconnect device with a tag tie or equivalent and shall have space for the worker's name, craft, and other required information. A danger tag must withstand the elements and expected atmosphere for as long as the tag remains in place. A lockout/tagout is used when:

- Servicing electrical equipment that does not require power to be on to perform the service
- Removing or bypassing a machine guard or other safety device
- The possibility exists of being injured or caught in moving machinery
- Clearing jammed equipment
- The danger exists of being injured if equipment power is turned on
Figure 1-23.
Equipment must be locked out and tagged out before preventive maintenance or servicing is performed.

Lockouts and tagouts do not by themselves remove power from a circuit. An approved procedure should be followed when applying a lockout/tagout. Lockouts and tagouts are attached only after the equipment is turned off and tested to ensure that power is off. The lockout/tagout procedure is required for the safety of teachers, students, etc. due to modern equipment hazards. OSHA provides a standard procedure for equipment lockout/tagout. OSHA's procedure is:

1. Prepare for machinery shutdown.
2. Machinery or equipment shutdown.
3. Machinery or equipment isolation.
4. Lockout or tagout application.
5. Release of stored energy.
6. Verification of isolation.

**Warning:** Personnel should consult OSHA Standard 29CFR1910.147 for industry standards on lockout/tagout.

Lockout/tagout shall not be removed by any person other than the person that installed it, except in an emergency. In an emergency, the lockout/tagout may be removed only by authorized personnel. The authorized personnel shall follow approved procedures. A list of company rules and procedures are given to any person that may use a lockout/tagout. Always remember:

- Use a lockout and tagout when possible
- Use a tagout when a lockout is impractical. A tagout is used alone only when a lock does not fit the disconnect device
- Use a multiple lockout when individual employee lockout of equipment is impractical
- Notify all employees affected before using a lockout/tagout
- Remove all power sources including primary and secondary

• Measure for voltage using a voltmeter to ensure that power is off

**Lockout Devices**

Lockout devices are lightweight enclosures that allow the lockout of standard control devices. Lockout devices are available in various shapes and sizes that allow for the lockout of ball valves, gate valves, and electrical equipment such as plugs, disconnects, etc.

Lockout devices resist chemicals, cracking, abrasion, and temperature changes. They are available in colors to match ANSI pipe colors. Lockout devices are sized to fit standard industry control device sizes. See Figure 1-24.

![Lockout Devices](image)

1-24. Lockout devices are available in various shapes and sizes that allow for the lockout of standard control devices.

Locks used to lockout a device may be color coded and individually keyed. The locks are rust-resistant and are available with various size shackles.

Danger tags provide additional lockout and warning information. Various danger tags are available. Danger tags may include warnings such as "Do Not Start," "Do Not Operate," or may provide space to enter worker, date, and lockout reason information. Tag ties must be strong enough to prevent accidental removal and must be self-locking and nonreusable.

Lockout/tagout kits are also available. A lockout/tagout kit contains items required to comply with the OSHA lockout/tagout standards. Lockout/tagout kits contain reusable danger tags, tag ties, multiple lockouts, locks, magnetic signs, and information on lockout/tagout procedures. See Figure 1-25. Be sure the source of electricity remains open or disconnected when returning to work whenever leaving a job for any reason or whenever the job cannot be completed the same day.

**Hazardous Locations:**

The use of electrical equipment in areas where explosion hazards are present can lead to an explosion and fire. This danger exists in the form of escaped flammable gases such as naphtha, benzene, propane, and others. Coal, grain, and other dust suspended in air can also cause an explosion. Article 500 of The Electrical Code National covers

hazardous locations. Any hazardous location requires the maximum in safety and adherence to local, state, and federal guidelines and laws, as well as in-plant safety rules. Hazardous locations are indicated by Class, Division, and Group.
General Production/Fabrication Area Recommendations

1. The production / fabrication area should be adjacent to the classroom seating area with interior vision panels to allow for supervision.
2. The production / fabrication area should provide convenient, but controlled access to the rest of the school for use by teachers needing access to tools.
3. The production / fabrication area should be isolated from the classroom and research areas to minimize distractions.
4. Noisy dust control and ventilation units should be located in auxiliary rooms or outside the building.
5. The laboratory should have provisions for the storage of safety equipment.
6. The production / fabrication area should be provided with a hardened, sealed concrete, non-slip floor. Designated machine operator zones should be identified on the floor with slip resistant floor materials.
7. Wall, ceiling and trim should be finished with durable, easily cleaned materials.
8. Large assembly areas should be available in the construction and manufacturing laboratories. An alternative would be to design the furniture and equipment type and location to allow the room to easily be reconfigured to meet the needs of instruction.
9. A suspended acoustic tile ceiling is acceptable if a 12 foot ceiling height is maintained.
10. A sink should be provided for water access with appropriate traps for waste line oil, paint, clay, ink and Plaster of Paris.
11. A finishing area should be provided with a separate adjacent room, preferably with an interior window to production/fabrication area for supervision. This area should have the following provisions:
   a. Storage for small quantities of paint, stains, brushes, cloths, sponges and sprays
   b. Floors that can withstand high traffic and resist damage from water, dirt or dust
   c. Drying racks
   d. Flammable liquid cabinets
   e. Exhaust system for paint fumes & to minimize dust
   f. Uniform glare free lighting overall with 50-100 foot candle illumination
   g. Scrub sink with hot and cold water and
   h. Disposal of waste material from the finishing process.
Storage of Materials

Tool Storage

Regardless of the tool storage system selected, there should be an organized and official storage place for every tool, piece of equipment and supply item. A central tool room makes security and taking inventory much easier and also means less keys. Wall panels or cabinets can be used to store tools. They can be placed in the tool room or also placed to each instructional area. Creating a silhouetted where each tool is suppose to be stored helps keep the tools organized and misplaced items can easily be detected. At the end of each class or the day missing tools can easily be identified. The other advantage is that the students can easily find the tools they are looking for.

http://www.globalindustrial.ca/g/maintenance/tool-storage/chests/wall-mounted-pegboard-cabinet

http://jdorganizer.blogspot.com/2008/04/tool-storage-locations-made-obvious.html

http://www.spectrasystems.co.uk/tool_storage_panels.htm

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Hazardous Material Storage

Commercial fertilizers, petroleum products, and pesticides and other products maybe stored in shops 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.

Agricultural Chemical Storage

All agricultural chemicals should be stored in a dedicated facility. Minimum standards dictate that a storage structure must:

- 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 should be located well away from and sloped away from any surface watercourses or groundwater supply sources.

It should be situated on land that is naturally impermeable or has been covered with an artificial impermeable base.

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

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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 the 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 recommend 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 agri-chemicals are stored. Each emergency plan should include information on 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 who 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 inadvertent use of a wrong 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 are dependent on sizes of fuel tanks and whether storage is aboveground 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 berm-ed 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 shop settings common chemicals that fall under these regulations are fuels, paints, and solvents. NOTE: the MSDS will always identify the type of the 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.

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- The cabinet must be listed with an approved testing laboratory (UL, FM, etc.) for the intended use.
- Cabinet capacities shall not exceed those given in the following table.

**Storage Capacity Limits for Flammable Materials**

<table>
<thead>
<tr>
<th>Class I Flammable Liquid</th>
<th>Flash Point less than 100°F</th>
<th>60 gallons or less per cabinet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class II Combustible</td>
<td>Flash Point less than 140°F but greater than or equal to 100°F</td>
<td>60 gallons or less per cabinet</td>
</tr>
<tr>
<td>Class III Combustible</td>
<td>Flash Point greater than or equal to 140°F</td>
<td>120 gallons or less per cabinet</td>
</tr>
</tbody>
</table>

**Combination**

- 120 gallons (no more than 60 gallons of Class I or II)

No more than three flammable storage cabinets (60-gallon capacity) are permitted in one fire area unless extra cabinets are separated from the first group of cabinets by 100 feet or more.

*** A list of Prohibited and Restricted chemicals can be found at:
[http://www.cdphe.state.co.us/regulations/consumer/101006schools.pdf](http://www.cdphe.state.co.us/regulations/consumer/101006schools.pdf)
STORAGE GROUPS

This storage system should be used in conjunction with specific storage recommendations from the manufacturer’s label and MSDS.

When possible, isolate all storage groups in separate cabinets. If space does not allow, use the following cabinet scheme to combine storage groups. Use secondary containment as shown to prevent spilled materials from contacting containers of incompatibles that are in the same cabinet.

A. Compatible Organic Bases
B. Compatible Pyrophoric & Water Reactive Materials
C. Compatible Inorganic Bases
D. Compatible Organic Acids
E. Compatible Oxidizers including Peroxides
F. Compatible Inorganic Acids not including Oxidizers or Combustibles
G. Not Intrinsically Reactive or Flammable or Combustible
J. Poison Compressed Gases
K. Compatible Explosive or other highly Unstable Materials
L. Non-Reactive Flammables and Combustibles including solvents
X. Incompatible with ALL other storage groups

For Storage Groups J, K, and X: Contact VEHS at 2-2057.

http://www.safety.vanderbilt.edu/resources/cls_chem_manage.htm
Welding Gases

Compressed gases such as oxygen, carbon dioxide, argon, and acetylene are commonly found in shops. Cylinders in use must be restrained by non-flammable restraints (e.g. chain) at the base and upper 1/3 of the cylinder. Gas must be stored in ventilated areas.

The follow 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:

3. Safe Handling Rules for Cylinders of Compressed Gases (*)
The rules of this section apply generally to the handling of all cylinders containing compressed gases. References to other publications giving additional handling precautions for specific gases are listed in Section 6.

3.1.9 Where the user is responsible for the handling of the cylinder and connecting it for use, such cylinders should 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."(4)

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

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

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

3.3.8 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.

3.3.10 Cylinders should be protected against tampering by unauthorized individuals.

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

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3.5.3 Do not store reserve stocks of cylinders containing flammable gases with cylinders containing oxygen. They should be segregated. Inside of buildings, stored oxygen and fuel gas cylinders should be separated by a minimum of 20 feet, or there should 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." (6)

3.7.1 ICC specification cylinders containing pressurized liquid oxygen, nitrogen or argon must be transported, stored, and used in an upright position. These materials are maintained at extremely low temperatures, and cylinders must be kept upright to permit venting of vapor periodically to maintain safe internal pressures.

(*)Rules pertaining to the storage and handling of cylinders apply with equal force to the storage and handling of spheres and drums where the alternate use of these containers is authorized by ICC Regulations.


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, weight of the material needs to be considered. The heaviest materials should be stored on lower levels and the lighter materials stored at higher levels. Vertical storage of materials should lean towards the wall, with the height limited to eight to ten 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 should be devised to dispense these types of materials. Materials such as sheet metal, which need to remain flat, are best stored either horizontally on wide shelving or vertically between full width dividers.
Floor and Safety Lines

Floor and safety lines should be used to mark areas around shop tools and equipment to provide maximum safety and reduce the chance of accidents happening. A “safety zone” is a safe, non-congested area in which to work. The area is most often marked with yellow or white lines. A non-skid surface can be provided to give a firm footing to the operator of the tool or machine. Only one person should be in this safety zone and only the machine operator should make the adjustments. Here are some examples:

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Safety Colors 9

1. RED-DANGER
   Fire. Red shall be used as the basic color for the identification of fire protection equipment and apparatus.
   Stop: Emergency stop bars, buttons, or electrical switches on hazardous machines shall be red.
   Danger: Safety cans and safety signs shall be painted red.

2. ORANGE-WARNING
   Orange shall be used as the basic color for designating dangerous parts of machines or energized equipment. Orange shall be used to emphasize hazards when enclosure doors are open or when gear bolts or other guards around moving equipment are open or removed, exposing unguarded hazards. Orange can also be used as background for electrical switches, levers, and controls.

3. YELLOW-CAUTION
   Yellow shall be the basic color for designating caution and for marking physical hazards. It can be used to identify parts of machines, such as wheels, levers, and knobs that control or adjust the machine. Solid yellow, yellow and black stripes, or checkers (or yellow with suitable contrasting background) should be used interchangeably using the combination that will attract the most attention. These strips are used in combination to mark stairs, protruding objects, and other stationary hazards.

4. GREEN-SAFETY
   Green shall be used to indicate the presence of safety equipment, safety areas, first aid, and medical practice.

5. BLUE-INFORMATION
   Blue is used for signs if a warning or caution is intended. Such signs are made of white letters on blue background and carry messages such as “OUT OF ORDER” or “DO NOT OPERATE.”

6. WHITE
   White is used to mark off traffic areas and can indicate the direction of traffic. White lines also mark work areas around objects in the shop. Yellow may be used in place of white to mark these areas or lanes.

7. BLACK AND YELLOW DIAGONAL STRIPES—RADIOACTIVITY
   A black and yellow diagonal striped pattern is designated as the marking for radiation hazards.

8. BLACK AND WHITE STRIPES
   Black, white, or a combination of these two shall be the basic colors for designation of traffic and housekeeping markings.

9. GRAY
   Gray is used on floors of work areas in the shop, bodies of machines, and table tips if painting is desired.

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Housekeeping

Studies by safety engineers have pointed out a definite relationship between the number of accidents in any particular laboratory and the housekeeping conditions of the laboratory. In the industrial arts/career and technical education laboratory, the teachers have the direct responsibility, in addition to their other duties for:

1. Establishing and maintaining cleanliness and orderliness
2. Eliminating hazards
3. Developing proper attitudes and orderly work habits of students.

Recommend housekeeping practices that are considered essential for the laboratory teacher to implement are:

1. Arranging all equipment to permit safe and efficient work practices
2. Providing for materials and supplies to be safely stored
3. Providing appropriate type and quantity of waste containers
4. Having floors cleaned regularly
5. Properly disposing of combustible waste materials
6. Prohibiting the storage of excess materials and debris on benches in the work areas
7. Conducting regular inspections to maintain clean and orderly conditions
8. Cleaning splash guards and collecting pans of all machines that use oil and coolants
9. Maintaining supply of brooms, bench brushes, shop towels and other cleaning equipment
10. Using housekeeping tools, equipment and supplies properly
11. Reminding students of their responsibility to keep the laboratory clean and orderly
12. Organizing a housekeeping routine which involves all students

A few items calling for further consideration under the good housekeeping include the following:

1. NEATNESS: It is important to have definite places for tools to be kept when not in use. Oily rags, waste paper, scrap materials and other flammable materials should be cleaned up daily and placed in suitable metal or other non-flammable containers.
2. PROPER STORAGE OF MATERIALS: Materials need to be stored or stacked securely and in such a way as to make them accessible without impairing the security of the stored materials. This calls for suitable storage space and for a careful study of proper racks, containers, bin lockers, etc. Provisions should be made to adequately store the variety of materials used in school laboratories.

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Attention should be given to accessibility, lighting and ventilation in storerooms.

3. MAINTENANCE OF AISLE SPACE:
   - Adequate aisles should be maintained 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 by painted white or yellow lines. This practice has been found satisfactory in industry and school laboratories.
   - A general rule is that main aisles should be parallel the flow of materials in process. Main aisles should be four feel (1.2 m) wide. Aisles should be kept clear of materials or equipment at all times.
   - Tool rooms and emergency equipment should be located off main aisles.
Shop Cleanup

Reasons for Keeping the Shop Clean:
1. Each student’s projects and possessions are stored properly. This way they are not in the way of other students and others using the shop do not harm the projects.
2. All project parts are stored in the same place so that the students can see them and know if they need to bring additional items for the project.
3. Shop spaces are cleared so that other classes can safely use the area.
4. Tools are returned to their proper place, which makes it easy to check for missing tools and ones that are in need of repair.
5. The students learn to put all the tools and materials in their proper place and then know where to find them.
6. Paint materials and equipment are cleaned and stored to avoid wasted material and ruined finished materials.
7. The hazards of fire and explosion are reduced by the proper storage of materials.
8. Students learn to cooperate and use teamwork.

Shop Cleaning Equipment:
- Floor brooms
- Floor dust mops
- Bench brushes
- Shop vacuum cleaner
- Dust collection and chip removal system
- Metal cans for rag storage
- Large metal trash cans
- Storage cabinets for combustible materials
- Scoop shovels and dust pans
- Varsol for cleaning up grease and oil spills
- Sawdust to absorb liquids
- Commercial material to sprinkle on the floor to control dust
- Clean rags
- Storage cabinets for tools and hardware
- Storage racks for lumber and metal
- Steel cans for metal used for practice welding
- Suitable containers for scrap wood
- Cabinets, lockers, fenced areas, etc, for project storage

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Shop Cleanup Tasks:
1. Removing all tools and materials from benches and floors before cleaning
2. Clean all paint brush off
3. Clean high areas such as racks, machines, and bench tops
4. Start cleaning at far sides and ends and work towards trash collecting areas
5. Use brooms and brushes in short strokes and lift intermittently (tap against ground to shake out dirt particles)
6. Use a commercial dust-absorbing material if available
7. Clean machines with vacuum cleaner whenever possible
8. Put oily rags in designated metal container that is closable
9. Use sawdust to absorb liquid spills such as oil
10. Put all trash in suitable containers
11. Place trash cans in their proper place
12. Put cleaning equipment away in their proper place
13. Clean all sink areas and throw away any paper towels
14. Help others finish cleaning up
Shop Cleanup Systems:

- **All-Pitch-In Method**
  - The teacher announces cleanup time verbally, or by using a whistle, bell, etc.
  - Students then clean up their own materials and what they know how to do.
  - This system is most often not successful because the students lack the skills and knowledge to do a good job at all cleanup tasks.

- **Cleanup Wheel Method**
  - This method uses a chart shaped like a wheel pictured in the figure 1-1 below
  - The teacher specifies all cleanup tasks on the outer portion of the wheel
  - Students are then placed in groups and put in the inner portion of the wheel
  - The change assignments, the teacher rotates the inner portion of the wheel that has the students names or group number in it
  - With the wheel, a checklist is also needed and should be given to an appropriate student (figure 1-2)
  - During cleanup the chosen student (foreperson) walks around and evaluates the student’s work

Figure 1-1: Shop Cleanup Wheel Chart; Herren, Ray V. *Agricultural Mechanics Fundamentals & Applications*. 6th ed. Clifton Park, NY: Delmar, 2009. Print

Figure 1-2: In this example, the teacher initialed the boxes next to the foreperson, indicating that they also observed the cleanup and approved the job done by the foreperson. Herren, Ray V. *Agricultural Mechanics Fundamentals & Applications*. 6th ed. Clifton Park, NY: Delmar, 2009. Print
• **Assignment Sheet Method**
  - Students are specifically assigned to each cleanup task, figure 1-3
  - The advantage to this is that as many students as necessary can be assigned to a specific task
  - Students can volunteer to do specific tasks and jobs can be changed as often as desired
  - The check off and grading process is similar to the chart checklist used above

![SHOP CLEANUP ASSIGNMENT SHEET](image)

<table>
<thead>
<tr>
<th>Task</th>
<th>Person(s) Responsible</th>
<th>Date and Rating</th>
<th>Average Score</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweep Benches</td>
<td>Avery</td>
<td>Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean</td>
<td>Opfer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welding Areas</td>
<td>Elson</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Graham</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweep Floor</td>
<td>Iddings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jones</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kirk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreman</td>
<td>Mozier</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1-3: Shop Cleanup Assignment Sheet; Herren, Ray V. *Agricultural Mechanics Fundamentals & Applications*. 6th ed. Clifton Park, NY: Delmar, 2009. Print
Emergency Action

General Guidelines
Primary Concerns
Secondary Concerns
Example Situations
Accident Reporting

Note: Make sure to abide by your school district policy for accident reporting.
Emergency Action\(^1\)

Emergency situations can arise anywhere in the school environment and the procedures for dealing with these events should be developed and approved by the individual administration unit (district or building) prior to the start of the school year. These procedures should be reviewed and revised periodically to determine their effectiveness and to make necessary modifications. The following information is provided to serve as guides for the individual district in the development of their own emergency procedures.

**It is recommended that an instructor complete FIRST AID training.**

General Guidelines In The Event of Student Accidents

In the event of accident, teachers should act promptly and decisively, following a preexisting, approved local previously practiced emergency plan! This plan might include the following general steps:

- Check the scene, assess the general situation and take whatever immediate action is necessary to remove the hazard and prevent students from being further exposed to injury.
- Check the injured party with a quick scan to assess the severity of the injury and decide on a course of action.
- Notify school authorities (school principal and school nurse) and call 911 or other pre-determined emergency or medical personnel, if injury appears to make the action necessary.
- Have a properly trained person appropriately care for the injured party.
- Ensure that a parent, guardian, or designated alternate person and/or the family physician have been contacted.

After the emergency has passed, record the facts and obtain witness reports. Provide copies of records (accident reporting forms) to an administrator and keep records on file in a safe place.

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\(^1\) Safety Guidelines for Technology Education & Elementary Science/Technology Education. Pennsylvania Department of Education, Bureau of Curriculum and Academic Services, Division of Curriculum and Instruction.  
Primary Concerns

These relate directly to the injured party and the reduction of hazard to that person. The degree of the emergency care would be dependent on the injury and the qualifications of the person administering the care. If the teacher is not qualified in first aid, he/she must only do the things that will assure no further damage to the injured person/s and immediately seek trained help. This might be limited to stopping the bleeding or covering a person in shock with a blanket. Although every teacher should be trained in basic emergency first aid, many are not. Serious damage to the injured student/s can sometimes result when a nervous, untrained and panic-ridden teacher treats them. The following basic steps are recommended as the first steps when an injury occurs:

1. Determine the extent and type of injury. If this is not possible, immediately obtain professional help.
2. Restore breathing, restore heartbeat and stop bleeding if trained in these areas; if not, send for help.
3. Apply only the first aid necessary to preserve life. Do no more until trained help arrives.
4. Disperse crowd and keep injured and the surrounding area as quiet as possible.
5. Notify school nurse, principal and immediate supervisor by sending other students to these people. Do not leave the injured person alone.
6. If the injury is minor (e.g., splinter, slight cut), send the student to the school nurse accompanied by another student. Do not send the injured student alone.
7. If a foreign particle has entered the eye, seek professional help. A teacher should never try to remove something from a student’s eye. If a liquid has entered the eye (e.g., acid), immediately wash the eye in eyewash and contact the nurse.
8. Notify parents/guardian and school officials.

It is the responsibility of the teacher to know what to do in case of an accident and also to know what not to do. This kind of information is best obtained through a variety of first aid courses offered through the Red Cross or other agencies. The first few seconds or minutes following a student’s injury are sometimes the most critical, and the action or lack of action that the technology teacher may take could be crucial to the student’s life.
Secondary Concerns

When the injured student has been administered to by professional help (e.g., nurse, ambulance crew or doctor), the concerns of the teacher are focused on the remaining students and the follow-up procedures in regards to the injury. Some action is necessary in the following areas:

1. Calm the other members of the class. Restore the situation to a safe environment. If the accident was serious, discontinue instruction for remainder of the period. The students will be too upset to perform effectively and may in fact be “accident repeaters” due to the accident.

2. Complete the accident report in accordance with school district policies. It is recommended that, at very least, copies should be forwarded to the school nurse, the building principal and immediate supervisor. Retaining one copy for the teacher’s permanent file is also recommended. The copy should be retained until the injured student reaches age 18 or graduates.

3. Analyze the accident to determine the root cause and effect of the accident and make written recommendations to the principal of corrective measures to be taken. (Retain a copy of the communication and subsequent action.)

4. Review and record safety practices, procedures, instruction and student evaluation delivered, and intended to prevent this type of accident from happening.

5. Follow-up in your classes with a discussion and instruction regarding the safe practices that were violated and contributed to the accident.
Example Situations

The procedures mentioned should also be followed for “almost accidents” or accidents without injury to assure the conditions that almost caused an accident are treated and eliminated from the laboratory environment.

Student on Fire – Fire Suppression:

Remember a panicky student on fire will probably not be cooperative! You may need assistance from other students or faculty. If you are near an emergency shower, obtain assistance in getting the student under the drench shower and douse flames with water. If not near an emergency shower, drop and roll the student and smother the flames with a retardant-treated wool fire blanket. (Never wrap a standing student in the blanket, because this creates a "chimney" effect.) Stop, Drop and Roll and/or Shower.

Materials on Fire – Fire Suppression

For materials on fire, obtain the nearest ABC fire extinguisher, remove safety pin and approach the fire. Only when 5–6 feet (1.5–1.8 meters) from the fire should you begin to discharge the extinguisher. Remember that the average fire extinguisher only operates 8–10 seconds at maximum efficiency. Take care to smother, not scatter, the burning chemical material. Smother burning alkali metals with clean, dry sand. Keep a covered sand bucket for that purpose.

Flammable and Combustible Liquids

Flammable and combustible liquids are categorized by their ease of ignition. Flammable liquids are more easily ignited than combustible ones. Examples of flammables are gasoline, acetone and lacquer thinner. Examples of combustibles are kerosene, fuel oil, mineral spirits and brake fluids. Flammable and combustible liquids are essential in many technology education classes. They must be stored and used in a manner that will provide a high degree of safety. Always read the label on the container before using any of these materials. Flammable and combustible liquids are potentially dangerous because:

1. Many produce vapors that are heavier than air and can accumulate along floors or other low points, lying in wait for a stray spark.
2. Many are readily oxidized, or can release heat, so rags or waste coated with them can catch fire spontaneously.
3. Vapors from some have harmful effects and can cause damage to nervous and/or waste elimination systems of the body.
4. All are poisonous if taken internally.
5. Most will remove protective oils from the skin and repeated exposure can cause dermatitis (skin rash).

Nearly flammable and combustible liquids will burn violently. Such fires are difficult to extinguish without proper extinguishing agents.

Specific Chemical Recommendations

The following actions are recommended for specific emergencies. Remember you must assess the situation and determine what is appropriate to the immediate situation. Always refer to the appropriate Material Safety Data Sheet (MSDS) for information.
regarding health hazards, reactivity, disposal, and personal protective equipment before using a chemical for personal or class use.

**Chemical in the Eye:**

Call 911 and send someone to notify the school nurse and an administrator. Flush the eye immediately with potable aerated 60°F–90°F (15.5º–32.2ºC) water at a rate of 3–5 gallons/minute (11.4–18.9 liters/minute). Hold eyelids apart as wide as possible and flush for at least 15 minutes or until emergency personnel arrive. Do NOT try to neutralize acids or bases, but wash the offending chemical out of the eye as quickly as possible to prevent further damage. If contact lenses are being worn, the water should wash them away. If the lens chemically adheres to the eye, do NOT try to remove it. Let a professional do that.

**Acid/Base Spills:**

Neutralize spilled acids with powdered sodium hydrogen carbonate (sodium bicarbonate/baking soda) and bases with vinegar (5% acetic acid solution). Avoid breathing vapors. Spread diatomaceous earth to absorb neutralized chemicals, sweep up, and dispose of properly. If the spill is directly on skin, flush the area as soon as possible with copious amounts of cold water from faucet or drench shower for at least 5 minutes. If the spill is on clothing, drench with water and cut/remove the clothing to remove the chemical from contact with the skin as soon as possible. If the skin appears acid-burned, daub a paste of sodium hydrogen carbonate on the affected area and obtain medical attention as soon as possible. If the skin appears burned by a strong base, daub vinegar on the affected area and obtain medical attention as soon as possible. Do NOT cover with bandages.
Emergency Communications

   Procedures should be established for communications of an emergency situation. Each technology education room should have access to a telephone with direct outside line for ambulance, fire and police emergencies.
   1. All students should know the location of the telephone and be familiar with the emergency procedures and numbers.
   2. All personnel in the laboratory should have access to the phone for emergency communications. (The telephone should not be locked in the teacher’s office.)
   3. Emergency procedures, police, ambulance, fire department numbers and the procedure for dialing on an “outside” line should be posted at each phone location.

Accident Reporting

   Any accident that occurs during technology education activities and in the laboratory must be reported. This applies to after school accidents as well as those during the school day. Any accident must be reported since this indicates corrective action that must be taken by the teacher, administrator or both. A form for the reporting of these accidents can be adapted from the one included in Appendix A. This report should be completed in accordance with school district policy.

Accident Analysis

   1. Require student to report all accidents to the teacher, regardless of the nature or severity.
   2. Keep a record of all technology education accidents resulting in injury to students, regardless of the nature or severity.
   3. Analyze all accident reports for the purpose of aiding in the prevention of other accidents.
   4. Use your school district’s printed form to record the details of accidents and forward to the appropriate personnel.

***Appendix A includes a Permission Form, Confidential Medical Information Form, Authorization to Consent to Treatment of a Minor, and an Accident Report Form
Personal Protective Equipment

Eye
Ear
Clothing
Gloves
Respiratory
Eye Protection Information

Phototropic (photochromic) lenses change depth of tint when exposed to varying degrees of ultraviolet light—that is, they darken when exposed to sunlight and fade when removed from the sunlight. These lenses do comply with current American National Standards Institute (ANSI) Z87.1 standards with limitations.

Photochromic lenses have limitations in operations requiring critical visual acuity or fast reaction to visual stimuli, particularly in operations where the wearer passes from outdoors to indoors in the course of his/her work activity. Also, these types of lenses should not be used as a substitute for the proper protection in hazardous optical radiation environments, for example, certain laboratory and shop operations such as welding or foundry work.

If an individual must wear tinted lenses, as prescribed by an eye specialist, industrial quality eye and face protection devices appropriate for the hazard involved should also be worn.

Posting of Eye Hazardous Areas

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

Fitting and Maintenance

Safety eyewear must be fitted properly. It should be the responsibility of the person in charge of dispensing safety glasses or goggles to see that properly fitted and adjusted eyewear is provided for each individual. Lenses of eye protectors must be kept clean. Restricted vision due to dirty lenses is sometimes a contributing factor to accidents. Eye protective devices that are shared shall be disinfected between uses.

Cleaning and Disinfecting Procedures

The following cleaning procedures are recommended in the ANSI Z87.1. Products shall be cleaned according to the manufacturer’s instructions. If none are available, clean with mild soap and warm water solution by soaking the device in the soap solution maintained at 120°F for 10 minutes. Rinse thoroughly and allow to air dry. Use appropriate glove protection and other personal protective equipment as required of hazardous and combustible standards apply. To disinfect, completely immerse the protector for 10 minutes in a solution of modified phenol, hypochlorite.

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quaternary ammonium compound or other disinfections reagent in a strength specified by the manufacturer of the protective equipment at room temperature of 20°C (68°F). Remove protector from solution and suspend in a clean, dry place for air-drying at room temperature or with heated air. Do not rinse because this will remove the residual effect of the disinfectant. Spray type disinfectant solutions and bactericides may be utilized when such pressurized spray solutions can be demonstrated to provide comparable disinfections with the immersion procedure outlined above. Store dry devices in a clean, dustproof container or area. Protectors showing the need for extensive cleaning should be disassembled to the extent possible without tools prior to the washing and disinfections procedure. We recommend each student have their own pair of safety glasses and goggles to reduce spread of eye disease.

**Inspection of Protectors**

Instructors and students should make a visual inspection of their eye protectors prior to use. Protective devices with broken parts, heat distortion, or excessive scratches on the lens are unsuitable for use and should not be worn. Pitted and scratched lenses may reduce vision and also, along with worn-out headbands, seriously reduce protection. Replace defective parts with new ones.

**NOTES**

1. Care shall be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards must be provided.
2. Operations involving heat may also involve optical radiation. Protection from both hazards shall be provided.
3. Face shields shall only be worn over primary eye protection.
4. Filter lenses shall meet the requirements for shade designations.
5. Persons whose vision requires the use of prescription (Rx) lenses shall wear either protective devices fitted with prescription (Rx) lenses or protective devices designed to be worn over regular prescription (Rx) eyewear.
6. Wearers of contact lenses shall also be required to wear appropriate covering eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments might represent an additional hazard to contact lens wearers.
7. Caution should be exercised in the use of metal frame protective devices in electrical hazard areas.
8. Welding helmets or hand shields shall be used only over primary eye protection.
9. Nonsided shield spectacles are available for frontal protection only.

**American National Standard Institute Z87.1**
Eye Protective Devices

**The illustrations shown are only examples of common forms of eye protection

**Shade Numbers for Welding**

Arc welding helmets and welding goggles with tempered safety glasses or proper shade and hardened cover lens in good condition. 1910.252(b) (i).

- Shield metal-arc welding – 1/16-5/32 electrodes. Shade number 10.
- Gas shielded ferrous arc welding 1/16- 5/32 electrodes. Shade number 12.
- Carbon car. Shade number 14.
- Oxyacetylene brazing. Shade number 3 or 4.
- Light cutting to 1 in. Shade number 3 or 4.
- Oxyacetylene welding up to 1/8 in. Shade number 4 or 5.
- Oxyacetylene welding up 1/8-1/2 in. Shade number 5 or 6.
Ear Safety

The ability to hear is a precious gift. Without it, it is difficult to lead a fully productive life either on or off the job. Noise can destroy hearing, create physical and psychological stress, and thereby contribute to accidents in addition to the obvious cause by making it impossible to hear warning signals. Practical arts and career and technical education laboratories and shops are not exempt from noise pollution considerations, particularly if maximization of learning and safety are the goal!

Noise is an unwanted sound. It is a form of energy or vibration that is conducted through the atmosphere. There are four variables that can affect the intensity of noise and its potential danger.

1. The level of the sound, as measured in decibels (dB).
2. The length of time to which one is exposed to the sound.
3. The numbers and lengths of quiet (recovery) periods between periods of sound.
4. Individual sensitivity to or tolerance for sound.

Table 1.1 indicates that workers cannot be exposed to a sound level that exceeds 90dB on the average for an eight-hour day. It should be noted that the standards in this table apply only to work; i.e., day-to-day environments, and schools are typically different. In some cases, however, vocational courses approximate the work situation and, hence, these standards might well apply. Furthermore, it also deserves noting that instructor exposure is often the equivalent of industry despite the fact that student exposure is not. Since hearing is affected by the totality of the noise that one is exposed to, any precautions are appropriate.

Fortunately, noise exposure can be controlled. No matter what noise problems occur in the laboratory and workplace, the technology exists to reduce the hazard. The responsibility to correct noise problems rests on the individuals, i.e., supervisors, teachers, etc., involved. In general, there are three basic ways to control noise.

1. Source Control: The best and most effective approach to control noise is to control it at its source since in this way no further hearing danger is posed and, therefore, other control methods are probably not needed. Techniques of noise source control include:

   a. Reduction of impact noise.
   b. Reduction of the speed of moving and rotating parts.
   c. Reduction of pressures and flow velocities in circulating systems.
   d. Reduction of flow resistance in circulation systems.
   e. Balancing of rotating parts.
   f. Reduction of friction in rotating, sliding, and moving parts.
   g. Isolation of vibration within equipment.
   h. Reduction of the size of the surface radiation areas.
   i. Application of vibration-damping materials to vibrating parts and surfaces.

---

2. **Path Control**: If source control is not possible, the next best approach is to control the noise along its path. Although such controls limit the number of persons exposed to the noise, they do not always eliminate the noise problem for all persons affected. In path control, noise is blocked or reduced before it is heard. This can be accomplished by:
   a. Containing or enclosing the noise.
   b. Absorbing the noise along its path.
   c. Deflecting the noise away from our ears.
   d. Separating the noise from the hearer.

3. **Hearing Protection**: Finally, ear protection equipment is available. This is not as desirable as either source or path control because it affords protection only to those wearing the equipment. Students must be willing to wear hearing protectors whenever they are exposed to potentially dangerous noise. Certain conditions and activities can reduce the effectiveness of the hearing protectors themselves.

### TABLE 1.1 PERMISSIBLE NOISE EXPOSURES

<table>
<thead>
<tr>
<th>Duration per Day in Hours</th>
<th>Sound Level — DBA — Slow Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>85</td>
</tr>
<tr>
<td>6.2</td>
<td>92</td>
</tr>
<tr>
<td>4</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>97</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>1 ½</td>
<td>102</td>
</tr>
<tr>
<td>1</td>
<td>105</td>
</tr>
<tr>
<td>½</td>
<td>110</td>
</tr>
<tr>
<td>¼ or less</td>
<td>115</td>
</tr>
</tbody>
</table>

Free safety and health consulting and education services are available from the state of Washington Department of Labor and Industries, Division of Industrial Safety and Health. To contact the Voluntary Services section nearest you, call 1-800-LISTENS.

**Hearing Protection**

Cotton should not be used as protection against abrasive sound. While a wad of cotton may minimize waves of certain frequencies, it fails to alter the intensity thus providing a false sense of security.

Sound is measured by two fundamental characteristics: frequency (related to pitch) or number of waves per second and intensity level (related to loudness). The human ear reacts to frequencies ranging from 20 cycles per second to about 20,000.
Sound at a level of 85 db. begins to lead to a loss of hearing, depending on (1) the intensity, (2) the frequency, (3) the duration of exposure, and (4) individual sensitivity.

The following are examples of noise and the approximate db for each.

- Busy street traffic at about 100 feet: 60 db.
- Office tabulating machines (electric typewriter, etc.): 80 db.
- 20 feet from subway: 90 db.
- Pneumatic diesel shovel (idling): 90 db.
- Automatic screw machines: 95 to 105 db.
- Wire rope stranding machine: 102 to 108 db.
- Header: 103 to 108 db.
- Circular saw: 105 to 115 db.
- Between two compressors: 110 db.
- Drop hammer (depending on size): 110 to 135 db.
- Punch press: 112 db.
- Between two drills, 20 feet apart: 117 db.
- Five feet from pneumatic press: 130 db.
- 40 feet from jet engine: 138 db.
- 59 feet from rocket engine: 150 db.
Clothing

- Do not wear clothing or jewelry that can get caught in any machinery or otherwise cause an accident.
- No loose clothing, baggy shirts, or dragging pants
- Do not wear any clothing that has cuffs or frayed edges
- No flannel
- Some tasks such as welding require you to wear long sleeves along with coveralls or a leather jacket
- Do not weld if your clothing or shoes if they have lots of oil on them
- Do not wear shorts
- Wear closed toed shoes (boots or heavy leather shoes if possible)
- NO flip-flops

Gloves

- Never wear gloves around rotating or moving equipment as they can get caught easily in the equipment
- Use special rubber-insulated gloves when working on or around live circuits
- When welding use all leather gloves, do not use ones with canvas backs
- Use rubber gloves when handling chemicals

Rubber-insulated gloves
Leather Welding Gloves


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Respiratory Protection

- If there is ever a danger of an inhalation hazard wear a respirator
- The four general types are:
  - Self-containing 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 are used under the same conditions as the SCBAs.
  - Full facepiece mask with chemical canister (gas mask): used to protect against brief exposure to a dangerous gas or fume.
  - Half mask or mouthpiece with mechanical filter: used where dust or other solid particle can be inhaled.

Other Resources:
***Washington Safety Videos:

PPE Guidelines

Please include in all safety rules

1. Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
2. Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
3. Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
4. A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
5. Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
1. Do safety glasses need to be worn when also using a face shield or welding helmet? Why or why not?
________________________________________________________________________
________________________________________________________________________

2. What is the lowest shade setting that should be used when arc welding?
   a. 8
   b. 9
   c. 10
   d. 11
   e. 12

3. Do not use ___________ as hearing protection because it does not minimize the intensity of the sound waves.

4. Do not wear any clothing that has ___________ or ________________.

5. List the proper PPE for welding:
   a. __________________________________
   b. __________________________________
   c. __________________________________
   d. __________________________________

6. What kind of gloves should be used when welding?
   a. Canvas backed leather gloves
   b. Leather gloves
   c. Rubber gloves
   d. No gloves are needed

7. What kind of shoes should not be worn in the shop?
   a. Boots                         c. Closed-toe shoes
   b. Leather shoes                d. Flip-flops or sandals

8. What does SCBA stand for:
__________________________________________________________________
__________________________________________________________________

9. What respiratory protection should be worn when there is dust and small particles present that can be breathed in?
   a. SCBA                          c. Gas mask
   b. Supplied air mask            d. Half mask

10. The Z-87.1 logo and manufacturing emblem on shop safety glasses tells the users specifically that the glasses are ____________.
    a. industrial quality    c. meeting OSHA standards
    b. safe                d. made in the USA
Safety

General
Automotive
Electricity
Fire
Greenhouses
Hazardous Materials
Land Labs
Painting
Plumbing
Tools/Equipment
Welding

NOTE:

Even though sample safety tests and questions are provided in this manual, teachers should modify the material to make up their own safety tests on general safety rules for the various areas, individual power tools and equipment, and anything else that applies to their shop not covered by this manual to fit their program. It is absolutely necessary that the teacher demonstrate in detail how to operate each piece of equipment or tool.

*****Safety Rules and Sample Questions were complied from the manuals mentioned in the acknowledgements as well as from Agricultural Instructors in the state of Colorado.
GENERAL SAFETY

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.

Operation Safety Guidelines

- Do not enter the lab unless an instructor is present.
- THERE WILL BE ABSOLUTELY NO HORSEPLAY IN THE LAB. Others can be injured by your actions.
- Devote all your attention to the machine or tool that you are using.
- Safety lines are for your protection. Stay behind them unless you are using a machine within the safety line area.
- Use the right tool for the right job.
- All safety guards must be in their proper positions while machines are being operated.
- All adjustments and set-ups must be securely fastened and tightened before the power is turned on.
- Machines must come to a dead stop before adjustment or leaving the machine area.
- Students not operating machines must stay away from the machine area. Before starting a machine, ensure other students are clear of the machine.
- Only one student is to work with any one machine at a time.
- Use all approved push sticks, push blocks, feather boards, and other safety devices. Some operations may require the use of a special jig or fixture.
- Think through the operation before performing it. Know what you are going to do, and what the machine will do.
- Allow the machine to reach its full operating speed before starting to feed the work through it.
- Keep the machine tables and working surfaces clear of tools, stock, and project materials. Also keep the floor free of scraps and litter.
- Material must never be forced into a machine faster than it will cut.
- Avoid talking to or bothering someone operating a machine.
- If tool or machine is broken or malfunctioning, do not use it; notify the instructor immediately.
- Ask for help from the teacher when operating unfamiliar tools or machines.
- Do not attempt to lift heavy loads without assistance. Always lift properly, using the power in your legs not your back. Bend your knees & keep the load close to your body.
- All tools must be returned to their proper storage space when not in use. All messes (especially paint jobs) need to be cleaned up immediately.
- Become familiar with the laboratory color coding system and observe the warnings issued by each color while working in the mechanics laboratory. Ex: Red = danger, yellow = caution, orange = warning, blue=information, green=safety.
- Be respectful of other projects. That means keep hands off. Touching, moving or damaging some else project will result negative consequences.
- REPORT ALL INJURIES IMMEDIATELY, no matter how minor.
• Never attempt to work with tools or equipment in the mechanics laboratory if under the influence of drugs or alcohol.
• At the end of class, the laboratory should be cleaned and all tools returned to their proper place.
1. What should you always do before making any adjustments to a machine or tool?
   ____________________________________________________________

2. The student should notify the instructor immediately in the case of a(an) __________.
   a. Accident
   b. Injury
   c. Defective equipment or tools
   d. All of the above

3. A student is permitted to leave the agricultural mechanics laboratory only ______.
   a. With the instructor’s permission
   b. To go to the office
   c. To go to the bathroom
   d. To get a drink

4. Which of the following is not allowed in the mechanics laboratory?
   a. Working and cleaning
   b. Carelessness and horseplay
   c. Thinking and doing
   d. All of the above

5. Operators of power tools should __________ if they are unsure about the operation of a tool or piece of equipment.
   a. Ask questions
   b. Wing it
   c. Refer to the owners manual
   d. Both a and c are correct

6. Students should never ______ while working in the mechanics laboratory.
   a. Listen
   b. Shout
   c. Talk
   d. Hear

7. Students should not rush laboratory work because it may lead to ________.
   a. Premature failure
   b. Structural collapse
   c. Accidents and injury
   d. A bad laboratory project

8. Approved safety glasses or goggles must be worn ________.
   a. Only in hazardous areas
   b. At all times unless other special eye and face protection is required
   c. In the classroom and shop
   d. None of the above

9. At the end of class, the laboratory should be __________.
   a. Left as is at the end of class
   b. Cleaned and all tools returned to their proper place
   c. Checked by the shop foreman
   d. Checked by the instructor

10. Shop clothing is unsafe if it is ________.
    a. Loose
b. Baggy
c. Flammable
d. All of these
e. None of these

11. While performing work in the mechanics laboratory, one should not _________.
   a. Get the tools to work with on your own
   b. Return tools and supplies to their storage areas
   c. Stay at your designated work station
   d. Disturb other workers

12. Loud noises in the mechanics laboratory allow others to _________.
   a. Hear better
   b. Work more easily
   c. Be prone to accident
   d. Be talkative

13. If tools and/or equipment become defective, one should _________.
   a. Fix them
   b. Report them to the instructor
   c. Put an “out of order” sign on them
   d. Only b and c

14. Before using power tools, students should _________.
   a. Think the action through before performing
   b. Pass a safety test
   c. Secure another student to help
   d. None of these

15. If a fellow student shows up for shop class under the influence of drugs or alcohol, what should you do to protect their safety?
   a. Notify the instructor
   b. Discourage them from working with the power tools and equipment
   c. Both a and b
   d. None of the above
AUTOMOTIVE

Safety is one aspect of the automotive repair industry that cannot be overemphasized. A good mechanic is a safe mechanic. If there is fast way or a safe way to do the job, take the safe way. Otherwise, you may not get the job done at all. Listed below are some of the potential exposures and safety precautions that you will be confronted with.

PERSONAL PROTECTIVE EQUIPMENT GUIDELINES
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.

PERSONAL HEALTH HAZARDS
- Wear appropriate personal protective equipment while spray painting; this includes using spray paint cans.
- Do not clean hands in solvent or gasoline. These materials are explosive and also can cause harm to skin.
- Avoid back strain when it is necessary to lift parts from the engine. Crouch down and let your legs do the work.
- Never place hands in front of a high-pressure grease gun.
- Keep open wounds properly dressed and covered.
- Never spray compressed air onto clothing or skin or into eyes.
- Wear safety glasses when under a vehicle. This will protect your eyes from falling debris.
- Wash hands and clothing frequently – this prevents skin problems and prevents tools from slipping out of your hands.

GENERAL PRECAUTIONS
- Always use caution when working, especially near the fan and belt.
- Oil or adjust moving parts only if authorized.
- Whenever possible, work with the engine switch in the “OFF” position.
- The fan belt should be tightened only when the engine is stopped.
- Always consider the engine and exhaust system to be “HOT.”
- Do not pour gasoline from an open container into the carburetor.
- Use extreme care when welding on vehicles – provide fire protection.
- Do not work directly above another student.
- Wait for the radiator to cool before removing the cap.
- Make sure that hoods are secured in an open position when working on the engine.
- When “pulling engines” be sure that ropes or slings are properly fastened. Don’t stand or lie under an engine or transmission fastened to a chain or lifting strap. The chain or strap could fail and you could be

JACKING AND HOISTING
- Do not jack up the vehicle if anyone is under it.
- Jack stands must be used when working under vehicles. When using a hoist, it must have air/hydraulic backup controls and/or locks.
- Avoid excessive shaking of the vehicle when on jack stands.
- Have the instructor inspect the jack stand supports before students work under any vehicle.
- Long jack handles are a tripping hazard and they should be barricaded or raised out of position.
- Do not use bumper jacks.
- Do not run an engine when the car is on the hoist or on jack stands.
- Caution should be observed when lowering a vehicle.

DRIVING AND LOCATING THE VEHICLE FOR WORK
- Do not wear eye protection with restricted vision when driving a vehicle in the shop.
- Only students with valid driver licenses and with the instructor’s permission should drive vehicles.
- Work should not be performed on vehicles parked in heavily traveled areas or on public thoroughfares.
- Towing or pushing should be done only with instructor approval.
- Have a fellow student guide you when parking a vehicle in a congested area.
- Someone must be in the driver’s seat of a vehicle when the engine is being started.
- Reckless driving is forbidden and constitutes a major safety violation that could cause termination of your participation in the mechanic laboratory.

GREASES, OILS, FUELS, AND SOLVENTS
- Clean up all spills immediately and ventilate the area.
- Use only approved solvents for cleaning parts. Do not use gasoline. Wear gloves when cleaning parts with solvents.
- Be sure that there is proper ventilation before an engine is started.
- Keep oil-soaked rags in approved rag waste containers.
- Check fuel connections for leaks before starting an engine.
- Keep flammable liquids in closed, approved containers.
- Clean up all oil/fuel/solvent spots and/or spills before starting an engine.
- Use drip pan for all vehicles stored overnight.

AIR PRESSURE
- Use an air gauge when inflating tires. Do not over inflate tires.
- When inflating truck tires that have a snap ring, the tire should be confined within an approved cage.
- Never aim an air hose at another person or at yourself.

WRENCHES AND TOOLS
- Keep all tools clean and free of oil and grease.
- Keep tools picked up from the floor.
- Make certain that wrenches and sockets fit properly
- Do not use tools with loose handles.
- Use tools only for the purpose for which they are designed.
- Creepers should be stood on end or stored in a rack when not in use.
- Do not use chisels or punches with “mushroom” heads.

CARBON MONOXIDE
Carbon monoxide is a poisonous gas caused by incomplete burning of gasoline or other fuels. It is present in
gaseous form when the engine is running. Even a small amount of carbon monoxide in your body can be fatal. That is why it is imperative that you an engine is only ran in a well ventilated area.

**COMPRESSED GAS**

- The most commonly used gases for cutting and welding are oxygen and acetylene. However, you may also be using hydrogen, nitrogen, Maap gas, argon, helium, Freon, ammonia, propane (liquefied petroleum gas), carbon dioxide, or sulphur dioxide in some of your projects.
- To use them safely you need to know their characteristics and be sure you are using the right bottle. There is no standard color code for compressed gas bottles! **Read the labels.**
- Treat compressed gas cylinders with the greatest respect. There is an immense amount of power in each cylinder. Careless handling resulting in valve or cylinder damage can produce instant death for you or your friends. Use a cart or hand truck for moving cylinders.

**FLAMMABLE GASES**

- Acetylene, hydrogen, propane, and Maap gas are highly flammable. They are normally handled in compressed gas cylinders or tanks. Acetylene is dissolved in acetone (Maap gas and propane are liquefied by pressure), so it is especially important that these cylinders be kept upright when in use.
- They will all form violently explosive mixtures with air or oxygen, so valves, regulators, hoses and other equipment must be tight and in good repair. **Shut off valves and regulators when they are not in use!**
- Store spare flammable gas cylinders in a well-ventilated location, separated by a fire resistant barrier — preferably outside.
- All gas cylinders must be secured and stored erect at all times. When storing or moving, cylinder caps **must be in place.** Students should not move cylinders unless secured to carts.

**OXYGEN**

For shop use, this gas is in a class by itself. It will combine with many common materials and under the right conditions will cause these materials to burn violently or to explode. Oxygen under high pressure can cause oils to explode. **NEVER USE OIL ON ANY OXYGEN VALVE OR REGULATOR EQUIPMENT!**

**NONFLAMMABLE GASES**

These include nitrogen, argon, helium, Freon, sulphur dioxide, and to some extent ammonia, which is flammable only in high concentrations. Some are odorless, and others (sulphur dioxide, ammonia) have extremely strong odors. None will support life, so adequate ventilation of the use is essential. Read up on the specific characteristics and detailed safety precautions for the gas you will use and discuss them with your instructor before proceeding.
1. ___________ ___________ is a poisonous gas caused by incomplete burning of gasoline or other fuels.
2. ___________ ___________ include nitrogen, argon, helium, Freon, sulphur dioxide, and to some extent ammonia.
3. ___________ ___________ acetylene, hydrogen, propane, and Maap gas.
4. Which of the following is the most appropriate personal protective equipment in the automotive shop?
   a. Safety Glasses, Welding Helmet, and Hearing Protection
   b. ANSI Z87.1 safety glasses, Hearing Protection, and Fitted Shop Coat
   c. Hand Held Face Shield, Flannel Coveralls, and Tennis Shoes
   d. Non-flammable Footwear, Old Frayed Shop Coat, and Safety Glasses
5. When combined with many common materials under the right conditions, ___________ will cause some materials to burn violently or to explode.
6. Do not use ___________ ___________ to hoist or raise a vehicle.
   a. Jack Stands
   b. Hydraulic Jacks
   c. Bumper Jacks
   d. Backup Locks
7. All tools should be kept ___________ and ___________ ___________.

Automotive Safety Test

Name:______________________________ Class/Yr:________________________
Date:______________________________ Score:________________________

1. ___________ ___________ is a poisonous gas caused by incomplete burning of gasoline or other fuels.
2. ___________ ___________ include nitrogen, argon, helium, Freon, sulphur dioxide, and to some extent ammonia.
3. ___________ ___________ acetylene, hydrogen, propane, and Maap gas.
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   a. Jack Stands
   b. Hydraulic Jacks
   c. Bumper Jacks
   d. Backup Locks
7. All tools should be kept ___________ and ___________ ___________.

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ELECTRICITY

Basic facts

- Electricity is the flow of electrons down a specified path.
- Operating an electrical switch is like turning on a water faucet. Behind the faucet (or switch) there is a source of water (or electricity), a way to transport it, and pressure to make it flow.
- Three factors determine the electrical resistance of a substance: What it is made of, its size and its temperature.
- Substances with very little resistance to the flow of electricity are called conductors.
- Metal is an example of a conductor. Copper and aluminum are commonly used and copper is the most widely used.
- Substances with high resistance that are able to prevent the flow of electricity are called insulators. Examples of insulators include glass, porcelain, plastic and dry wood.
- When human skin is dry, it is a poor conductor. But when moist (perspiration or with water in the environment), skin readily conducts electricity. Use extreme caution when skin may be damp or wet.
- The flow of electricity is called an electrical current.
- A path through which electrical current flows in a circle is a circuit.
- How we measure electricity:
  - Amperage- measures the rate of flow of energy in a conductor
  - Voltage- measure of the electrical pressure
  - Watts- measures the amount of work that can be done by amps and volts
  - Watts=volts*amps
- Grounding a tool means intentionally creating a low-resistance path to the earth.
- Shocks result when the body becomes part of the electrical circuit.

Shock

Shocks typically occur when a person contacts both wires of an energized circuit, one wire of the energized circuit and the ground, or a metallic part in contact with an energized wire and the ground. Effects from shocks can range from a barely perceptible tingle to severe burns and immediate cardiac arrest.

Areas of special concern

- **Contact with power lines**: Overhead and buried power lines are especially hazardous because they carry extremely high voltage. To avoid hazards: follow posted warning signs, contact utilities for buried power line locations, stay 10-ft or more away from overhead lines, de-energize and ground lines when working near them, and use non-conductive wood or fiberglass ladders near power lines.
- **Cranes and derricks/ loaders and hoist**: 30% of electrical related fatalities involve cranes and overhead lines. If contact occurs, follow these procedures: Remain inside the crane cab until lines have been de-energized, crane operator should try to remove crane from contact by reversing direction, and all others should keep away from crane, ropes and load since the ground around the machine may be energized.
- **Path to Ground missing or discontinuous**: if the power supply to equipment is not grounded or if path is broken, the current may travel through a workers body.
- **Avoid Hazards by**: grounding all systems, circuits and equipment, frequently inspecting CTE Health and Safety Education Guide electrical systems to ensure path to ground is continuous, visually inspecting all electrical equipment, and removing equipment from service if defective.
- **Power tools**: Because these tools are so common, workers are constantly exposed to a variety of hazards. Tool safety tips: never carry a tool by its cord, and never yank cord to disconnect it. Keep cords away from heat, oil and sharp edges. Disconnect tools when not in use. Avoid accidental starting by keeping finger

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off the “on” switch while carrying tools. Use appropriate personal protective equipment. Keep work areas well lit. Use double insulated tools and remove damaged tools from use.

**Grounding**

- **System or service ground**: A wire call the neutral conductor is grounded at the transformer, and again at the building service entrance. Primarily designed to protect machines, tools, and insulation against damage.
- **Equipment ground**: Grounding the equipment itself provides another path for the current to flow to the ground. It is intended to offer enhanced protection to the worker.
- **Disadvantage to grounding**: A break in the grounding system may occur without the user’s knowledge. Using a Ground Fault Circuit Interrupter (GFCI) is one way of overcoming grounding deficiencies.
- **GFCI**: A ground fault occurs when there is a break in the low resistance grounding path. The ground fault circuit interrupter is a fast-acting circuit breaker designed to shut off electric power in the event of a ground fault within as little as 1/40th of a second.

<table>
<thead>
<tr>
<th>Current</th>
<th>Common Item/Tool</th>
<th>Reaction to Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001 amps</td>
<td>Watch Battery</td>
<td>Faint tingle</td>
</tr>
<tr>
<td>0.005 amps</td>
<td>9-volt battery</td>
<td>Slight shock</td>
</tr>
<tr>
<td>0.006-0.025 amps</td>
<td>Christmas tree light bulb</td>
<td>Painful shock. Muscular control is lost.</td>
</tr>
<tr>
<td>0.05-0.9 amps</td>
<td>Small electric radio</td>
<td>Extreme pain. Breathing stops; severe muscular contractions occur. Death may result.</td>
</tr>
<tr>
<td>1.0-9.9 amps</td>
<td>Jigsaw (4 amps); Sawsall® or Port-a-Band® saw (6 amps); portable drill (3-8) amps</td>
<td>Ventricular fibrillation and nerve damage occur. Death may result.</td>
</tr>
<tr>
<td>10 amps and above</td>
<td>ShopVac® (15-gallon); circular saw</td>
<td>Heart stops beating; severe burns occur. Death may result.</td>
</tr>
</tbody>
</table>

**Double-Insulated Tools**

- **Hand-held tools manufactured with non-metallic cases are called double insulated. If approved, they do not require grounding under the National Electrical Code. Although this design method reduces the risk of grounding deficiencies, a shock hazard can still exist.**
- **Such tools are often used in areas where there is considerable moisture or wetness. Although the user is insulated from the electrical wiring components, water can still enter the tool's housing. Ordinary water is a conductor of electricity. If water contacts the energized parts inside the housing, it provides a path to the outside, bypassing the double insulation. When a person holding a hand tool under these conditions contacts another conductive surface, an electric shock occurs.**
- **If a power tool, even when double insulated, is dropped into water, the employee should resist the initial human response to grab for the equipment without first disconnecting the power source.**

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ELECTRICITY

Personal Protective Equipment Guidelines
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.

Operation Safety Guidelines
- Never disconnect or damage any safety device that is provided by the manufacturer or specified by electrical codes.
- Make sure all receptacles, switches and fixtures are secured to a box and that the box is properly grounded.
- Do not touch electrical appliances, boxes or wiring with wet hands or wet feet.
- Do not remove the long grounding prong from three-prong, 120-volt plugs.
- Use ground fault interrupters in kitchen, bathroom, laundry and outdoor circuits, or wherever moisture may increase shock hazard.
- When installing a circuit, make sure the cable is large enough to carry the intended current. Also make sure the circuit is properly protected by a circuit breaker or fuse.
- Make sure all electrical wire connections are tight and secured in a box with a cable clamp.
- Immediately discontinue the use of any extension cord that feels warm or smells hot. This means that too much amperage is trying to flow through the wire.
- Do not place extension cords under carpeting.
- Install all electrical wiring according to the specifications of the National Electrical Code.
- Use only double insulated portable tools or tools with three-wire grounded cords.
- If a fuse is blown or a circuit breaker is tripped, notify the instructor immediately.
- Do not leave heat-producing appliances unattended --things like soldering irons, etc.
- Place all heaters and lamps away from combustible materials.
- Keep the metal cases or cabinets of electrical appliances grounded at all times.
- Keep electrical motors lubricated and free of dirt. Dirty motors can accumulate flammable materials and overheat.
- Keep appliances dry to reduce shock hazard and prevent rust.
- Do not use any switches, outlets, fixtures or extension cords that are cracked or damaged in any way.
- Follow manufacturer's instructions for installation and use of all electrical equipment.
1. Which one of these rooms would not require a ground fault interrupter?
   a. Bathroom
   b. Bedroom
   c. Kitchen
   d. Laundry room

2. Substances with very little resistance to electricity are called:
   a. Utilities
   b. Conductors
   c. Insulators
   d. Circuits

3. Substances with high resistance to the flow of electricity are called:
   a. Utilities
   b. Conductors
   c. Insulators
   d. Circuits

4. We measure electricity by:
   a. ________________
   b. ________________
   c. ________________

5. What is the formula for calculating the amount of work that can be done:
   a. volts=watts*amps
   b. volts=amps/watts
   c. watts=volts*amps
   d. watts=volts/amps

6. The path through which electricity flows in a circle is:
   a. Current
   b. Circle
   c. Path
   d. Circuit

7. Grounding a tool means intentionally creating a ________resistance path to the ground.
   a. High
   b. Low
   c. Non
   d. Varied

8. Shocks result when the body becomes part of the ________.
   a. Current
   b. Electrical circuit
   c. Insulator
   d. Resistance

9. Which of the following will produce the strongest reaction to an electrical current:
   a. Christmas tree light bulb
   b. 9 volt battery
   c. watch battery
   d. Circular saw

10. Overhead power lines are especially hazardous because:
    a. They carry extremely high voltage
    b. Large equipment operators may not be able to see how close they are to a line.
c. If contact does occur, equipment operators may try to exit the cab while the vehicle is still energized.
d. All of the above.
To produce fire, three things must be present at the same time. If any one of the three is missing, a fire cannot be started; or with the removal of any one element, the fire will be extinguished.
Article I. Standard Letter Symbols for Fire Extinguishers

GREEN   RED   BLUE   YELLOW

A   B   C   D

ORDINARY COMBUSTIBLES   FLAMMABLE LIQUIDS   ELECTRICAL EQUIPMENT   COMBUSTIBLE METALS

Distinctive letters, shapes, and colors mark extinguishers according to the classes of fires on which they should be used.
Types of Fire Extinguishers

**Dry Chemical** extinguishers are usually rated for multipurpose use. They contain an extinguishing agent and use a compressed, nonflammable gas propellant.

**Halon or halatron** extinguishers contain a gas that interrupts the chemical reaction that takes place when fuels burn. These types of extinguishers are often used to protect valuable electrical equipment since they leave no residue to clean up.

**Water** extinguishers contain water and compressed gas and should be used on Class A (ordinary combustibles) fires.

**Carbon Dioxide (C0²)** extinguishers are most effective on Class B and C (liquids and electrical) fires. Since the gas disperses quickly, these extinguishers are only effective from 3 to 8 feet. The carbon dioxide is stored as a compressed liquid in the extinguisher.
This Is Your New ABCDs of Portable Fire Extinguishers

A fire extinguisher is a storage container for an extinguishing agent such as water or chemicals. It is designed to put out a small fire, not a big one. An extinguisher is labeled according to whether the fire on which it is to be used occurs in wood or cloth, flammable liquids, electrical, or metal sources. Using one type extinguisher on another type fire can make the fire much worse. So learn how extinguishers are labeled and used. When putting out a fire, point the extinguisher at the base of the fire. Traditionally the labels A, B, C, or D have been used to indicate the type of fire on which an extinguisher is to be used. Recently pictograms have come into use. These picture in blue the type of fire on which an extinguisher is to be used. Shown in black with a red slash are pictures of fires on which the extinguisher is not to be used. For example, on a class “A” type, the following symbols would appear:

NFPA 10, Standard for Portable Fire Extinguishers, recommends that extinguishers be labeled with pictograms. However, the user may find the traditional A, B, C, D labels or both the pictograms and the A, B, C, D labels on an extinguisher.

You need an extinguisher at home.
If you plan to buy one extinguisher, a multipurpose dry chemical labeled ABC puts out most types of fires—wood, paper, and cloth, flammable liquid, or electrical fires. If you buy more than one, you might want to get a BC for the kitchen, an A for the living room, and an ABC for the basement or garage.

Fire extinguishers where you work.
It is management’s job to have extinguishers available for use and your job to know how they work.

Buying and maintaining an extinguisher.
1. Extinguishers come in dry chemical, foam, carbon dioxide, water or halon types. Whatever type you buy, a testing laboratory should label it.
2. The higher the number rating on the extinguisher, the more fire it puts out. High-rated ones are often (not always) the heavier models. Make sure you can hold and operate the one you buy for home use or be required to use at work.
3. Ask your dealer how to have your extinguisher serviced and inspected. Recharge it after ANY use. A partially used extinguisher might as well be empty.
4. Extinguishers should be installed away from potential fire hazards and near an escape route.
**ABCDs**

**Class A**—Extinguish ordinary combustibles by cooling the material below its ignition temperature and soaking the fibers to prevent re-ignition.

**Fires in paper, cloth, wood, rubber, and many plastics require a water-type extinguisher labeled A.**

**Class B**—Extinguish flammable liquids, greases or gases by removing the oxygen, preventing the vapors from reaching the ignition source or inhibiting the chemical chain reaction.

**Fires in oils, gasoline, some paints, lacquers, grease in a frying pan or in the oven, solvents, and other flammable liquids require an extinguisher labeled B.**

**Class C**—Extinguish energized electrical equipment by using an extinguishing agent that is not capable of conducting electrical currents.

**Fires in wiring, fuse boxes, energized electrical equipment, and other electrical sources require an extinguisher labeled C.**

**Class D**—Extinguish combustible metals such as magnesium, titanium, potassium, and sodium with dry powder extinguishing agents specially designated for the material involved.

**Combustible metals such as magnesium and sodium require special extinguishants labeled D.**
FIRE SAFETY

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.

Safety Guidelines
Fire Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. What 3 things must be present to produce a fire:
   a. ____________________
   b. ____________________
   c. ____________________

2. If your clothing catches fire, what should you do?
   ______________________________________________________________________

3. Where do you aim the fire extinguisher when putting out a fire?
   ______________________________________________________________________

4. Write the number of the description that best describes the fire extinguisher
   that it belongs to:
   ____A 1. Ordinary solid like paper, wood, or cloth
   ____B 2. Combustible metals
   ____C 3. Flammable liquids, gases, and grease
   ____D 4. Electrical

5. A fire extinguisher should always be located by the ____________.
GREENHOUSES

The following are guidelines and rules for greenhouse usage from John Wood Community College in Illinois. These provide a good overview of the safety requirements when working with students in a greenhouse facility.

Greenhouse Safety

PURPOSE:

A. This policy reflects JWCC Safety and Security Procedures and emulates floriculture industry standards to effectively provide a safe and secure educational environment for students, faculty, and staff.

B. Working within a confined environment requires a disciplined management of hazardous materials including the use of pesticides and growth regulators commonly used in plant production. The most efficient and successful method of reducing exposure to pesticides is to maintain a sanitary environment, which reduces pest populations. In addition, with federal regulations defining naturally and organically grown vegetables, the use of pesticides on food crops will need to be monitored and possibly restricted.

SAFETY PROCEDURE:

A. The following rules will be an obligation for all faculty/staff to follow if they will be conducting and supervising laboratory exercises and projects in the Greenhouse:

1. Any plant materials, including plugs, cuttings, and seeds, must be from a reliably clean source and will be inspected for pest infestations upon arrival. Any plants or associated materials found inappropriately placed in the greenhouse with a pest infestation will be immediately removed by the greenhouse manager.

2. Growing supplies (e.g. pots, trays, inserts, etc.) must be sterilized if they are to be brought into or stored in the Greenhouse.

3. Hazardous materials must have a Material Safety Data Sheet (MSDS) on file in accordance with the college’s Hazard Communication (MSDS) procedure prior to being used in the Greenhouse. A hard copy of the MSDS should be placed in the Hazardous Materials folder in the Greenhouse. Hazardous Materials in the Greenhouse without an MSDS will be removed.

4. Pesticides, fertilizers, soil test and water alkalinity test kits, bleach, algaeicides, and flammable materials must be stored in the flammables cabinet in the
Greenhouse. Soilless media and amendments require an MSDS, but are not required to be secured.

5. Pesticide applications must be recorded in the pesticide application log in the Greenhouse. Restricted entry intervals must be observed and notice of an appropriate re-entry time should be posted on the Greenhouse door. Illinois Department of Agriculture regulations require that pesticide applications in the Greenhouse are conducted by an individual possessing a Public Applicators License in Ornamentals, or by a licensed Operator under the supervision of the Applicator. Appropriate licensing is maintained by JWCC Horticulture faculty.

6. Never drink from hoses in the Greenhouse as fertilizers and pesticides may have been applied through them.

7. Never place food items on surfaces in the Greenhouse as fertilizer and pesticide residues may be present.

8. Safety Training for Agricultural Workers – The EPA initiated the revised Worker Protection Standard (WPS) in August 1992. It mandates that persons working in areas where pesticides are used be trained in pesticide safety. There are additional requirements concerning the posting of warning signs, the use of personal protective equipment (PPE), and re-entry into treated areas. The EPA defines an agricultural worker as one who performs tasks related to the cultivation and harvesting of plants on farms or in greenhouses, nurseries, or forests. Persons who handle pesticides including mixing, loading, applying, or cleaning equipment must receive additional training for handling pesticides. As a user of the Greenhouse Facility, it is important you understand the pesticide policies and procedures for this facility. Persons who do not comply with the WPS regulations, either out of a lack of knowledge or willful disregard are placing themselves and the college at risk. All faculty, staff, and students using the greenhouse should complete WPS training prior to using the facility. Video training is online at [http://www.ag.ndsu.nodak.edu/aginfo/pesticid/wps.htm#video](http://www.ag.ndsu.nodak.edu/aginfo/pesticid/wps.htm#video) (select the video link for “WPS for Greenhouses & Nurseries”).

9. Because students are assigned to work on laboratory assignments and individual projects in the greenhouse without direct supervision by a faculty or staff member it is required that faculty educate their students with regard to campus emergency procedures. Faculty who will have students working in the greenhouse at times when campus is closed, such as holidays and school closings, are responsible for notifying Campus Security of their schedule.

10. The Greenhouse is a wet and humid environment. When conducting laboratory procedures using electrical equipment, use appropriate precautions.
11. Any area of the greenhouse used for a laboratory exercise or projects must be cleaned and materials stored upon completion of the exercise or project. Materials that are not properly removed and stored will be disposed.

12. Inclement Weather:
   
a. The Greenhouse will be vacated anytime that lightning is observed in the area.

b. The Greenhouse will be vacated when a tornado warning has been issued. Please refer to the college’s *Emergency Response Procedures* for details regarding taking shelter during a tornado warning.
HAZARDOUS MATERIALS & CHEMICALS

A hazardous chemical is any chemical that can do harm to your body. Most industrial chemicals can harm you at some level based on the level of toxicity and how much of the chemical gets into your body. Several factors of the chemical exposure affect the result on the human body. These factors include: the level of toxicity; the dose of chemical that actually enters the body; the physical form of the chemical and the route by which the chemical enters your body.

Chemical basics
There are three forms of chemicals: Solid, liquid and gas.

- **Solids:** Dust or powder can be released into the air by cutting, sanding or drilling, or by dry sweeping or blowing down with compressed air and then inhaled. Also, dust in the air can settle out on work surfaces or eating utensils and then be swallowed with food or drink. Fumes are extremely small droplets of metal formed when metal has been vaporized by high temperatures (usually welding). It looks like smoke. Some solids are fibers, which are similar to dusts, but have an elongated shape (like fiberglass or asbestos).

- **Liquids:** can be splashed on the skin and cause burns or irritation. Liquids can also be absorbed through the skin into the body. Liquids can be sprayed and forms mists or evaporate and form vapors which can be inhaled. Liquid mists can be inhaled, can settle on the skin and be absorbed or like dust, mists can settle out and contaminate food or drink.

- **Gases and vapors:** Gases are chemicals that are in a gas form at room temperature (e.g., chlorine and helium). Vapors (e.g., paint thinner, gasoline) evaporate from chemicals that are liquid or solid at room temperature. Gases and vapors enter the body by inhalation.

Routes of entry

- **Inhalation** (breathing in the chemical and the most common route of entry). Most inhaled gases and vapors are carried into the lungs and absorbed into the bloodstream. With mist or dust, the size or the particles or droplets affect where they settle in the respiratory tract and what symptoms or diseases will develop.

- **Absorption** (the chemical soaks through your skin). Solvents and pesticides are examples of compounds that can be absorbed through the skin.

- **Ingestion** (swallowing the chemical). This typically happens by contamination:
  - Chemicals rub off dirty hands and contaminate food, drinks, or tobacco products.
  - Chemicals in the air can settle on food or drink and be swallowed and then absorbed in the digestive tract. This is a great reason to wash your hands before you eat, drink, or smoke.

Chemical toxicity

- The effect of any toxic chemical depends on the amount of chemical that enters the body. This is called the dose. Acute toxicity is a measure of how toxic a chemical is at high levels over a short period of time. Chronic toxicity is the measure of the toxicity over a long period of time. Chemicals can have both acute and chronic toxic effects.

- Many chemicals have exposure limits and are often called “PELs” for permissible exposure limits. Levels in the air must be kept below these limits to protect your health. An example would be 100 parts per million.

- **Carcinogens:** not all chemicals cause cancer. In fact the list is pretty short. WISHA has specific

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regulations on the carcinogens: Vinyl chloride, benzene, DBCP, methylene chloride, cadmium, ethylene oxide, arsenic, butadiene, and acrylonitrile. Manufactures must list any known or suspected carcinogens in their products.

- Chemicals that may harm a developing fetus are called teratogens. Chemicals that cause genetic mutations or changes are called mutagens.
- Another group of toxic chemicals are called sensitizers. Sensitizers can “switch on” and bad reaction in an individual. The reaction to a sensitizer can vary wildly from person to person. Once sensitized, increasingly smaller amounts cause a reaction and the reaction itself can become more severe.

**Corrosive chemicals**

- Corrosive chemicals are usually used to clean metals, and the most common are acids and caustics. These chemicals can damage skin, eyes, and the respiratory system. Examples of corrosive chemicals are sulfuric acid, ammonia, sodium hydroxide and chlorine.
- On the skin, corrosive chemicals can cause visible burns or damage. The extent of damage depends on how long the corrosive is on the skin and the level of concentration of the chemical.
- Corrosive exposure to the eyes is extremely serious. Exposure to the eyes can cause permanent damage or blindness unless washed out immediately.
- Inhaling corrosive chemicals can cause severe irritation to permanent scarring of the lungs and difficulty in breathing.
- Personal protective equipment should be used as the first line of defense against corrosive chemical exposure. Using rubber gloves, aprons and goggles can prevent exposure damage. Emergency eyewash stations and water should be readily available in case of accidental contact with corrosives. Although this must be available, it should not be considered a line of defense.

**Flammable liquids**

- It is the vapors from a flammable liquid, not the liquid itself, that ignite and cause fire or explosion.
- The flammability of a liquid depends on 3 things: its vapor pressure, flash point and limits of flammability.
- Vapor Pressure is a measure of how fast a liquid evaporates. Higher pressure means more rapid evaporation. The warmer the liquid, the higher the vapor pressure.
- Flash point is the lowest temperature that a flammable liquid can generate enough vapors to form a mixture with air that will ignite. The lower the flashpoint, the more easily the liquid will burn.
- Limits of flammability: refers to the range of a mixture of air and vapor that is flammable. Mixtures can be too lean (not enough vapor and too much air) or too rich (too much vapor, not enough air) to ignite and burn. This is usually written as a percent, for example: The “lower explosive limit” of acetone is 2.5% and the “upper explosive limit” is 12.8%. Acetone will not ignite outside of those mixture ranges.
- Vapor density: a measure of how heavy a vapor is when compared to air. Air is measured as 1.0, so any vapor that has a density greater than 1.0 is heavier than air and can flow like a liquid and collect on the floor or in a low spot. This may create a fire or explosion hazard if the vapor flows to an ignition source.

**Metals**

Metals can be both physical (explosion) and health hazards (elevated blood pressure, brain damage, kidney damage, and death).

**Getting information about hazardous materials**

- You can get information two ways. From the product label, or from the product material safety
Material Safety Data Sheets (MSDSs):
- MSDSs contain more information than what was listed above. All of the following information is included (with example in parentheses): Name of hazardous chemicals (acetone), physical and chemical properties (flammability and volatility), Physical hazards (possible burns), health hazards (headaches, eye irritation), the route by which the chemical enters the body (inhalation), the legal limit allowed in the air (750 parts per million), if the chemical is a carcinogen (no), precautions for safe use (adequate ventilation, keep away from open flame), exposure control methods, including personal protective equipment (respirator, rubber gloves), emergency and first aid procedures (eyes: flush with water for 15 minutes), the date the MSDS was prepared or revised (1996) and the contact information for the person responsible for the information in the MSDS (John Doe, phone and address).

Protect yourself from hazardous chemicals by:
- Knowing what is in the product you work with, using the smallest amount of the chemical to do a job, and maintaining machinery and equipment to prevent leaks or releases, Using ventilation to reduce amounts of chemicals in the air, enclosing a chemical process as much as possible, wearing necessary personal protective equipment.
- In case of leak or spill: Inform supervisor of unusual odors, spills, or releases. Leave an area of a large spill or release.

If you have been exposed to a chemical:
- Let your supervisor know
- Find out what the chemical was
- Follow the first aid directions in the MSDS
- Get medical attention as needed
- Check PPE before going back in the area.
1. There are three forms of chemicals. Select the answer that best lists these 3 forms.
   a. Vapor, fumes, dust
   b. Vapors, gas, liquids
   c. Mist, solids, liquids
   d. Solids, liquids, gas

2. There are three routes of entry for chemicals to enter the body. Match the 3 routes with their definitions:
   a. Inhalation 1._____ This typically happens by contamination of food or drink
   b. Absorption 2._____ Gases or vapors are carried into the lungs
   c. Ingestion 3._____ Solvents and pesticides are examples of chemicals that can be absorbed this way.

3. A carcinogen is a chemical that causes:
   a. Burns
   b. Eye damage
   c. Cancer
   d. Mutations

4. The amount of chemical that enters the body is called the:
   a. Dose
   b. Exposure limit
   c. Sensitizer
   d. Toxicity

5. MSDS stands for Material Safety Data Sheet. List 3 things you can find on an MSDS:
   a. ____________________________________________
   b. ____________________________________________
   c. ____________________________________________
PAINTING

Personal Protective Equipment Guidelines
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.

Preparation
- 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 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 MSDS for complete list of hazards and precautions).

Health and Safety Guidelines for Painting

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 that are unlabeled or their contents cannot be determined. Always follow the safety recommendations for the material being used.

Health Hazards

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 Materials Safety Data Sheet (MSDS) (see below) for each paint. These are available from the manufacturer or paint supplier. The MSDS 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.

As 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.

How to Control Health Hazards
Environmental Control
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.
Painting Safety Questions
Name:______________________________  Class/Yr:_____________________
Date:_______________________________  Score:________________________

1. Never use materials that are _______________ or if their contents cannot be determined.

2. List three things you should do when using paints, stains, or other finishes:
   a. _______________________________________________________________
   b. _______________________________________________________________
   c. _______________________________________________________________

3. The _______________ describes hazards and precautions that should be taken.

4. When spray-painting you should make sure there is proper ________________.

5. When painting in an enclosed room:
   a. Keep windows open
   b. Keep doors closed
   c. Turn off ignition sources
   d. Both a and c
PLUMBING

Personal Protective Equipment Guidelines
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.

General Information
- Plumbing is the installing and repairing of water pipes and fixtures.
- Pipe is a ridged tube like material that liquid or gas travels through.
- Water pressure is calculated by finding the force that is exerted on the walls of the pipe. \[ \text{Pressure} = \frac{\text{Force}}{\text{Area}} \]
- Static water pressure is the pressure that water exerts while it is at rest. Two ways static pressure is created is to store water at an elevated location (gravity pulls the water down) or a pump is used.
- Dynamic water pressure is the pressure at any point when the water is flowing past. The pressure will vary because some will be lost due to friction.
- What kinds of pipe are used?
  - Copper- resists corrosion, is easy to work with, and can withstand freezing and heat
  - Plastic- easy to install and cheap
    - PVC (polyvinyl chloride)- white and rigid and is used for cold water pipes, vent and drain systems
    - Black Poly Pipe (Polyethylene)- is somewhat flexible and is used mainly in cold water lines
    - ABS (acrylonitrite-butadiene-styrene)- last a long time and is used in sewers
  - Steel- not used as must because it rusts easily
    - Galvanized Pipe
    - Black Pipe

Materials
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 MSDS for more information.
- Pipe sealing compounds may also poses some hazards (see MSDS).

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

General Safety Rules
- 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 when soldering pipe in place not to burn the surrounding building. 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.
Plumbing Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. What is plumbing?

______________________________________________________________________________________________

2. What is the formula for the force that is exerted on the walls of the pipe?
   a. Pressure=Force*Area
   b. Pressure=Force/Area
   c. Force= Pressure/Area
   d. Area=Pressure/Force

3. What is static water pressure?

______________________________________________________________________________________________

4. What is dynamic water pressure?

______________________________________________________________________________________________

5. Name the 3 types of pipe used in plumbing:
   a. _______________________
   b. _______________________
   c. _______________________

6. What kind of metal is most commonly used in plumbing?
   a. Aluminum
   b. Steel
   c. Copper
   d. Silver

7. Do not use ___________ solder when doing any water plumbing.
TOOLS & EQUIPMENT

NOTE: Even though sample safety tests and questions are provided in this manual, teachers should modify the material to make up their own safety tests on general safety rules for the various areas, individual power tools and equipment, and anything else that applies to their shop not covered by this manual to fit their program. It is absolutely necessary that the teacher demonstrate in detail how to operate each piece of equipment or tool.

*****Safety Rules and Sample Questions were complied from the manuals mentioned in the acknowledgements as well as from Agricultural Instructors in the state of Colorado.

The following list contains an information sheet, sample safety questions, labeled picture, and unlabeled picture for each tool or piece of equipment listed below:

- Band Saw
- Belt/Disk Sander
- Bench Grinder
- Buffer
- Circular Saw
- Drill Press
- Drill
- General Hand Tools
- Hydraulic Press
- Jigsaw
- Jointer
- Metal Cut Off Saw
- Metal Lathe
- Metal Shear
- Milling Machine
- Miter Saw
- Notcher
- Planer/Surfacer
- Portable Grinder
- Radial Arm Saw
- Reciprocating/Bayonet Saw
- Router
- Scroll Saw
- Shaper
- Table Saw
- Wood Lathe
Band Saw Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

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- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distractions.
- Check to see that the upper blade guide clears the stock by one-quarter inch.
- Plan sawing procedure so there is a maximum forward feed with a minimum of backing out cuts.
- Allow the machine to come to full speed before starting a cut.
- Allow no one to stand to the right of the band saw while in use. A broken blade could fly out in that direction.
- Make adjustments only when the machine is at a dead stop. Never reach around the blade of a running band saw. Use a helper when necessary.
- Ask the instructor to approve all special set-ups.
- Place a support under long or wide work pieces.
- Do not cut any material which does not lay flat on the work table. If it is necessary to cut round stock, do so only with a holding jig.
- Feed material into machine at a moderate rate of speed. Never force the cut.
- If sawing freehand, use one hand to guide the stock into the blade and the other hand to push the stock into the blade.
- Do not place excess stress on the blade by twisting the stock, cut curves gradually.
- Do not attempt to cut a smaller radius than the blade will allow.
- Use relief saw cuts when cutting sharp curves to prevent the blade from binding.
- Do not have your hands directly in line with the saw blade when cutting. Keep your fingers a safe distance from the blade. Use a push stick when necessary.
- If the band saw should break, shut off the power, stand back away from the machine until it comes to a complete stop (don’t touch the blade), and notify the instructor.
- When finished using the band saw: turn off the power, wait until the machine has come to a complete stop. Clean scraps from the machine, and return the upper blade guide assembly to a down position.
Band Saw Safety Questions

1. ____________ stock should not be cut on a band saw without a V-block or holding jig.
   a. small
   b. large
   c. flat
   d. round

2. When finished using the band saw, one should:
   a. ___________________________________
   b. ___________________________________
   c. ___________________________________

3. Plan sawing procedures so that there is a ____________ forward feed with a ____________ amount of backing out of cuts.
   a. minimum, maximum
   b. maximum, minimum
   c. minimum, minimum
   d. maximum, maximum

4. When is it permissible to reach around the blade of a running band saw?
   a. when cutting small pieces
   b. when cutting round stock
   c. never

5. The upper blade guide must clear the stock by _____ inches?
   a. 1/16”
   b. 1/8”
   c. 1/4”
   d. 1/2”

6. When sawing small stock, you should always use a ___________.
   a. push stick
   b. line guard
   c. hand rail
   d. round guide

7. Relief cuts are cuts made with the band saw. They ____________.
   a. are cuts made in a hurry
   b. prevent the blade from binding
   c. are special cuts for hardwood
   d. are special cuts for softwood

8. It is safe to place the hand in line with the blade of the band saw ____________.
   a. only when the machine is not operating
   b. only when the hand is more than 2” from blade
   c. only when the hand is more than 4” from blade
   d. only when the hand is more than 6” from blade

9. While operating the band saw, it is a safe practice to ____________.
   a. open bandsaw covers very carefully
   b. reach across material being cut on table
   c. maintain a balanced stance at all times
   d. wait until the end of class to clean up scraps
10. When you give work your individual attention, you __________.
   a. look around
   b. talk to your helper
   c. concentrate on the work at hand
   d. think about assignment for next period

11. The best time to remove scrap material from the band saw is __________.
   a. when the saw stops
   b. as you work
   c. after excessive scrap build-up
   d. depends on job

12. If the blade breaks on the band saw, shut off the power and __________.
   a. try to remove blade
   b. put on the brake
   c. move away quickly
Band Saw

Name:______________________________________________
Date:_______________________________________________

[Diagram of a Band Saw with labels for each part:
1. Blade Tensioning Screw
2. Blade Cover
3. Arm
4. Thrust Bearing
5. Table
6. Table Insert
7. Table Angle Scale
8. Switch
9. Work Lamp
10. Guide Post
11. Guide Post Locking Screw
12. Guide Locking Screw
13. Blade
14. Blade Guides
15. Blade Slot
16. Miter Gage Slot]
Belt/Disk Sander Information Sheet

Name: ________________________________________________
Date: _________________________________________________

Personal Protective Equipment Guidelines

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• Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
• Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
• A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
• Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
• Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

• Make sure all guards are in place and operating correctly.
• Avoid distraction.
• Be certain the belt or disc is correctly mounted. The belt must track in the center of drums and platen. Do not operate the disk sander if the abrasive paper is loose.
• Disconnect the electrical power to the sander when changing the belt or disc or making major adjustments.
• Check the guards and the table adjustments to ensure they are in the correct position and securely locked in place before the power is turned on.
• Use the table, fence and other guides to control the position of the work, whenever possible. Adjust the disc table to achieve the desired angle on the stock being sanded. The table can be adjusted up to 45 degrees on most sanders.
• Small and/or irregular-shaped pieces should be held in a hand screw clamp or a special jig or fixture.
• When sanding the end grain of narrow pieces on a belt sander, always support the work against the table.
• If the sanding disc rotates in a counterclockwise direction, position the material to be sanded from the center of the disc to the left edge. If positioned in this manner the sanding action will help to hold the stock down on the table. If the stock is positioned from the center of the disc to the right edge of the disc the sanding action will pick the edge of the stock up and created an unsafe condition.
• Do not reach across the sanding disc to turn the sander on or off. Your arm or hand may touch the edge of the rotating disc and cause a serious cut or entanglement. Move to the front of the sander and turn the machine off.
• Try to position yourself so that sanding dust will not be thrown toward the breathing zone.
• Hold stock steady as it is being sanded, but do not put so much pressure on the sanding disc or belt that the sander slows down.
• Keep the pieces moving along this surface so it will not burn.
• Always use a pad or a push block when sanding the pieces of stock on the belt sander.
1. Do not operate the disk sander if the _______________ is loose.

2. What must you do before making any adjustments to the belt/disc sander?
   __________________________________________________________________________

3. Where should the stock being sanded be held if the sanding disc rotates in a counterclockwise direction?
   a. Center to right edge of the disc.
   b. Center to left edge of the disc.
   c. Center to top edge of the disc.
   d. Center to bottom edge of the disc.

4. What may happen to an operator who reaches across the rotating sanding disc to turn the sander off?
   a. Nothing, this is a relatively safe move.
   b. Saw dust will likely be thrown toward your face.
   c. May receive a serious cut on the hand or arm from the rotating sanding disc.
   d. The sander may throw a disc off and hit your hand or arm.

5. On most disc sanders the table can be adjusted ___________ degrees.
   a. 25
   b. 35
   c. 45
   d. 60

6. When sanding the end grain of a piece, make sure to:
   a. Support the work against the table
   b. Apply extreme pressure
   c. Apply very light pressure
   d. Run the piece back and forth quickly

7. If the sander starts to slow down when you are sanding what are you doing wrong?
   a. Not applying enough pressure
   b. Applying to much pressure
   c. Nothing, this is normal

8. Keep the work moving when sanding it so that it does not:
   a. Become to soft
   b. Breaks to pieces
   c. Burn
Bench Grinder Information Sheet

Name:______________________________________________
Date:_______________________________________________

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• Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
• A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
• Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
• Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

• Make sure all guards are in place and operating correctly.
• Avoid distraction.
• The tool rest must be adjusted to within 1/8” or less of the grinding wheels.
• Spark deflections must be adjusted to within 1/8” or less of the grinding wheel.
• Do not use grinding wheels when worn less than ½ of their original diameter. Replace the wheel when worn to ½ of the original diameter. When the grinding wheel is worn to the paper washer it should be replaced.
• For fast cutting action a course grit grinding wheel should be selected; for finish grinding, a fine grit grinding wheel should be used. The smaller the grit number the coarser the grinding wheel cut. A 60 grit grinding wheel is recommended for most tool fitting.
• Use the face of the grinding wheel only unless it is designed for grinding on the side.
• Inspect the grinding wheels for irregular wear or cracks before turning on the power.
• Stand to one side when starting the machine. Do not stand in direct line with the grinding wheel when using the grinder. Stand to the side so that if a piece of the grinder wheel is thrown off it will not hit you.
• Allow the grinder to come up to full speed before starting grinding operations.
• Hold the work piece against the grinding wheel firmly, so that it will not slip and cause your hand or finger to come in contact with the wheel.
• Small work pieces should be held with “vise grip” type pliers. Rags or gloves should not be used to hold work pieces.
• Make sure the operator can see the work well by keeping the safety shields clean and work lights functional.
• Keep fingers a safe distance from moving grinding wheels.
• To avoid overheating and damaging the grinding wheel, do not apply excessive pressure. The metal being ground should be moved back and forth across the grinding wheel to produce an even wear pattern. Do not continuously grind in one spot on the grinding wheel.
• Do not grind non-ferrous materials on the grinder.
• Stop the grinder if it clatters or vibrates excessively. This could be a danger signal that the wheel is out of balance.
• Cool the metal often enough so the temper is not removed.
• Make certain the grinder is turned off and has stopped rotating before leaving the operating zone.
1. If excessive pressure is applied to a grinding wheel:
   a. the wheel may get too hot
   b. the wheel may chip or crack
   c. the machine might overheat
   d. both a and b

2. A grinder tool rest should never be more than _____ inch from the grinding wheel.
   a. 3/8
   b. 1/4
   c. 3/16
   d. 1/8

3. When grinding, the operator should not stand ____________.
   a. in direct line with the grinding wheel
   b. to the left side of the grinder
   c. to the right side of the grinder
   d. on either side of the grinder

4. What personal protective equipment should be used when using a grinding wheel is/are ________.
   a. safety glasses
   b. gloves
   c. dust mask
   d. all of the above
   e. a and c above

5. The spark deflector on a grinder should be adjusted to within ____ inches of the grinding wheel.
   a. 1/4
   b. 1/8
   c. 1/16
   d. 1/32

6. Before grinding, the operator should ________.
   a. allow the grinder to reach full operating speed
   b. make certain others are not standing in line with the grinding wheel action
   c. clean the grinder safety shields
   d. a and b above
   e. a, b and c above

7. Which of the following grinder wheels would cut the fastest?
   a. Fine grit
   b. Medium grit
   c. Course grit
   d. They would all cut the same

8. A grinding wheel should be replaced when worn to ____ of it’s original diameter.
   a. ¾
   b. ½
   c. 3/8
   d. ¼
9. Which of the following grinding wheels would produce the smoothest grinding surface?
   a. 30 grit  
   b. 40 grit  
   c. 60 grit  
   d. 90 grit

10. Use the _____________ of the grinding wheel unless the sides are designed for grinding.
Bench Grinder

Name: ____________________________________________
Date: ____________________________________________

SAFETY SHIELD ⑩
GRINDING WHEEL ⑨
ADJUSTABLE TOOL REST (ONE EACH WHEEL)
WATER POT ⑦
MOTOR ①
ADJUSTABLE SPARK DEFLECTOR ②
WHEEL GUARD ③
DUST CHUTE ④
SWITCH ⑤
PEDESTAL ⑥
Bench Grinder

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________
Buffer Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

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• Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
• Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
• A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
• Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
• Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

• Make sure all guards are in place and operating correctly.
• Avoid distractions.
• No more than one person should work on a single wheel at one time.
• To prevent burns, avoid contact with the revolving wheels.
• Never use gloves, rages or parts of a shop coat to hold a work piece. These could be easily caught in the wheel resulting in injury.
• Use only the lower front quarter of the buffing wheel.
• Use care when buffing corners or openings. The wheel could grab the work piece.
• When finished using the buffer: turn the power off, wait until the machine comes to a complete stop, and brush off the machine.
Buffer Safety Questions

1. When operating the buffer you should:
   a. remove jewelry and wear eye protection
   b. obtain permission and make sure all guards are properly secured
   c. avoid distractions
   d. all of the above

2. How many people are allowed to use a single buffer wheel at a time?
   a. one
   b. two
   c. three
   d. as many as you want

3. Why should one be careful that fingers do not come in contact with the revolving wheel?
   a. to prevent burns
   b. to prevent deep cuts
   c. to prevent extreme wear on the wheel
   d. all of the above

4. Do not use ______________, _________________, or ___________________ to hold hot objects while buffing.

5. Always buff on the ___________________________________ of the wheel.
   a. top half
   b. center portion
   c. lower front corner
   d. upper front corner

6. List three things you should do once finished using the buffer.
   a. __________________________________________
   b. __________________________________________
   c. __________________________________________

7. Use care when buffing _________________ or ___________________ because the wheel could grab the work piece.
Circular Saw Information Sheet

Name: _____________________________________________
Date: ______________________________________________

Personal Protective Equipment Guidelines

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- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
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- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Use properly secured and adjusted guards at all times.
- Avoid distractions.
- Always use sharp blades.
- Position the stock so that it is stable and stationary and can be cut from a balanced and comfortable position by the operator. Smaller pieces should be secured in a vice or clamped to a bench.
- Make sure that retracting guard returns automatically to cover the blade before starting the saw.
- Check the blade depth setting to be sure the blade does not extend more than 1/8” below the material.
- Allow the saw to come to full speed before starting to cut.
- When finished cutting, do not set the saw down until the blade stops.
- Always make sure the power cord is clear of the blade.
- Push the saw through the material at a steady pace. Avoid going too fast, this condition can be recognized by noticeable reduction in the RPMs (revolutions per minute) of the saw blade.
- Be sure the material you are cutting is properly supported to avoid bending the blade.
- If the saw blade binds or smokes, stop cutting immediately and notify the instructor.
- When finished using the circular saw: allow the saw to come to a full stop, unplug the saw, wrap the cord properly and return it to its designated storage place.
Circular Saw Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. Before making a cut with the circular saw, you should position the stock so it is:
   ______________________________________

2. Make sure the blade does not extend more than _____ below the material.
   a. 1/2"
   b. 1/4"
   c. 1/8"
   d. 1/16"

3. When finished using the circular saw:
   a. allow the saw to come to a full stop
   b. unplug and wrap the cord up properly
   c. return the saw to the proper storage area
   d. all of the above

4. Make certain before cutting that the ____________________________ returns automatically.

5. Before beginning a cut, the saw should be allowed:
   a. to start turning
   b. to reach full speed
   c. to reach a moderate speed
   d. none of the above

6. Make sure the __________________ is out of the way before making any cuts.

7. The saw blade must be ____________________________ before it can be set down on a surface.

8. Why is it important to keep a firm grip on the saw at all times?
   ______________________________________________________________________
   ______________________________________________________________________

9. Never push or force the saw any ___________ than it can cut.

10. The blade on the circular saw should be:
    a. Chipped
    b. Sharp
    c. Dull
    d. It doesn’t really matter
Circular Saw

Name:______________________________________________
Date:_______________________________________________

[Diagram of a circular saw with labeled parts:
- Trigger Switch (8)
- Guard Lift Handle (7)
- Retractable Guard (6)
- Blade (5)
- Handle (1)
- Angle Scale (2)
- Tilt Lock Knob (3)
- Tilting Base (4)]
Drill Press Information Sheet

Name:__________________________________________________
Date:__________________________________________________

Personal Protective Equipment Guidelines

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minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety
glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable
  circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing,
  frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be
  worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory
  settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- Make all adjustments only when the power is off. Exception: speed changes on variable speed machines
  should be make only while the machine is running.
- All tables should be secured before using the machine.
- Select the proper drill type for each job. If uncertain which to use ask your instructor.
- To avoid injury always remove the chuck key immediately after use.
- Hold material securely with drill press, vise or clamp.
- Keep hands away from revolving spindle, chuck, drill, and chips.
- Operate feed handle so that the drill cuts evenly into the work.
- Ease up on the feed pressure when the drill begins to break through the material.
- When drilling is complete slowly return the feed handle to the up position.
- The drill press should be completely stopped before attempting to remove work, chips, or cuttings.
- Step away immediately if work comes loose and is seized by drill, and shut off machine at the power
  panel. Do not attempt to shut off the machine at its switch.
- Never walk away from a drill press that is still running. Remove the drill bit and chuck key when finished.
Drill Press Safety Questions

Name:______________________________  Class/Yr:_____________________
Date:_______________________________  Score:________________________

1. If the stock becomes seized or becomes loose one should:
   a. step away immediately
   b. try to stop the material by hand
   c. turn the power switch off on the machine
   d. shut the machine off at its power panel
   e. both a and d

2. Drill press work should be held:
   a. with a pair of tongs
   b. by the hands
   c. in a vise or firmly clamped to the table
   d. by an assistant at all time.

3. When drill begins to break through the work, you should:
   a. ease up on the feed pressure
   b. maintain the same feed pressure
   c. stop the drill press immediately
   d. apply more pressure.

4. Never use your ____________ to clear chips away from the spindle.

5. If a piece of work begins turning with the bit:
   a. shut off the power and allow the drill to stop
   b. step away from the machine and notify the teacher
   c. stop the work with vise grips
   d. run

6. Adjust the ___________ to suit the material and the size of the hole being drilled.
   a. lighting
   b. chuck
   c. drill speed
   d. ventilation

7. Keep the drill bit sharp and running cool by using ____________.
   a. light but steady pressure
   b. cutting oil
   c. extreme pressure
   d. low drill speeds

8. Before starting the drill press:
   a. center punch all targets
   b. make sure the drill bit is running true
   c. remove the key from the chuck
   d. all of these are correct
Drill Information Sheet

Name: ________________________________________________
Date: _________________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Avoid distraction.
- Disconnect the drill from the electrical supply when installing bits.
- Clamp stock so it will not move during the drilling operation.
- Before drilling, turn the drill on to see if the bit is centered and running true.
- Align the bit with the desired hole location before turning the drill on.
- Hold the drill firmly with both hands while drilling.
- When drilling deep holes with a twist drill, move the bit up and down several times while drilling to remove cuttings and reduce overheating in the bit.
- Do not allow the cord to become wrapped around the drill when working.
- If the electrical cord becomes frayed or starts to separate from the drill housing, notify the instructor immediately.
- Remove the bit from the drill as soon as the work is completed.
- Select the correct bit for the finish and material being drilled. Make sure the bit is securely tightened in the drill chuck.
- Be extremely careful when using larger portable electric drills (3/8" and 1/2"). If the bit should hang or get caught the drill will twist in the operators hands causing a sprain or bruised fingers.
- Always remove the key from the chuck before drilling.
- To prevent seizing, reduce the feed pressure when the drill bit is about to come through the material.
- Always center punch or make a starting indentation in the material being drilled to get an accurate starting point for the drill bit.
- Tighten the drill bit by rotating the chuck key to all three holes in the chuck. This will help to keep the drill bit centered.
- Use only straight shank or Silver and Deming drill bits in portable electric drills.
- Apply moderate even pressure to the drill during the drilling operation. If excessive pressure is required to make the bit cut then the bit is dull and needs to be sharpened.
- Maintain good balance at all times when drilling.
- Use slow drill speeds for drilling metal and fast speeds for drilling wood.
- To obtain holes that are placed accurately, drill a small pilot first then drill the final hole.
Drill Safety Questions

Name: ________________________________  Class/Yr: _______________________
Date: _________________________________  Score: ___________________________

1. The purpose of turning the drill on before attempting to drill a hole is to _____.
   a. See if the drill operates.
   b. See if the drill bit is running true.
   c. Make sure the chuck key has been removed.
   d. None of these.

2. The purpose of moving the drill and bit up and down often when drilling a deep hole is to
   _________________.
   a. Ream the hole slightly larger.
   b. Give the drill operator better drilling leverage.
   c. Help keep the hole centered.
   d. Reduce overheating in the drill bit.

3. If a large capacity portable drill bit hangs during the drilling operation what will likely happen?
   a. The bit will break.
   b. The drill will twist in the operator’s hands causing a sprained wrist or bruised fingers.
   c. The drill will likely stall out and overheat.
   d. The hole will become badly distorted.

4. What kind of pressure should be applied to a drill during the drilling operation?
   a. Light, even.
   b. Medium, even.
   c. Moderate, even.
   d. Heavy, even.

5. What type of drill speed is needed for wood drilling operations?
   a. Low
   b. Low-medium
   c. Medium
   d. High

6. What type of drill speed is needed for most metal drilling operations?
   a. Low
   b. Medium-low
   c. Medium-high
   d. High

7. The purpose of a pilot hole when drilling is to _____________.
   a. Make the final hole drilling operation easier.
   b. Guide the final drilling operation and achieve a more accurately placed hole.
   c. Reduce the feed pressure needed to drill the hole.
   d. Allow the final hole to be drilled at a faster rpm and achieve a smoother finish.

8. To prevent seizing when drilling the operator should ______________.
   a. Reduce the rpm’s of the portable electric drill
   b. Lubricate the drill bit.
   c. Use a high speed drill bit.
   d. Reduce the feed pressure when the bit is about to come through the material being drilled.

9. If excessive pressure is needed for the bit to cut then:
   a. The bit is hot
   b. The operator is not standing correctly
   c. The bit is dull and needs to be sharpened
   d. Nothing needs to be done

10. When finished with your work, always make sure to:
a. Remove the bit and put it away
b. Leave the bit in so someone else can use it
c. Leave the drill out for others to use
d. Leave the bit out for others to use
General Hand Tools Information Sheet

Name: ____________________________________________
Date: ____________________________________________

Personal Protective Equipment Guidelines
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines
- Select the proper size and type of tool for the job. Learn and follow the correct procedure for using each tool.
- The use of a “cheater” or any other means for increased leverage is hazardous. All wrenches are designed to a specific size-length-strength ratio.
- Cutting tools must be properly sharpened and in good condition.
- Clean hands of oil/grease before using any tool.
- Handle sharp-edged and pointed tools with care; carry tools so that the sharp edges are pointing down and away from you.
- Secure small or short work pieces with a vise or clamp.
- Never carry tools in your pockets.
- Use tools only for the purpose for which they are intended.
- Do not use tools with loose or cracked handles. They may break while in use, causing injury.
- Keep punches and chisels in good condition. Mushroomed heads may chip and cause injury.
- Be sure any file with tang is equipped with a handle.
- Never pry, hammer on, or hammer with a FILE; it may shatter.
- Do not use screwdrivers as chisels or pry bars.
- Do not use a hard hammer on another hardened surface. Small pieces are likely to break off and injure someone.
- Report any damaged or broken tools to your instructor.
- Caution should be used when handling tools to others. Tools should be passed with the handles first.
- When finished with a tool, clean it and return it to its proper storage place.
General Hand Tools Safety Questions

Name: ____________________________  Class/Yr: ______________________
Date: ____________________________  Score: __________________________

1. Cutting tools should be in good condition and ____________.

2. When carrying sharp pointed tools, carry them ____________ and ____________ from you.
   a. Down, toward
   b. Down, away
   c. Up, toward
   d. Up, away

3. Small or short work pieces should be secured with a ____________ or ____________.

4. Why do you not use a tool with a cracked or broken handle?
   __________________________________________________________________________

5. Use tools:
   a. For whatever is necessary at the time.
   b. As a hammer even if they are not intended to.
   c. For different uses.
   d. Only for how they were intended to be used.

6. Files must have what on them to be safe to use?
   __________________________________________________________________________

7. Name 3 examples of hand tools not being used properly:
   a. _________________________________________________________________________
   b. _________________________________________________________________________
   c. _________________________________________________________________________

8. When passing tools to others, hand them the this first:
   a. The handle
   b. The pointed end
   c. The middle of the tool
   d. It doesn’t matter

9. Report any broken or damaged hand tools to the ________________.

10. When finished using a hand tool what should you do?
    __________________________________________________________________________
Hydraulic Press Information Sheet

Name: ____________________________________________
Date: ______________________________________________

Personal Protective Equipment Guidelines
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines
- Avoid distraction.
- Other students and observers are to stay outside the working area.
- When pressing out bearings or bushings, make sure that the work is centered before applying pressure.
- Apply light pressure and then re-check to see if the work is properly aligned and level.
- Do not apply pressure if the work is sitting at an angle.
- Ask the teacher to check the set-up before increasing pressure.
Hydraulic Press Safety Questions

1. Before using the hydraulic press, the student must first:
   a. lock bleeder valve
   b. obtain permission from the teacher
   c. set work on the press
   d. test the equipment.

2. The hydraulic press operator must:
   a. wear approved eye protection
   b. wear gloves
   c. wear a leather apron
   d. wear a helmet.

3. When pressing out bearing
   a. you must wear gloves
   b. work must be centered properly
   c. apply as much pressure as possible.

4. After applying light pressure to the work:
   a. increase pressure immediately
   b. check for leaks in the press
   c. check work level and alignment
   d. relieve pressure immediately.

5. Do not apply ____________ if the work is at an angle.

6. Ask the ____________ to check the set-up before increasing pressure.

7. Apply ____________ pressure and then re-check to see if work is properly aligned and level.

8. Always wear appropriate safety ____________ when operating the hydraulic press.
Jigsaw Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines
- Make sure all guards are in place and operating correctly.
- Make all adjustments with the power off, then rotate the motor by hand as a final check. Have 1” between upper chuck and the sleeve. Use this method to check for blade tension.
- Be sure switch is OFF before plugging in.
- Do not overreach. Keep comfortable footing and balance.
- Use clamps to secure work piece to a stable platform.
- Do not force the tool. Use the correct blade for your application.
- Disconnect power before making any adjustments or storing the tool.
- Before and after use, check for misalignment or binding of parts, breakage of parts, and any other condition that may affect the tool’s operation. If damaged, tell the instructor immediately.
- Hold tool by the handle, not the power cord.
- Do not leave the power switch locked on before unplugging.
- Keep the blade path free of hands, legs, wood knots, work clamps, and the power cord.
- Make sure all adjustments screws and the blade holder are secured tightly before making a cut.
Jigsaw Safety Questions

Name:______________________________  Class/Yr:_____________________
Date:_______________________________  Score:________________________

1. Always wear:
   a. Safety glasses
   b. Loose clothing
   c. Jewelry
   d. All of the above

2. You should use ____________ when using the jig saw to secure your work to the table.

3. Keep the blade path free of:
   a. Hands and legs
   b. Work clamps
   c. The power cord
   d. All of the above

4. Don’t __________ the tool: let the blade cut at its own speed.

5. When making adjustment be sure:
   a. The power is turned off
   b. The machine is unplugged
   c. The machine is turned off and unplugged
   d. None of the above

6. If the blade is damaged:
   a. Fix it
   b. Notify your instructor
   c. Have your friend help fix it
   d. Finish your work
Jigsaw
Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________
Jointer Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- Make all adjustments with the power turned off.
- The absolute minimum length of material that may be jointed is 12" long.
- Do not adjust or move the rear or out feed table.
- A push stick must be used on all materials that would bring the hands within 2" of the cutter.
- An assistant should help support the long pieces.
- Several light cuts are safer and produce better results than on heavy cut.
- Always joint with the grain. This will give you a smoother cut and a better finish.
- One must not use the jointer for work less than ½" thick. Then stock may splinter and break.
- Push stock over the knives at a moderate speed.
- Stand to the left side of the machine. You will not have to reach as far forward to push the work over the cutter.
- Shift your hands on the material so they do not pass directly over the cutters at any time.
- Push the stick far enough past the knives so that the guard will return closed.
- Material being jointed must be free of nails, screws, and other foreign objects.
- Do not change the depth of the outfeed table. The setting is critical and must be adjusted by a qualified person.
- When finished using the jointer: turn off the power, wait until the machine has come to a complete stop, and dust the machine off.
Jointer Safety Questions

1. The shortest length of stock that can be safely cut on the jointer is:
   a. six inches
   b. four inches
   c. eighteen inches
   d. twelve inches

2. Why do you joint with the grain?

3. When must you use a push stick?

4. Never apply __________ to stock directly over the cutter - head.

5. Position __________ away from extreme ends of stock, and push through with a smooth, even motion.

6. Never pass the hands directly __________ the cutter knife while holding on to the stock.

7. __________ need to be used if you are going to surface pieces thinner that 3”.

8. When the stock is longer than twice the length of the infeed and outfeed tables, another ______________ or support table must be used to support the stock.

9. If you are not sure how to perform an operation on the jointer, you should _______.
   a. ask the instructor for assistance
   b. ask another student for assistance
   c. refer to the operator’s manual
   d. read about it in the textbook

10. When jointing an edge; you never joint a board that is less than _______ “thick.
    a. 1/8”
    b. 1/4 “
    c. 1/2 “
    d. 2/3”

11. Stock should be pushed through the jointer with ____________.
    a. either hand
    b. both hands
    c. the right hand
    d. the left hand

12. If you can, why do you want to lap your fingers above the top of your wood extending them back over the fence?
Jointer

Name: ____________________________________________
Date: ____________________________________________

FENCE TILT CONTROL

1. FENCE WIDTH CONTROL
2. FENCE
3. FRONT OR INFEED TABLE
4. SWING GUARD
5. ADJUSTING HAND WHEEL
6. DEPTH SCALE
7. SWITCH
8. FRONT TABLE LOCK
9. REAR OR OUTFEED TABLE
10. FRONT OR OUTFEED TABLE
Jointer

Name: ____________________________  Class/Yr: ______________________
Date: ____________________________  Score: _________________________
Metal Cut Off Saw Information Sheet

Name: ________________________________________________
Date: _________________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- Make sure the stock is tightly clamped in place before you start cutting.
- Keep our hands clear of the path of the blade at all times.
- Do not force the cut, pushing on the saw to much could overload the machine or damage the blade.
- Even though the saw cuts automatically, make sure you are watching in case something goes wrong like the blade twisting or jamming, the stock twisting free, or if the machine fails to stop when it should.
- Be careful with fresh cut pieces of metal and wear gloves. They can be sharp and hot so cool and de-burr them right away.
- If metal chips or filings build up in the saw, turn it off and clean it with a brush, never use your hand.
Metal Cut Off Saw Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. What could happen if you try and force the cut while using a metal cut off saw?
   ______________________________________________________________________
   ______________________________________________________________________

2. What must you watch for as the cut proceeds?
   a. the blade twisting or jamming
   b. the stock twisting free
   c. the saw not stopping when it is suppose to
   d. all of the above

3. How do you handle a freshly cut piece of metal?
   ______________________________________________________________________
   ______________________________________________________________________

4. If filings build up on the machine, how should you clean them off?
   a. use a brush
   b. use your hand
   c. use your glove
   d. all of the above

5. Never hold the material being cut against the fence by hand, use...
   a. The clamp provided      c. Vise-grips
   b. C-clamps               d. All of these

6. Before attempting to cut, ________________.
   a. Make sure others are clear of the area.
   b. Make sure the blade is in a safe operating condition
   c. Allow the blade to reach full speed
   d. All of these
Metal Cut Off Saw

Name: ____________________________________________
Date: ____________________________________________
Metal Cut Off Saw

Name:______________________________  Class/Yr:_____________________
Date:_______________________________  Score:________________________
Metal Lathe Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines
- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- Never leave the chuck key in the lathe chuck. Remove all unnecessary tools from the immediate work area.
- Rotate spindle by hand to check clearance before engaging the power.
- Remove chips with a brush, never by hand. Lathe chips are very sharp.
- Make sure work is secure and lathe is set at correct speed and feed before starting the machine.
- Handle chucks and face plates carefully because of the weight.
- Make all adjustments and measurements only when the machine is at a dead stop (variable speed control excepted).
- Remove tool holder and toll post before filing or polishing.
- Make sure the stock has completely stopped rotating before attempting to handle it.
- Do not hand stop the lathe chuck; allow it to coast to a stop.
- Before turning on the power, check to see that the tailstock, tool holder and job are properly clamped.
- Use hand power only when putting on or removing the chuck or faceplate. Do not use the power that operates the lathe.
- Do not leave the chuck wrench or any other tool in the chuck. If the machine is turned on, the wrench may fly out and injure the operator or another person.
- Never try to measure work or feel the edge, or adjust a cutting tool when the lathe is running.
- Do not take heavy cuts on long slender work. Doing so may cause the job to fly out of the machine.
- As a general rule, do not change or shift gears while the lathe is running.
- Stand erect in order to keep your head away from flying chips.
- Keep your hand away from revolving gears.
Metal Lathe Safety Questions

1. The ______________ must be removed from the chuck.

2. All adjustments to the lathe are to be made:
   a. While the machine is coasting
   b. By the lab foreman
   c. When the machine is at a dead stop
   d. All of the above are true.

3. When assembling or removing the chuck:
   a. Place a board on the ways
   b. Grip the chuck firmly
   c. Never use the power that operates the lathe
   d. All of the above are true.

4. The chuck wrench should never be left in the lathe chuck because:
   a. It is awkward to use the lathe that way
   b. The work place will become loose as the lathe operates
   c. It will interfere with the operation of the crossfeed
   d. It may be thrown from the lathe and injure someone.

5. When the lathe is running, you should never:
   a. Adjust the cutting tool
   b. Feel the edge
   c. Try to measure the work piece
   d. All of the above are true.

6. Before operating the lathe, loose sleeves should be rolled up and:
   a. Wrist watches and jewelry removed
   b. Long hair tied back or in a net
   c. Both “a” and “b” are correct
   d. Neither “a” or “b” are correct.

7. You should check to see that the tailstock, tool holder and work piece are properly clamped before:
   a. Turning the machine off
   b. Leaving for a break
   c. Turning on the power
   d. Lubricating the machine.

8. Remove lathe chips from the bench with:
   a. Your hand
   b. A brush
   c. While the machine is stopped
   d. both b and c

9. Do not make any ______________ on the lathe while it is running.

10. Never ____________ the work piece or touch the blade with your fingers while the lathe is operating.
Metal Lathe

Name:______________________________________________
Date:_______________________________________________

[Diagram of a metal lathe with numbered parts and labels such as CROSS SLIDE, COMPOUND SLIDE, SADDLE, TAILSTOCK, BED, LEAD SCREW, APRON, THREAD DIAL, CHIP PAN, BASE, CONTROL LEVER FOR HALF NUTS, MOTOR SWITCH, CLUTCH, FEED SELECTOR, HEADSTOCK, REVERSE FEED LEVER, QUICK CHANGE GEAR BOX, THREAD & FEED LEVERS, SPEED CONTROL HAND LEVER, and MICROMETER COLLARS.]
Milling Machine Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- Make all adjustments and measurements with the machine at a complete stop.
- Handle cutters carefully, as they are sharp.
- Be sure the cutter is tightly held and the material is securely held by a vise, clamps, or magnetic chuck.
- Check spindle rotation, speed, depth of cut and all power feed adjustments before starting the cut.
- Take care to prevent jamming the vise or the work into the column or cutter.
- Keep hands away from the cutter. Remove chips with a brush after the machine is at a dead stop.
- Keep the floor around the milling machine clear of chips and wipe up any spilled cutting oil immediately.
- Once a cutting pass is made do not back out or return to the starting position without proper clearance.
- Make sure the cutter is rotating in the right direction. Feed against the cutter unless the machine is capable of climb cutting.
- Remain with the machine for the duration of the cut.
- Never run your hand over the work while the machine is running.
- When finished using the milling machine, disengage all automatic feeds, turn off the power, stand by until the machine has come to a complete stop, remove the cutter and work piece and brush away chips.
Milling Machine Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. When should you make adjustments or take measurements when using the milling machine?
   a. While cutting
   b. While the machine is running
   c. Whenever as long as the instructor is near
   d. When the machine is at a complete stop

2. List 3 things to check before using the milling machine:
   a. _________________________________
   b. _________________________________
   c. _________________________________

3. Once a cutting pass is made do not ___________________ or return to the starting position.

4. How should you remove the chips from the machine?
   ________________________________________________________________

5. The floor around the milling machine should be:
   ________________________________________________________________

6. Handle the cutter carefully, as it is ________________________________.

7. Feed _______________ the cutter unless otherwise stated.
   a. Against
   b. With
   c. In the same direction
   d. With the grain

8. When you are done using the machine what should you do?
   ________________________________________________________________
   ________________________________________________________________
Miter Saw Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

• Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
• Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
• Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
• A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
• Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
• Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

• Make sure all guards are in place and operating correctly.
• Avoid distraction.
• Make sure the saw is securely attached to a table or base support before attempting any cut.
• Hold or clamp the material securely before making any cut.
• Keep hands at least 4 inches away from the rotating saw blade when making a cut.
• Make sure the electrical cord and plug are in good operating order before using the saw.
• After the saw blade has cut through the material, continue to hold the saw down, release the trigger switch, and let the saw blade stop rotating before allowing the blade to return to it's starting position.
• Never attempt to remove scrap material from the cut zone until the blade has stopped rotating and your hand is removed from the on/off switch.
• Keep the saw blades sharp and the saw well lubricated where necessary.
• If cutting long stock, support the long end to prevent the material from binding or jamming the saw blade after the cut is finished.
• Unplug the saw when making adjustments on the saw.
• Make a trial cut on a piece of scrap material before attempting final cuts to make sure the saw is cutting properly and that the miter and bevel angles are set accurately.
• If the material is bowed or warped, clamp the stock to the saw base before making the cut to avoid binding or saw kickback.
• Align the saw blade on the waste side of the cut line.
• Hold the saw firmly and lower the blade slowly into the material being cut. After the cut is completed continue to hold the blade in the down position, release the off/on switch, wait till the blade stops rotating and the raise the blade to the up position.
• If the motorized miter saw is mounted on a slide, pull the saw out to the extended position, turn the switch on. lower the blade into the material, and push the saw forward to make the cut.
• Hold the material securely when making cuts.
• When making multiple cuts of the same dimensions, clamp a stop on the saw table to assure accuracy of the cut and to reduce the time needed to make the cuts.
• If the saw should kickback, continue to hold it firmly in the down position, release the off/on switch and wait for the blade to stop rotating.
• When cutting long stock use a helper or a solid support stand to help hold the material steady while the
cut is being made.

- When finished using the miter saw: allow it to come to a complete stop, lock blade down, clear the scraps and clean up the work area.
Miter Saw Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. The work piece should be held against the:
   a. fence
   b. table
   c. blade
   d. both a & b

2. How must the saw blade be held after the cut is finished and before the blade stops rotating?
   a. Release it to the up position.
   b. Hold it in the down position.
   c. Raise 1" above the stock being cut.
   d. Pull to the out position.

3. Allow motor to reach full speed before ____________.

4. How can the saw operator prevent the blade from binding when cutting warped, bowed, or long stock?
   a. Clamp the stock to the table.
   b. Hold the saw firmly.
   c. Push the saw through the material slowly.
   d. Hold the saw down securely after the cut is made.

5. When is it safe to remove wood scraps from the cutting zone on the motorized miter saw?
   a. While the saw is positioned over material and ready for a cut to be made.
   b. While the saw blade is clamped in the down position.
   c. While the saw is off and the hand is not on the Off/On switch.
   d. While the blade is up.

6. Where should the saw blade be positioned when cutting is completed and the operator is leaving the work zone?
   a. Up
   b. Down
   c. In its safest position
   d. Either a or b

7. Perform all adjustments when the miter saw ______________.

8. Hands or fingers never come closer than __________ to the rotating blade when operating the motorized miter saw.
   a. 2 inches
   b. 4 inches
   c. 6 inches
   d. 8 inches

9. The purpose of a trial cut before making the actual cut with the motorized miter saw is to
   ____________.
   a. see if the material is positioned correctly.
   b. see if the saw is cutting properly and is set accurately.
   c. see how the material will cut.
   d. test the sharpness of the saw blade.
   e. all of the above

10. Where should the saw blade be aligned when making a cut with the motorized miter saw?
    a. Left side of the marking line
b. Right side of the marking line  
c. Waste side of the marking line  
d. On the marking line  

11. How should the saw blade be moved throughout the stock when making a cut with a motorized miter saw that has a sliding arm?  
   a. Push down, then pull out  
   b. Push down  
   c. Pull out then push down  
   d. Pull out, push down, then push forward  

12. If a kickback should occur when a cut is being made the saw operator should ____________ .  
   a. jump out of the way.  
   b. turn loose of the saw immediately.  
   c. raise the saw to the up position immediately.  
   d. hold the saw firmly in the down position and release the On/Off switch.
Miter Saw

Name: ____________________________________________
Date: ____________________________________________

1. Fence
2. Table
3. Lever
4. Miter Scale
5. Turn Base
6. Vertical Hold-down Vise
7. Arm
8. Slide
9. Dust Bag
10. Stationary Blade Guard
11. Off/On Switch
12. Safety Start Button
13. Handle
14. Blade
15. Retractable Blade Guard
16. Bevel Scale
Personal Protective Equipment Guidelines
• Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
• Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
• Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
• A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
• Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
• Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines
• Make sure all guards are in place and operating correctly.
• Avoid distraction.
• Never use a machine or tool for anything other than its intended purpose. Use the proper tool and equipment for the task.
• Do not operate the machine in excess of its rated capacity.
• To avoid personal injury, keep hands away from blade areas while notching.
• The material thickness being notched should be within the rating of the hand notcher otherwise damage to the hand notcher and personal injury may occur.
• Mount hand notcher securely to a solid work bench prior to use and work bench must be secured to the floor.
• Maintain machine in proper operating condition keep clean of chips and debris.
• Always stop cutter before adjusting machine operation.
• Material should be positioned & clamped in vise. Set swivel vise at desired angle and tighten down. Position table left to right as required for best cut. Be sure to position material as close to spindle as possible.
• Use in & out feed to achieve proper depth of notch.
• Back cutter away from work as soon as cut is completed.
Notcher Safety Questions

1. The notcher operator must:
   a. wear approved eye protection
   b. wear gloves
   c. wear a leather apron

2. When cut is complete
   a. check to be sure the blade has cooled
   b. back cutter away from work.
   c. apply as much pressure as possible.

3. Select the most correct statement:
   a. Use in & out feed to achieve proper depth of notch.
   b. Avoid using in and out feed to achieve proper depth of notch.

4. If you are not sure how to perform an operation on the notcher, you should ______.
   a. ask the instructor for assistance
   b. ask another student for assistance
   c. read about it in the textbook

5. When should you make adjustments or take measurements when using the notcher?
   a. While the machine is running
   b. Whenever as long as the instructor is near
   c. When the machine is at a complete stop
Notcher

Name: ________________________________________________
Date: ________________________________________________

ACTUATING LEVER
GUIDE
TABLE
BLADES
GUIDE
Notcher

Name:______________________________ Class/Yr:_____________________
Date:_____________________________ Score:_____________________

ACTUATING LEVER

TABLE

GUIDE

BLADES

GUIDE
Planer/Surfacer Information Sheet

Name: ____________________________________________
Date: _____________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- Use only clean lumber (free from nails, screws, paint, and other imbedded materials) to avoid damaging the knives.
- Use a support stand to off-bear the lumber when planing. An off-bearer only supports and moves with the stock as it comes through the planer.
- Disconnect the electrical service in the circuit breaker before making any service adjustments to the planer or before changing blades.
- Never stand or walk directly behind the machine when it is in operation.
- Do not overload the planer by trying to cut more than the capacity of the machine. The depth of cut will depend upon the width of the lumber, rate of feed and the kind of lumber.
- The depth of cut should never be set at more than 1/16 inch.
- Feed lumber into the planer with the grain of the wood.
- When feeding material into the machine, stand to he side nearest the switch. Never stand behind a piece of lumber being planed, as kickbacks can cause serious injury.
- If the planer becomes overloaded during the cut stop the machine, wait until the cutter head completely stops, then lower the table to clear the work. Kickbacks may occur if the stock is removed from the planer before the cutter head stops.
- Never force material through the planer. If the lumber does not feed properly, stop the machine and have the instructor help you correct the feed problem.
- Feed only one board through the planer at a time. Kickbacks can occur while attempting to surface more than one board at a time.
- Pass lumber around the planer, not over it, when running lumber through the planer a second time.
- Never attempt to surface lumber that is shorter than the distance between the infeed and outfeed rollers.
- Never plane lumber less then ¼” thick unless a slave board is used.
- When finished planing turn the machine off and wait until all moving parts have stopped before leaving the work area.
- Bed rollers should be adjusted at maximum height when surfacing rough lumber and at minimum height after the lumber has been smoothed on both sides.
- The variable speed control should be set at maximum feet per minute when only a rough finish is desired.
and at low feet per minute when a fine finish is desired on the board.

- Use a backing board if you are planning stock that is thin.
- Stand to one side when operating the planer to avoid injury from kickback.
- When feeding wood into the planer, keep your fingers from getting caught between the table and your wood, otherwise your fingers may be badly bruised.
- Allow material to travel completely through the planer before making any additional depth cut adjustments.
- Do not remove chip accumulation while machine is running.
- When finished using the planer: turn off the power, wait for the machine to come to a full stop, and clean off the machine.
Planer/Surfacer Safety Questions

Name:______________________________  Class/Yr:_____________________
Date:_______________________________  Score:________________________

1. The wood should be feed through the planner with the _______________.
2. The maximum amount of cut recommended for a thickness planer is ________.
   a. 1/32 inch
   b. 1/16 inch
   c. 1/8 inch
   d. 1/4 inch
3. Before operating a planer, articles of clothing such as ties and coats, should be ________.
   a. removed
   b. kept away from the blades
   c. held out of the way by another student while you are planing
   d. worn with caution
4. Which item(s) should not be worn when operating the planer ________.
   a. lapel pins
   b. finger rings
   c. long earrings
   d. necklaces
   e. all of the above
5. Before starting the planer ________________.
   a. make sure that all guards are in place and securely fastened
   b. clear the area of scraps, sawdust, oil, or grease
   c. clear the machine and table area of chips, tools, or other matter
   d. all of the above
6. Never stand or walk directly behind the planer when in operation because ________.
   a. sawdust will get in your face
   b. a kickback may occur causing a serious injury
   c. knots may fly out and hit you
   d. it is difficult to get to the off-on switch quickly if the need arises
7. The purpose of the off-bearer when using the planer is to ____________.
   a. pull the stock through the planer
   b. support and pull the stock through the planer
   c. support and move with the stock as it comes through the planer
   d. remove sawdust, support and help pull stock through the planer
8. Which type of stock should never be run through the planer?
   a. painted stock
   b. green stock
   c. over dried stock
   d. extra long stock
9. When leaving the planer work area ________.
   a. turn the machine off
   b. turn the machine off and leave
   c. turn the machine off and clean up
   d. turn the machine off and wait until all moving parts stop before leaving the planer work area.
10. How many boards can be fed safely through the planer at one time?
a. 1
b. 2
c. 3
d. It depends on the size of the planer
Portable Grinder Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Keep the cord away from the disk grinding wheel and any other revolving accessory.
- Use special care when working corners, sharp edges, raged welds, etc. to prevent snagging.
- Check the cord for condition. Make sure there are no bare wires showing from the cord.
- Never stand on a wet surface when using a portable grinder.
- Be sure the switch is off before connecting to the power source.
- Make sure the grinder disk or wheel is tightened securely before operating and after mounting a new wheel, disk or brush, always allow it to run a few minutes to be certain it is properly mounted.
- Position the grinder so that sparks and grit thrown of during grinding will not hit the operator or others working in the area.
- Make sure the material being ground is well secured.
- Never grind with the portable disc grinder in an area that houses flammable materials or combustible gases.
- Replace the grinding disk when it becomes worn to half its original diameter.
- Wear long sleeve leather gloves when grinding with the portable disc grinder to protect hands and forearms.
- Hold the portable disk grinder with both hands when grinding.
- Never lay the portable disc grinder down until the disk as stopped rotating.
- Keep the electrical cord and extension cords out of the way of the work when grinding.
- When using the wire brush attachment on the portable disc grinder, hold the grinder extra firm to prevent it from being thrown about and cause an accident.
- Do not use a damaged wheel, make sure and replace it before use.
- Be sure to hold the portable disc grinder firmly when the off/on switch is turned on. The centrifugal force created by the rotating disk will cause the portable disc grinder to move or jump.
- For extended periods of grinding the operator may lock the off/on switch in the on position to avoid fatigue from holding the switch on manually.
- When laying the portable disc grinder down, always position it on the tool rest.
- When finished using the portable grinder: wait until it has come to a complete stop, then unplug and wrap the cord, return to its proper storage place.
Portable Grinder Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. What personal protective equipment should be worn when operating the portable disc grinder?
   a. Safety glasses
   b. Safety glasses and hearing protection
   c. Safety glasses, hearing protection and gloves
   d. Safety glasses, hearing protection, gloves and respirator.

2. When operating the portable disc grinder the grinding disk should be positioned so the sparks and grit are thrown _____________.
   a. away from the operator.
   b. away from the operator and others in the work area.
   c. up to avoid hitting others.
   d. down to avoid hitting others.

3. Grinding with the portable disc grinder should not occur in an area which___________.
   a. is enclosed.
   b. is freshly painted.
   c. has windows.
   d. houses flammables or combustible gases.

4. The grinding disc should be replaced when worn to _____________ of its original diameter.
   a. 1/4
   b. 1/2
   c. 5/8
   d. 3/4

5. Hands and arms should be protected by wearing ____________ when using the portable disc grinder.
   a. gloves
   b. long sleeved shirt
   c. long sleeved leather jacket
   d. long sleeved leather gloves.

6. What can the operator expect to happen when the wire brush attachment is used on the portable disc grinder?
   a. The grinder may jump or be thrown about.
   b. The grinder rocks back and forth.
   c. The grinder stays steady on the material being bushed.
   d. None of the above.

7. When the portable disc grinder is laid down it should be positioned _____________.
   a. with the disc down.
   b. on its left side.
   c. on its right side.
   d. on the tool rest with the grinding disc facing up.

8. Make sure the switch is in the ___________ position before connecting it to the power source.

9. After a new disc has been put on what should you do?
   a. start working again
   b. make sure it is tightened as much as possible
   c. run it for a minute to make sure its mounted correctly
   d. none of the above

10. What can the operator do to avoid hand and finger fatigue when using the portable disc grinder for extended periods of time?
    a. Eat lots of carbohydrates.
    b. Drink plenty of water.
c. Wear long sleeved gloves
d. Use the switch lock.
Portable Grinder

Name: ____________________________________________
Date: _____________________________________________

1. Tool Rest
2. Off/On Switch
3. Switch Lock
4. Electrical Cord
5. Cord Strain Reliever
6. Handle
7. Guard
8. Grinding Disk
9. Locking Nut
10. Spindle
Radial Arm Saw Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly. Keep the guard and anti-kickback devices in position.
- Avoid distraction.
- When setting up to work, check the saw blade for missing teeth and cracks. Make sure the blade is properly mounted. Keep the saw blade clean and sharp.
- Do not operate the saw without permission from the instructor.
- Be certain that hand tools and loose stock are removed from the saw table before using.
- Always turn the power off and wait until the blade stops rotating before removing wood scraps or leaving the radial arm saw.
- Disconnect the electrical service at the source before changing blades.
- Guards should be in place and used at all times.
- Devote your undivided attention to the work being performed. Do not talk to others or be engaged in "horseplay" while using the radial arm saw.
- Avoid awkward work positions, they could result in slips which may cause contact with the saw blade. Establish a comfortable position prior to sawing.
- Check the stock for nails, screws, and loose knots before sawing.
- Always pull the saw through the stock slowly to insure full control. This saw tends to pull itself into the work and it may have to be held back on thick stock.
- After the cut is complete, return the saw to the rear of the table before removing stock. The radial arm saw should have a safety return spring device that automatically returns the saw to the rear of the table.
- Be sure material is held firmly against the guide fence and table before starting a cut. Support long pieces of stock.
- Keep the blade and arbor flanges free from dirt and grease.
- Be sure all clamps and locking handles are properly tightened before operating the radial arm saw.
- Do not cut round stock on the radial arm saw. The saw will roll the wood into the blade, jamming the machine.
- Cut only one piece of stock at a time.
- Lock the saw yolk in position to prevent it from moving forward when the power is turned on.
- Allow the saw to reach full speed before starting a cut.
- Always stand with your face and body to one side of the saw blade.
Do not saw stock shorter than 12 inches
After the power is cut off, do not stop the blade by allowing it to cut into a board.
All stock must be firmly placed against the guide fence for all cutting operations; otherwise the material will be thrown back against the fence.
Allow the motor to come to maximum speed before making any cuts.
Always rip against the rotation, never in the saw direction.
All tools should be removed from the working surface before the machine is started.
Before turning on the motor, make sure all clamps and licking devices are tight and the depth of cut is correct.
Be sure the blade is not touching any wood when the power is turned on.
This saw pulls itself into the work, and on some hardwoods it is necessary to hold back on the handle to prevent the saw from choking.
Do not let the saw coast out and grab the edge of a board. This may damage the machine seriously.
Avoid working across the saw line with hands or arms.
Never leave the saw hanging at the end of the arm. Push it back against the post and fasten it back in its position ready for the next cut.
Do not make any adjustments to the saw while it is running.
Never attempt to clear away scraps close to the saw while it is running.
When finished using the radial arm saw: return the motor and yoke against the column, turn the power off, wait until the blade has come to a complete stop, and clean the area off.
Radial Arm Saw Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. When sawing with the radial arm saw, which of the following should not be done?
   a. Use the blade guard
   b. Wear protective eye covering
   c. Stand in line with the saw blade
   d. Secure a helper or use a support for long stock

2. Do not saw stock with a length less than ________.
   a. 8”
   b. 10”
   c. 12”
   d. 14”

3. The depth of cut is adjusted by turning the ________.
   a. elevating handwheel
   b. locating pin
   c. motor yoke
   d. saw yoke

4. After a cut has been made, the following should be completed before leaving the radial arm saw ________.
   a. return the saw to rear of table
   b. remove wood scraps
   c. wait until the blade stops rotating
   d. all of these are correct

5. Before making a cut with the radial arm saw you should ________.
   a. allow the saw to reach full speed
   b. hold the saw to prevent it from coming forward
   c. make sure all locking handles are secure
   d. all of the above

6. Which of the following should be completed before using the radial arm saw?
   a. Support long end of stock
   b. Adjust depth of cut
   c. Check stock for nails, knots
   d. All of the above

7. The radial arm saw should be held firmly to regulate the rate of cut, since the saw ________.
   a. vibrates
   b. feeds itself into the work
   c. cuts too deep
   d. none of the above

8. The radial arm saw should be operated only after ________.
   a. obtaining the instructor’s permission
   b. wearing approved eye protection
   c. removing jewelry
   d. all of the above

9. Establish a comfortable, stable position for sawing ________.
   a. by sawing a few scraps
   b. before starting to saw
   c. by moving around while sawing
   d. by the trial and error method

10. Always rip ________________ the rotation of the blade.
a. against
b. with
c. in the direction of
d. none of the above
Radial Arm Saw

Name:______________________________________________
Date:_______________________________________________
Radial Arm Saw

Name: ____________________________ Class/Yr: ________________________
Date: ____________________________ Score: ____________________________
Reciprocating/Bayonet Saw Information Sheet

Name: ________________________________________________

Date: _______________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- Make sure the blade is the correct type a for the material and that it is correctly mounted.
- Be sure the switch is off before connecting it to a power source.
- Keep the electrical cord out of the way of the cut being made.
- Hold the saw firmly with both hands when making cuts. This saw will vibrate a lot during operation and must be held tightly to keep the cut on line and to avoid being dropped during operation.
- Do not operate close to other workers since the saw vibrates a lot and because the blade on this saw is unguarded.
- Do not bind or pinch the blade when making cuts with the reciprocating saw. Binding the blade may cause the blade to break or possibly jerk the saw from the user's hands.
- Use a vise or clamps to securely hold material being cut.
- Keep cutting pressure constant; do not force the blade into the work.
- If the saw requires excessive pressure to cut, it is in need of a new blade. Change the blade before continuing to use the saw.
- Always keep the base tight against the material being cut.
- Do not set the saw down until it has stopped completely.
- Disconnect the saw from the power source before changing blades or making adjustments.
- Allow the saw to come to full speed before it contacts the work.
- Do not attempt to cut curves so sharp that the blade will be twisted.
- Be sure to place the saw on its side to avoid damage when not using it.
- When finished using the saw: allow the saw to come to a full stop, unplug it and wrap the cord, and return it to its designated storage area.
Reciprocating/Bayonet Saw Safety Questions

Name: ____________________________  Class/Yr: _______________________
Date: _____________________________  Score: __________________________

1. Always start the tool before blade contacts the ________________________.

2. When cutting with the reciprocating saw, why must the saw be held firmly?
   a. The shape of the saw makes it easy to slip out of the hands.
   b. The material being cut is not secured and causes the saw to vibrate a lot.
   c. Cutting positions are awkward and can easily cause the operator to drop the saw.
   d. The saw vibrates a lot, which can lead to the saw being dropped by the operator.

3. The reciprocating saw should not be operated close to other workers because
   ________________.
   a. it is noisy.
   b. it vibrates a lot and blade is unguarded.
   c. the saw runs at excessively high speed.
   d. all of these.

4. To reduce the risk of ________________ always unplug tool before attaching or remove
   accessories or making adjustments.

5. Allowing the tool to come to a complete stop before removing the _______________ from a
   partial cut or laying the tool down.

6. If the reciprocating saw requires a lot of pressure to get it to cut in should _____________.
   a. be held in a different position.
   b. have the blade changed.
   c. be adjusted to a higher cutting speed.
   d. have the cutting position changed.

7. Binding the blade on the reciprocating saw may cause ________________.
   a. the blade to break.
   b. the blade to bend.
   c. the saw motor to overheat and burn out.
   d. damage to the material being cut.

8. Keep pressure _____________ while cutting.
   a. heavy
   b. constant
   c. light
   d. irregular

9. Do not try to cut sharp curves because the blade will _________________.

10. When you are not using the saw set it:
    a. on the blade
    b. on the ground
    c. on its side
Reciprocating/Bayonet Saw

Name:______________________________________________
Date:_______________________________________________

Blade 1
Blade Set Screw 2
Brushes 3
Switch Lock 4
Off/On Switch 5
Handle 6
Cord Reliever 7
Rocker Shoe 9
Electrical Cord 8
Reciprocating/Bayonet Saw

Name: ____________________________  Class/Yr: ______________________
Date: ____________________________  Score: _______________________

[Diagram of a reciprocating saw with numbered parts]

1.  9.  
2.  7.  
3.  8.  
4.  
5.  
6.  
7.  
8.  
9.  

[Diagram legend and labels]
Router Information Sheet

Name: ____________________________________________
Date: ____________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- Be sure the switch is in the off position and the machine is set on its side before plugging it in.
- Have a firm grip on the router handle when you turn on the switch. Use both hands to hold the router while making cuts.
- Make sure the router bit is not in contact with the stock before turning the switch on.
- Be sure the stock is clamped securely to the work bench.
- Keep the electrical cord positioned away from stock being cut to prevent the cord from being cut by the router bit.
- Unplug the electric before making adjustments to the router or before inserting bits.
- Insert the bit at least ½ inch in the collet; then tighten the collet nut to hold the bit in place.
- Adjust the cutter depth on the router with the electrical cord unplugged.
- After the depth of cut adjustment is made experiment on a scrap piece of lumber to make sure it is correct. If further adjustment needs to be made, unplug the router!
- Feed the router from the left to right on the work. Feed the router in same direction as the grain of the wood.
- Feed the router with a uniform speed. Feeding too slowly will cause the bit to burn the wood while going too fast will result in rough cuts and excessive wear.
- To prevent splintering, cut the middle section first, then move the router in the same direction as the grain of the wood.
- After completing the cut, turn off the motor but do not lift the router from the work until the bit has stopped rotating.
- Hold the router with both hands, and use a steady, slow, even feed. Do no force the router into the work piece.
- When finished using the router: turn off the power, wait until it come to a complete stop, unplug it and remove the bit, place all items in proper storage place.
Router Safety Questions

Name: ____________________________  Class/Yr: __________________________
Date: ____________________________  Score: __________________________

1. The part used to hold bits in a portable router is the _________.
   a. collet
   b. jacobs chuck
   c. 4 jaw chuck
   d. pilot

2. When starting a cut with the router, the bit should ________.
   a. not be in contact with the stock
   b. be in place and ready to start cutting immediately
   c. slightly tilted to make starting easier
   d. elevated to make it easier to see

3. Feeding the router too fast will result in ________.
   a. fine cuts
   b. excessive wear
   c. splintering
   d. burning the stock

4. Cutting with the router is more efficient if the router is moved ________.
   a. left to right
   b. right to left
   c. clockwise
   d. counter clockwise

5. Which is not a safety precaution for the router ________.
   a. wear safety glasses
   b. hold the router with both hands
   c. use a bit with a pilot end
   d. disconnect electrical power before changing bits

6. When changing cutters, one should insert the shank of the bit ________ inch into the chuck.
   a. 1/8
   b. ¼
   c. ¾
   d. ½

7. After a cut is completed, one should ________.
   a. lift router from work
   b. disconnect router
   c. shut off the motor
   d. wait until bit stops rotating before doing anything

8. When cutting with a router the power cord should be located ________.
   a. in front of the router base.
   b. to the left of the stock.
   c. to the right of the stock.
   d. away from the line of work.

9. A major safety precaution to observe when changing router bits is ________.
   a. keep the bit clean and sharp
   b. keep the depth of cut adjusted to a minimum.
   c. unplug the router before changing the bit.
   d. loosen the micrometer adjustment so you can reach the bit.

10. The correct procedure for holding the router while making a cut is ________.
    a. to hold on the stock with pressure on the cutter bit side
b. to hold firmly with both hands

c. to hold the handle with one hand and guide the router with the other hand

d. to hold one hand on the handle and the other hand on the motor housing
Scroll Saw Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

• Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
• Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
• Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
• A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
• Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
• Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

• Make sure all guards are in place and operating correctly.
• Avoid distraction.
• Remove tie, ring, and other jewelry, and roll up sleeves.
• Make all adjustments with the power off.
• Make sure blade is properly tensioned before operating the saw.
• Make sure the teeth point downward toward the table.
• Never turn the saw on before clearing the table of all objects (tools, scraps of wood, etc.)
• Do not cut material that is too small to be safely supported.
• Avoid awkward hand positions where a sudden slip could cause a hand to move into the blade.
• Always keep hand and fingers away from the blade.
• Do not attempt to saw material that does not have a flat surface, unless a suitable support is used.
• Make relief cuts before making long curves.
• Always hold the work firmly against the table.
• Do not feed the material to fast while cutting. Only feed the material fast enough so that the blade will cut.
• When cutting a large work piece make sure the material is supported at table height.
• Use caution when cutting round material such as dowel rods or tubing. They have a tendency to roll while being cut causing the blade to bite.
• Never perform layout, assembly or set-up work on the table while the saw is operating.
• Stop the saw before removing scrap pieces from the table.
• Disconnect the machine from power source when making repairs.
• Shut off power and clean the scroll saw and work area before leaving.
Scroll Saw Safety Questions

1. Make sure the blade is properly ______________ before using.
2. Do not stand in an ______________ position when using the saw.
3. Feed the materials into the saw at a ______________ speed.
   a. fast
   b. moderate
   c. slow
   d. uneven
4. Make sure the teeth on the saw point ______________.
   a. upward
   b. downward
   c. to the side
   d. it does not matter
5. Make “_______________” cuts before cutting long curves.
6. What should you do when you want to remove scraps from the table?
   ______________________________________________________________________
7. Always hold the work ______________ against the table.
8. Be careful when cutting round materials because:
   a. they stay stationary
   b. they can roll around
   c. they can cause the blade to bite
   d. both b and c
Shaper Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- Always use the shaper insert.
- Wear a dust mask or connect a dust collection system to the dust chute. Keep the dust chute mounted to the shaper insert even if you do not have a dust collection system. The chute guards the cutter below the table. You can collect dust and chips in a trash receptacle positioned beneath the table.
- When mounting cutters and collars, make certain that the tongue washer is correctly installed and directly under the hex nut and that the nut is tight. Also that the arbor set-screw is tightened against the flat of the spindle.
- Be sure the cutter(s) is positioned with the cutting edge facing to the left.
- Listen for chatter or signs of looseness at start-up. If you hear, see or suspect problems, turn off the power and unplug the machine. Correct any problem with the help of the instructor before proceeding.
- Keep cutters clean, maintained and sharp.
1. The shaper operator must:
   a. wear a face shield
   b. wear gloves
   c. wear approved safety glasses or goggles

2. Be sure the cutting edge is facing
   a. the left
   b. the right
   c. the bottom

3. Select the most correct statement:
   a. Always use sharp cutters.
   b. Always use the shaper insert.
   c. Always use the dust chute
   d. All of the above are correct.

4. If you are not sure how to perform an operation on the shaper, you should ______. 
   a. ask the instructor for assistance
   b. ask another student for assistance
   c. read about it in the textbook

5. When should you make adjustments to the shaper?
   a. While the machine is running
   b. Whenever as long as the instructor is near
   c. When the machine is at a complete stop
Table Saw Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines
- Make sure all guards are in place and operating correctly; the top guard must be down over the blade at all times. Be sure it will move freely up and down when the work passes under.
- Avoid distraction.
- The saw blade must not extend more than 1/8” above the stock when stock is being cut.
- The splitter guard must be raised above the table to full height when ripping stock.
- Be sure that all fences and tilting devices are securely fastened before the power is turned on.
- The edge of the material that will run against the fence or miter gage must be square and true.
- All adjustments must be made when the saw is at a dead stop.
- Make certain the saw table and the floor around the saw is clear of all scraps, materials, and tools before power is turned on.
- All special set-ups and dado heads must be inspected by the instructor before power is turned on.
- Be sure the saw blade, when angled, will clear both sides of the insert before turning power on.
- Always clamp stops securely on the table when cut is shorter than the length of stock.
- Do not use a dull blade.
- Have saw running at full speed before starting to cut.
- Do not cut used stock, stock with loose knots, stock with warp, stock with wind, or stock with cracks or splits.
- No board less than 12 inches in length may be ripped on the saw.
- Cylindrical stock must not be cut on the circular saw.
- A clearance block must be securely fastened to the rip fence when using the fence as a stop for cross-cutting.
- A push stick must be used when ripping stock into pieces less than 4 inches in width.
- Maintain a 4 inch margin of safety around the blade at all times.
- Stand to one side of the saw blade when turning the power on.
- Do not stand directly in line with the saw blade when cutting stock.
- Do not overcrowd or bind the saw.
- No stock is to be ripped without the use of the ripping fences or cut off without the use of the sliding miter gage. Never cut stock freehand.
- Never pull material through the table saw.
- Do not place your hands in front of or over a moving blade.
- Never attempt to clear scraps close to the blades with your fingers. If they must be cleared away, permit the saw blade to come to a dead stop or use a push stick at least 10 inches long.
- When helping to “tail off” the saw, students must never pull on a board being ripped. They should hold the board up, and allow the operator to push the stock through.
- Stock must never be lowered over a blade unless a stop block has been securely fastened to the table of the saw.
- The dado head must be taken off the saw after use.
- Stop the saw when you are through using it, or are leaving it.
- Clean saw table and floor around saw after use.
Table Saw Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. Before the power is turned on, one should be certain that…
   a. The blade will turn freely
   b. The saw and floor are clear of scraps
   c. You are wearing your safety glasses
   d. All of these are correct

2. It is acceptable to cut…
   a. Stock with loose knots
   b. Stock that is exceptionally warped
   c. Stock with bad splits
   d. Stock with square and true edges

3. What should be done with articles of clothing such as ties, coats and long sleeves when operating the table saw?
   a. Keep them away from the saw blade
   b. Remove or fasten them out of the way
   c. Do not get close to the saw
   d. Have a student hold them out of the way

4. Which of the following items should NOT be worn when operating the table saw?
   a. Rings
   b. Gloves
   c. Bracelets
   d. All of these

5. When sawing with the table saw, which of the following would not be a safe practice?
   a. Use the blade guard
   b. Secure a helper to support the material being sawed
   c. Push the material through the saw with the right hand and a push stick
   d. Stand in line with the saw blade

6. After a cut has been completed, what should the operator do before leaving the table saw?
   a. Turn the electrical service off at the circuit breaker or fuse box
   b. Clear the work zone of all students
   c. Make sure the saw blade has stopped turning
   d. Lock the blade

7. When making a rip or crosscut, the saw blade should extend no more than ________ inches above the stock being cut.
   a. ¼
   b. 1/8
   c. 3/8
   d. ½

8. Which type of stock should never be ripped on the table saw?
   a. Square stock
   b. Thick stock
   c. Round stock
   d. Flat stock

9. A push stick must be used if material is less than _____ inches in width.
   a. 4
   b. 6
   c. 8
   d. 10
10. Do not use a ____________ blade.
   a. sharp
   b. pointed
   c. dull
   d. new
Table Saw

Name:______________________________________________
Date:_______________________________________________

1. Miter Gage
2. Fence
3. Guidebar
4. Fence Clamp
5. Switch
6. Clean-Out
7. Raising Handwheel
8. Lock Knobs
9. Tilt Handwheel
10. Tilt Scale
11. Table
12. Saw Guard
13. Table Throat Plate Insert
Wood Lathe Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Remove jewelry, eliminate loose clothing, and confine long hair.

Operation Safety Guidelines

- Make sure all guards are in place and operating correctly.
- Avoid distraction.
- If you are not familiar with the operation of wood lathes, obtain advice from your instructor.
- Make sure wiring codes and electrical connections are followed and that the machine is properly grounded.
- Tighten all locks before operating.
- Rotate work piece by hand to check clearance before engaging power.
- Make sure the tool rest is adjusted properly. 1/8” away from work and 1/8” above center line.
- Remove the tool rest before sanding or polishing.
- Rough out work piece before installing on face plate.
- Examine set-up carefully before turning on power.
- When turning between centers make sure the tailstock center is snug against the work piece and locked. Tailstock center should be lubricated if it is not a ball bearing center.
- Make sure screw fasteners do not interfere with the turning tool at the finished dimension of the work piece when faceplate turning.
- Examine workpiece for flaws and test glue joints before placing the workpiece in lathe.
- When roughing, do not jam tool into workpiece or take too big a cut.
- Make sure index pin is disengaged before starting the lathe.
- Use lowest speed when starting a new workpiece.
- Always operate machine at the prescribed speeds.
- DO not exceed recommended speeds when outboard turning.
- Disconnect lathe from power source when making repairs.
- Make all adjustments with the power off.
- Shut off the power and clean the lathe before you leave it.
Wood Lathe Safety Questions

1. List 3 things that you should not wear when using the wood lathe.
   a. ________________________________
   b. ________________________________
   c. ________________________________

2. If you are not familiar with operating the lathe ask ____________ for help.
   a. Another student
   b. The instructor
   c. nobody

3. The tool rest should be place ________ from the work edge and _________ above the center line.
   a. 1/16", 1/16"
   b. 1/16", 1/8"
   c. 1/8", 1/16"
   d. 1/8", 1/8"

4. Make sure the machine is properly ________________ and correctly connected to electricity.

5. Tighten all ____________ before operating the machine.

6. Use the ____________ speed when starting on a new work piece.
   a. Fastest
   b. Most powerful
   c. Slowest
   d. Middle

7. Rotate the work piece ________________ to check clearance.
   a. by hand
   b. using the machines power
   c. neither a or b
   d. both a and b

8. Do not jam the work piece into the tool or ________________.
   a. move too slowly
   b. take too big of a cut
   c. pay attention to how much is being cut
   d. all of the above
Wood Lathe

Name:______________________________________________
Date:_______________________________________________

[Diagram of Wood Lathe with labeled parts:]

- Headstock Spindle (10)
- Tool Support Base (11)
- Tool Support (12)
- Locking Handle for Tool Support Base (6)
- Variable Speed Control (7)
- Switch (8)
- RAM Lock (2)
- RAM (3)
- Tailstock (5)
- Bed (4)
- Tailstock Locking Clamp (1)
The following list contains an information sheet, sample safety questions, labeled picture, and unlabeled picture for each tool or piece of equipment listed below:

GMAW (Mig) Welder
Oxyacetylene Welder
Plasma Cutter
SMAW (Arc) Welder
Tig Welder

NOTE:

Even though sample safety tests and questions are provided in this manual, teachers should modify the material to make up their own safety tests on general safety rules for the various areas, individual power tools and equipment, and anything else that applies to their shop not covered by this manual to fit their program. It is absolutely necessary that the teacher demonstrate in detail how to operate each piece of equipment or tool.

*****Safety Rules and Sample Questions were compiled from the manuals mentioned in the acknowledgements as well as from Agricultural Instructors in the state of Colorado.
GMAW (Mig) Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines
• Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
• Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
• Use an approved helmet with minimum #10 shaded lens for non-ferrous and # 12 for ferrous metals.
• Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
• A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
• Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
• Wear leather gloves and coveralls for protection against burns.

Operation Safety Guidelines
• 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” prior to 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 your pockets as they 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 1/16” is sticking out of the tip. This should be done often so the electricity can connect from the metal wire to the piece of metal more easily.
• Before re-threading wire through the welding cable make sure you cut the wire with side cutters. The cutters provide a clean cut so the wire feeds through the cable cleanly.
• Tack the end of metal pieces together to hold them in place before making your 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 your instructor so they can put a new tip on.
• Cool the metal after each weld so that the metal does not get to hot, especially with thinner metal pieces.
• Change the wire speed when the machine is on. You may have to adjust the wire speed when you are welding to get a desired speed.
GMAW (Mig) Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. What are 4 items of personal protective equipment you should wear when GMAW welding?
   _____________________________________________________________________
   _____________________________________________________________________

2. The minimum shade that should be used when GMAW welding is:
   a. #8    c. #10
   b. #9    d. #11

3. When the welding machine is turned on can you touch the welding wire?
   a. Yes if you are very careful
   b. Yes if an instructor is nearby
   c. No you never should
   d. You can every once in a while

4. Never weld in a location that:
   a. Is poorly ventilated
   b. Is wet
   c. Has flammable materials nearby
   d. All of the above

5. Use _________________ to clean out the tip, do not pound it on a table.

6. What should you do to the wire and tip fairly often to keep them in good working order.
   a. Nothing
   b. Clip it with cutters
   c. Tap it on the table
   d. Clip it with cutters clear to the tip

7. If your wire melts to the tip what should you do?
   a. Leave it
   b. Have someone else try to fix it
   c. Tell your instructor
   d. Continue welding

8. How do you know how fast to move the tip along or what angle it should be held at when welding?
   _____________________________________________________________________

9. What should you do after each weld?
   a. Take a break    c. Make another weld
   b. Cool the metal    d. Clean the metal

10. When should you change the wire speed?
    a. When the machine is on
    b. When the machine is off
    c. It doesn’t matter
Oxyacetylene Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines
- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Use an approved helmet with minimum #10 shaded lens for non-ferrous and # 12 for ferrous metals.
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Always wear gloves and a #5 welding shield or goggles when welding or cutting.
- Keep clothes, hands, and gloves free from grease and oil.

Operation Safety Guidelines
- 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 unnecessary release of free acetylene into the air because it is very 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 torch on regulator valves.
- Do not attempt to use or repair a damaged regulator. Turn it in to your instructor 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 lighted 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 should always be tight. Check periodically with soapy water solution for leaks.
- Protect hoses from hot iron, sparks, and traffic. Replace all worn hoses.
- Always keep the welding or cutting tip pointed away from yourself and others to prevent saturating you clothes with gases before lighting.
- Know your gas welding system.
- Keep 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 1 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 OVER 15 LBS PER SQUARE INCH.**
- Let some oxygen escape from the blowpipe by opening and closing the oxygen blowpipe valve.
- Lighting the torch:
  - 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 you have a neutral flame burning at the tip.
- When you have 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 of both gauges, close the oxygen blowpipe valve.
  - Now you can coil the hoses, replace the equipment and tools, and clean the area.
- If you are not sure about something, **ASK THE INSTRUCTOR FOR HELP**
Oxyacetylene Safety Questions

1. The ___________ should always be turned off first when finished with your work.
   a. Regulators
   b. Lights
   c. Acetylene
   d. Oxygen

2. The oxygen valve (on the tank) should be turned on ________________.
   a. 1 turn
   b. 1/2 turn
   c. All the way
   d. After the acetylene

3. The acetylene hose is _________ and the oxygen hose is _________.
   a. Red, green
   b. Green, red
   c. Orange, white
   d. White, orange

4. Acetylene fittings are ______________ while oxygen fittings are ____________.
   a. Right handed, left handed
   b. Left handed, right handed
   c. Brass, steel
   d. Steel, brass

5. Oxygen or fuel gas from a cylinder may be used only through ____________.
   a. any reducing regulator
   b. an approved gas specific pressure reducing regulator
   c. a ¼ inch copper coil
   d. a manifold unit

6. Which lubricant should be used when connecting the parts of an oxy fuel gas welder?
   a. Oil
   b. Soapy water
   c. Thread lubricants
   d. None of these

7. Gas welding equipment should be systematically checked for leaks using _________.
   a. soap and water
   b. saltwater solution
   c. antifreeze and water solution
   d. non detergent soap and water solution

8. The acetylene cylinder valve wrench should be left in position to ____________.
   a. close the valve promptly if the need arises
   b. prevent it from being lost
   c. prevent leakage
   d. make closing the cylinder valve easier

9. Acetylene cylinders should be stored ____________.
   a. apart from oxygen cylinders
   b. in an upright position
   c. away from combustibles
   d. all of these

10. Full oxygen cylinders should be stored _________.
    a. in a dry place
b. in a cool place
c. separate from the fuel gas cylinders
d. with the empty oxygen cylinders

11. When storing or moving cylinders ___________.
   a. keep empty and full cylinders separate
   b. keep protective caps in place
   c. keep 20 feet from all other combustibles
   d. all of these

12. The proper eye protective equipment for gas welding is ___________.
   a. polarized sun glasses
   b. approved goggles with no. 5 shaded lens
   c. tinted face shields
   d. tinted goggles

13. Proper protective clothing for gas welding includes ___________.
   a. gauntlet gloves
   b. flame resistant clothing
   c. high top leather shoes
   d. all of these

14. Which of the following should be used for lighting a torch ___________.
   a. matches
   b. flammable lighter
   c. striker
   d. any of these are acceptable

15. The maximum line regulator pressure for acetylene is ___________.
   a. 10 p.s.i.       c. 20 p.s.i.
   b. 15 p.s.i.       d. 30 p.s.i.

16. When gas welding one should have ___________.
   a. adequate ventilation of welding fumes
   b. careful handling of lighted torch
   c. careful handling of hot metal
   d. all of these
Oxyacetylene

Name:______________________________________________
Date:_______________________________________________
Oxyacetylene

Name:______________________________  Class/Yr:_____________________
Date:_______________________________  Score:________________________
Plasma Cutter Information Sheet

Name: ________________________________________________
Date: _________________________________________________

Personal Protective Equipment Guidelines

- Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
- Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
- Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
- A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
- Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
- Wear protective clothing when using the plasma arc cutter. Clothing should be wool or cotton with long sleeves and gauntlet gloves and leather apron.
- Never wear synthetic clothing when using the plasma arc cutter, many synthetics are highly flammable.
- Always wear industrial quality eye protection a #5 shaded lens is the minimum for the plasma arc cutter process. The shaded lens needed to adequately protect the eyes varies by the thickness of the metal being cut and the intensity of the arc required to make the cut. Follow the manufacturer’s recommendation for selecting an appropriate shaded lens for given plasma arc cut

Operation Safety Guidelines

- Make sure that work area is well ventilated when using the plasma arc cutter. The plasma arc cutter process generates lots of fumes and therefore must be well ventilated.
- The operator should 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 plasma arc cutter in areas where combustible or explosive gases or materials are located.
- Chlorinated solvents and cleaner vapors in the presence of plasma arc cutter generates a toxic phosgene gas. Avoid plasma arc cutting use in areas which house chlorinated solvents and cleaners.
- Never touch any parts on the plasma arc cutter that are electrically connected. The plasma arc cutter 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 plasma arc cutter.
- Do not use the plasma arc cutter 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 plasma arc cutter arc rays and fumes.
- Use pliers or tongs to handle hot metals cut by the plasma arc cutter. Cool and store hot metal before leaving the work area.
- To activate the plasma arc cutter make sure the air pressure is sufficiently around 70 p.s.i. for most plasma arc cutter units and the ground clamp is attached to the work piece.
- Turn the plasma arc cutter on and adjust the amperage 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 and vice versa. 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 good straight cuts.
- The shielding cup and constricting nozzle should be held approximately 1/8" to 1/4" above the metal being cut. The operator should 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 plasma arc cutter in damp or wet locations. The hazards of electrical stock 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 duration's.
- Cuts with the plasma arc cutter may be made by moving forward, backward, or sideways. Determine which direction is easiest for you and use that procedure as often as possible.
- Always move the plasma arc cutter (PAC) as fast as possible when making a cut. This increases time efficiency, improves the cut quality, and reduces the build up of dross.
- Compressed air used in plasma arc cutter should be dry or the cutter will not yield a quality cut or it not cut at all. An auxiliary air filter may be place in the compressed air line to condition the air for a plasma arc cutter.
- Always turn the plasma arc cutter 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 plasma arc cutter will have a life of about twice the life of the constriction nozzle. Keep a supply of constricting nozzles and electrodes on hand as they deteriorate quickly during continuous use. Turn the plasma arc cutter off to put on replacement parts.
- Keep the plasma arc cutter torch leads and ground lead stored so they will not be cut or damaged when not in use.
Plasma Cutter Safety Questions

Name: ____________________________  Class/Yr: _______________________
Date: _____________________________  Score: __________________________

1. Why should synthetic clothes never be worn when operating the plasma arc cutter?
   a. They are too expensive.
   b. They create an electrical shock hazard.
   c. They are highly flammable.
   d. They are energy absorbing which creates a health hazard.

2. The minimum shaded lens that should be used for plasma arc cutting is ____.
   a. 3
   b. 5
   c. 8
   d. 10

3. The fume plume for plasma arc cutting is ________________.
   a. minimal.
   b. about like oxy-fuel gas welding.
   c. large and needs to be ventilated well.
   d. light and dissipates quickly.

4. Avoid using the plasma arc cutter in ________________.
   a. outside locations.
   b. interior locations.
   c. shops with concrete floors.
   d. area where combustible gases are stored.

5. What combustible gas is generated when aluminum is cut with the plasma arc cutter in the presence of water or moisture?
   a. Propane
   b. Methane
   c. Acetylene
   d. Hydrogen

6. What personal protective equipment should be worn when operating a plasma arc cutter?
   a. Shaded lens
   b. Shaded lens, and hearing protection.
   c. Shaded lens, hearing protection, and gloves.
   d. Shaded lens, hearing protection, gloves, and leather apron.

7. Electrical shock is more of possibility in the plasma arc cutting process than with arc welding process because of ________________.
   a. the type of equipment used.
   b. the high voltage and amperage used.
   c. the high arc temperatures.
   d. the plasma gases used in the cutting process.

8. What approximate air pressure must be present to activate most plasma arc cutters?
   a. 40 p.s.i.
   b. 50 p.s.i.
   c. 60 p.s.i.
   d. 70 p.s.i.

9. What happen to the travel speed of the plasma arc cutting machine when the metal being cut is thick?
   a. It must be slowed down.
   b. It must be speeded up.
   c. Travel speed does not change.
   d. Travel speed is a function of the operator's ability.

10. The constricting nozzle should be held about ____________ above the metal being cut when using the
plasma arc cutter.
  a. 1 inch
  b. 3/4 inch
  c. 1/2 inch
  d. 1/4 inch

11. Avoid cutting with the plasma arc cutter in ________________ locations.
   a. extremely dry
   b. damp or wet
   c. extremely hot
   d. cold

12. Cuts with the plasma arc cutter should be made with the torch moving ________________.
    a. forward.
    b. backward.
    c. side ways.
    d. any of these.
Plasma Cutter

Name:______________________________________________
Date:_______________________________________________

Control Panel
1. Access Panel
2. Torch Leads
3.

Regulator/Filter
4.

Torch Head Assembly
5. Filter Assembly (2-Stage)
6.

Electrode
7.

Gas Distributor
8.

Constricting Nozzle (Tip)
9.

Shielding Cup
10.

Ground Clamp
11.
Plasma Cutter

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________
SMAW (Arc) Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

• Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
• Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
• Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
• A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
• Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
• Wool or cotton clothing, high top leather shoes, gauntlet gloves, welding apron or leathers, and leggings are recommended. DO NOT wear clothing made of synthetic fibers when welding. Some synthetic fibers are highly flammable.
• A number 10 filter lens is minimum for most arc welding processes.

Operation Safety Guidelines

• 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. (Ex. propane, gasoline, grease, and coal dust).
• Do not carry matches, butane or propane lighters or other flammables in your 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.
• Guard against the use of damp or wet clothing when welding. The use of such clothing increases the possibility of electrical shock.
• Never breath 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 laboratory.
• 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 should 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 steam from burning you.
• Never weld with the cables coiled over the shoulders.
• Disconnect the power to a welding machine before making any repairs.
• Treat all cuts or burns promptly. Report accidents to the instructor immediately; treat any cuts or burns promptly.
• Cool and store any hot metal before leaving the work area.
• Do not use cables with frayed, cracked or 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 should be installed according to provision of the National Electric Code and the manufacturers recommendations.
• A power disconnect switch should be conveniently located near each welding machine.
• Turn the welder off and store cables before leaving the welding area.
• The operator should 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 damp areas; keep hands and clothing dry at all times. Dampness on the body increases the chance of electrical shock when welding.
• 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.
SMAW (Arc) Safety Questions

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________

1. For proper eye protection when arc welding the minimum shade number of the filter lens should be ________.
   a. 4
   b. 6
   c. 10
   d. 12

2. The welding area should be kept free of ________.
   a. grease, fuels and solvents
   b. ultraviolet rays
   c. infrared rays
   d. electrodes

3. Arc welding produces harmful ________.
   a. noise
   b. light rays
   c. heat
   d. gas

4. When arc welding do not use cables that are ________.
   a. welded
   b. soldered
   c. cracked, cut or frayed
   d. spliced

5. Careful handling of compressed gas cylinders includes ________.
   a. keeping caps in place
   b. fastening in an upright position
   c. labeling when empty
   d. all of these
   e. only a and b

6. Gloves used for arc welding should be ________.
   a. leather gloves
   b. cotton gloves
   c. synthetic material gloves
   d. cloth gloves

7. When welding, the operator should not carry ________.
   a. paper in his/her pockets
   b. cigarette lighters
   c. rags
   d. tools
   e. all of the above

8. When welding the operator should never lay or stand ________.
   a. on concrete floors
   b. on damp ground
   c. on metal
   d. on wood structures

9. When starting to arc weld, the operator should ________.
   a. turn on the exhaust fan
   b. clean area of scraps and tools
   c. shield others from arc rays
10. Welding cables should be protected from _________.
   a. sparks and flames
   b. excessive voltage
   c. excessive amperage
   d. all of these

11. The amperage setting should be made while the welding machine is _________.
   a. running a bead
   b. not under load
   c. warmed up
   d. turned off

12. Hot metal should be handled with _________.
   a. gloves
   b. aprons
   c. tongs or pliers
   d. rags

13. Any cuts or burns should be _________.
   a. treated at the end of class
   b. treated promptly by an authorized person
   c. coated with salve
   d. packed in ice

14. When working in an area with other people, what should be done before an arc is struck?
   a. Check the electrode holder
   b. Tell others you plan to strike an arc
   c. Check the cables for cuts and burned insulation
   d. All of these

15. If the electrode holder is placed on a grounded welding table with the welding machine on, what will happen?
   a. Nothing
   b. The welding machine will automatically shut off
   c. A deadly electrical circuit is established
   d. An arc will be struck
TIG Information Sheet

Name:______________________________________________
Date:_______________________________________________

Personal Protective Equipment Guidelines

• Eye protection (safety glasses) must be worn at all times in the laboratory. Eye protection must meet a minimum standard of ANSI Z87.1. Eye protection should provide both front and side protection.
• Face shields, welding helmets, and hand-held shields must be worn over primary eye protection (safety glasses).
• Hearing protection should be worn when the noise level exceeds 85 decibels (for example a portable circular saw operates at 105 decibels).
• A shop coat or coveralls are recommended to be worn at all times in the shop. No loose fitting clothing, frayed edges or rolled edges of garments, which could be caught in machinery or catch sparks should be worn. Take care to make sure that no flannel or oily garments are worn in the laboratory.
• Complete coverage of the foot and non-flammable footwear (no nylon) are required in the laboratory settings.
• Use a #10 or higher lens when welding with a TIG welder

Operation Safety Guidelines

• Check all welding cables to be sure they are in good repair and properly connected. Be sure the equipment is properly grounded.
• Make sure 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. Don’t touch the tungsten rod with bare hand when the welder is on.
• Make sure gas is on during operations and TURN OFF after welding job is complete.
• Unprotected skin is quickly sunburn by the arc rays.
• Do not touch live electrode or electrical parts.
• Repair or replace worn, damaged, or cracked torch or cable insulation.
• Turn off welding power source before changing tungsten electrode or torch parts.
• Keep all covers and handle securely in place.
• Allow torch to cool before touching.
• Do not touch hot metal.
• Protect hot metal from contact by others.
• To reduce risk of electric shock, follow these procedures:
  • Keep cables close together by twisting or taping them, or using a cable cover.
  • Do not place your body between welding cables. Arrange cables to one side and away from the operator.
  • Do not coil or drape cables around your body.
  • Keep head and trunk as far away from the equipment in the welding circuit as possible.
  • Connect work clamp to workpiece as close to the weld as possible.
  • Do not work next to, sit or lean on the welding power source.
  • Do not weld whilst carrying the welding power source or wire feeder.
TIG Safety Questions

Name:______________________________  Class/Yr:_____________________
Date:______________________________  Score:________________________

1. What is the minimum lens shade that should be used when Tig welding?
   a. #5
   b. #8
   c. #10
   d. #12

2. Make sure the equipment is properly _______________ and in _______________ _______________.

3. List at least 5 things you must do to protect yourself from burns and electric shock:
   a. ___________________________________________________________________________
   b. ___________________________________________________________________________
   c. ___________________________________________________________________________
   d. ___________________________________________________________________________
   e. ___________________________________________________________________________
TIG

Name:______________________________ Class/Yr:_____________________
Date:_______________________________ Score:________________________
Checklists

Tool & Equipment List
Missouri Checklist
This is a list of possible tools/equipment that would be found in a shop, based on 15-20 students. The tool/equipment in your shop should be determined by your course content.

<table>
<thead>
<tr>
<th>Description</th>
<th>Recommendations</th>
<th>Actual</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Acreage wheel</td>
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<tr>
<td>Air Compressor, 5 horsepower</td>
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<tr>
<td>Air Wrench, 1/2 drive</td>
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<td>Anvil-150lbs</td>
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<td>Arc Welding Table with 5 stations or 5 booths with screens</td>
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<td>Band Saw</td>
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<td>Battery Charger, 6-12-24 volt</td>
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<td>Bench grinders-1 equipped with wire wheel</td>
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<td>2</td>
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<td></td>
</tr>
<tr>
<td>Drill, 3/8&quot;</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>★Engine Stands</td>
<td>5</td>
<td></td>
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</tr>
<tr>
<td>★Engine, Briggs and Stratton</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>★Flywheel Puller</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>★Flywheel Wrench</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Grinder, Portable 4&quot;</td>
<td>4</td>
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</tr>
<tr>
<td>Grinder, Portable 7&quot;</td>
<td>2</td>
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</tr>
<tr>
<td>Hammers, Ball Peen, 16-24 ounce</td>
<td>3</td>
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</tr>
<tr>
<td>Hammers, Blacksmith's, 2#</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Recommendations</td>
<td>Actual</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------------------------------------------------------------</td>
<td>-----------------</td>
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</tr>
<tr>
<td>Hammers, Claw, 16 ounce</td>
<td>5</td>
<td></td>
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<tr>
<td>Hammers, Framing, 24 ounce</td>
<td>5</td>
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<tr>
<td>Hammers, Sledge, 10#</td>
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<tr>
<td>Hammers, Sledge, 3#</td>
<td>1</td>
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<tr>
<td>Hoist or cherry picker, 1 ton</td>
<td>1</td>
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<tr>
<td>Hydraulic Press</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jigsaw</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jointer</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level, 24'</td>
<td>2</td>
<td></td>
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</tr>
<tr>
<td>Level, 48&quot;</td>
<td>2</td>
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</tr>
<tr>
<td>Level, Torpedo</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lockers</td>
<td>60</td>
<td></td>
<td></td>
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<tr>
<td>Metal cut off saw, stationary, 14&quot;</td>
<td>1</td>
<td></td>
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<tr>
<td>★Metal Lathe</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal Shear</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Micrometer, 0-1&quot;</td>
<td>2</td>
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<tr>
<td>Micrometer, 1-2&quot;</td>
<td>2</td>
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<tr>
<td>Micrometer, 2-3&quot;</td>
<td>2</td>
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<tr>
<td>Micrometer, 3-4&quot;</td>
<td>2</td>
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<tr>
<td>★Milling Machine</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Miter Saw, 10&quot;</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>★Notcher</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Oxyacetylene Welding Table with 5 stations</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxyacetylene Welding Units equipped with #1, 3, 5, and 9 cutting tips</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paint Gun</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parts Washer</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe Wrench, 10&quot;</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe Wrench, 14&quot;</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planer/Surfacer</td>
<td>1</td>
<td></td>
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<tr>
<td>Planes, Block</td>
<td>4</td>
<td></td>
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<tr>
<td>Planes, Jack</td>
<td>4</td>
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<td>Planes, Jointer</td>
<td>1</td>
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<tr>
<td>Plasma Cutter, 230 volt</td>
<td>1</td>
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<tr>
<td>Ratchets, 3/8&quot; drive</td>
<td>2</td>
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<tr>
<td>Radial Arm Saw</td>
<td>1</td>
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<tr>
<td>Power Cords 25' 12 gauge hd grounded plug</td>
<td>4</td>
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<tr>
<td>Ratchets, 1/2&quot; drive</td>
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<tr>
<td>Reciprocating/Bayonet Saw</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>★Ring Compressors</td>
<td>2</td>
<td></td>
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<tr>
<td>★Ring Groove Cleaners</td>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>Router</td>
<td>2</td>
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<tr>
<td>Sander, Combination Belt/Disk</td>
<td>1</td>
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<tr>
<td>Sander, Orbital, 4-6&quot;</td>
<td>1</td>
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<tr>
<td>Sander, Palm, 4&quot;</td>
<td>4</td>
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</tr>
<tr>
<td>Description</td>
<td>Recommendations</td>
<td>Actual</td>
<td>Comments</td>
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<tr>
<td>--------------------------------------------</td>
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</tr>
<tr>
<td>Sander, portable belt</td>
<td>2</td>
<td></td>
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<tr>
<td>Saw, Backsaw</td>
<td>2</td>
<td></td>
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<tr>
<td>Saw, Coping</td>
<td>1</td>
<td></td>
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<tr>
<td>Saw, Crosscut</td>
<td>5</td>
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<tr>
<td>Saw, Hacksaw</td>
<td>1</td>
<td></td>
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<tr>
<td>Saw, Keyhole</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Saw, rip saw</td>
<td>2</td>
<td></td>
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</tr>
<tr>
<td>Screwdriver Set, Flat</td>
<td>2</td>
<td></td>
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<tr>
<td>Screwdriver Set, Phillips</td>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>Scroll Saw</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>★Shaper</td>
<td>1</td>
<td></td>
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<tr>
<td>Shop Vacuum</td>
<td>1</td>
<td></td>
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<tr>
<td>Socket Set, 1/2&quot; drive, 3/8&quot;-1 1/4&quot;</td>
<td>2</td>
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<tr>
<td>Socket Set, 3/8&quot; drive, 1/4&quot; through 1 1/4&quot;</td>
<td>2</td>
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<tr>
<td>Socket Set, Metric</td>
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</tr>
<tr>
<td>★Spark Tester</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Squares, Combination</td>
<td>5</td>
<td></td>
<td></td>
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<tr>
<td>Squares, Framing</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squares, Try</td>
<td>5</td>
<td></td>
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<tr>
<td>Steam Cleaner/Pressure Washer</td>
<td>1</td>
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<tr>
<td>Table Saw, 10&quot;, minimum of 2 horsepower</td>
<td>1</td>
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<tr>
<td>★Tig Welder</td>
<td>1</td>
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</tr>
<tr>
<td>Torque Wrench, Ft lb</td>
<td>1</td>
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</tr>
<tr>
<td>Torque Wrench, In lb</td>
<td>1</td>
<td></td>
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<tr>
<td>Transit</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>★Valve Grinders</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>★Valve Spring Compressor</td>
<td>2</td>
<td></td>
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</tr>
<tr>
<td>Vise Grips</td>
<td>5</td>
<td></td>
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<tr>
<td>Vise-Steel Bench</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vise-Woodworking</td>
<td>8</td>
<td></td>
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<tr>
<td>Welder-SMAW (Arc), AC/DC, 250 Amp</td>
<td>5</td>
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<tr>
<td>Welder-GMAW (Mig), 250amps</td>
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<tr>
<td>Wood Lathe</td>
<td>1</td>
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</tr>
<tr>
<td>Wrenches, Adjustable End (Crescent), 8, 12, 14</td>
<td>2 each</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wrenches, Metric, Combination End</td>
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<td></td>
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<tr>
<td>Wrenches, SAE, Combination End</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Wrenches, SAE, Open End</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

***Adapted from Ag Mechanics Equipment List-June 1999
★ For more advance specialized facilities/programs
## Sample Shop Safety Checklist

<table>
<thead>
<tr>
<th>Name of School _________________________________</th>
<th>Date of Check ________________________________</th>
<th>State Supervisor ________________________________</th>
</tr>
</thead>
</table>

### Agricultural Laboratory

<table>
<thead>
<tr>
<th>1. Walking – Work Surfaces</th>
<th>Met</th>
<th>Not Met</th>
<th>Needs Improvement</th>
<th>N/A</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Laboratory appearance neat and orderly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2. Aisles, passageways, and corridors free of obstructions and properly indicated.</td>
<td></td>
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<tr>
<td>3. Floors free of obstructions.</td>
<td></td>
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<tr>
<td>4. Floors maintained in a clean and dry condition.</td>
<td></td>
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</tr>
<tr>
<td>5. An absorbent material available for grease and oil spills on floors.</td>
<td></td>
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</tr>
<tr>
<td>6. Non-skid surfaces provided at stationary tools on smooth floors.</td>
<td></td>
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<tr>
<td>7. Safety lanes provided around stationary tools.</td>
<td></td>
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<tr>
<td>8. Walls and storage areas clear of objects that might fall.</td>
<td></td>
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<tr>
<td>9. Stored wood and metal stacked safely and solidly.</td>
<td></td>
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<tr>
<td>10. Scrap wood and metal stored neatly in proper bins.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>11. Fixed stairs provided to overhead storage room(s).</td>
<td></td>
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</tr>
<tr>
<td>12. Stairways having more than 4 risers have a standard hand railing 30 in. – 34 in. high.</td>
<td></td>
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</tr>
<tr>
<td>13. Every opening. Floor, or platform 4 ft. or more above ground level has a standard guard rail 42 in. high with an intermediate rail and toe board of at least 4 in. above the floor. Rail must withstand 200# thrust.</td>
<td></td>
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</tr>
<tr>
<td>14. Fixed ladders meet design specifications. Rung to back clearance 7 in. maximum rung spacing – 12 in. caged if more than 20 ft. to a maximum of 30 ft.</td>
<td></td>
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<tr>
<td>15. Portable ladders in good repair.</td>
<td></td>
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</tr>
<tr>
<td><strong>Agricultural Laboratory</strong></td>
<td>Met</td>
<td>Not Met</td>
<td>Needs Improvement</td>
<td>N/A</td>
<td>Comments</td>
</tr>
<tr>
<td>-----------------------------</td>
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</tr>
<tr>
<td>16. Portable ladders not exposed to elements, heat or dampness.</td>
<td></td>
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</tr>
<tr>
<td>17. Portable ladders hung or stored horizontally.</td>
<td></td>
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</tr>
<tr>
<td>18. All portable ladders have safety feet. 1910.25(d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>19. All gears, moving belts, chains, and shafts, etc., are protected by permanent guards.</td>
<td></td>
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<tr>
<td>20. All ventilating fans are properly shielded.</td>
<td></td>
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<tr>
<td>21. Safety hooks are used on all chains and lifting devices. 1910.179(h)</td>
<td></td>
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</tr>
<tr>
<td>22. Rated load plainly marked on the side of lifting equipment. 1910.179(b)(5)</td>
<td></td>
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</tr>
<tr>
<td>23. Fans and flywheels within 7 ft. of the floor are guarded with a guard having holes not greater than ½ in. in width. 1910.213(h)</td>
<td></td>
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<tr>
<td>24. Washing facilities are provided and properly maintained</td>
<td></td>
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</tr>
</tbody>
</table>

**II. Means of Egress**

1. Laboratory has at least two exits. 1910.36(3)

2. Exit signs visible and directional exit signs provided if necessary. 1910.36(3)

3. Exit signs have letters 6 in. high. ¾ in. strip. 1910.37(Q)(6)

4. Exit signs have 5-candle illumination. 1910.37 (Q)(6)

5. Non-exit doors clearly identified “NOT AN EXIT” or otherwise labeled for use. 1910.37(Q)(2)

6. Exit doors and access to exits not locked from exit side. 1910.37(f)(3)

7. Emergency lighting for exits provided and operational.

**III. Fire Protection**

1. Fire alarm provided. 1910.36(3)

2. Fire Extinguisher locations properly marked. 1910.157(c)(1)

<table>
<thead>
<tr>
<th>Agricultural Laboratory</th>
<th>Met</th>
<th>Not Met</th>
<th>Needs Improvement</th>
<th>N/A</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Fire extinguishers of proper type.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Class A – wood, paper, cloth and rubber. Recommended Extinguisher type – foam and dry chemical</td>
<td></td>
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<tr>
<td>Class B – flammable liquid, gas, and grease. Recommended Extinguisher type – dry chemical CO2 and foam.</td>
<td></td>
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<tr>
<td>Class C – energized electrical. Recommended Extinguisher type – dry chemical and CO2.</td>
<td></td>
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<tr>
<td>Class D – combustible metals <strong>1910.57</strong>. Recommended Extinguisher type – specific for the chemical.</td>
<td></td>
<td></td>
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<tr>
<td>5. Fire extinguishers tested yearly. <strong>1910.157(e)(3)</strong></td>
<td></td>
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<tr>
<td>6. Maximum height of fire extinguishers from floor to extinguisher top is 5 ft., if over 40#, 3 ½ ft. <strong>1910.157(3)</strong></td>
<td></td>
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<tr>
<td>7. Wool fire blanket(s) readily available. <strong>1910.44</strong></td>
<td></td>
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<tr>
<td>8. Safety cans used for flammable or combustible liquids. <strong>1910.106(e)(z)</strong></td>
<td></td>
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<tr>
<td>11. A non-flammable cleaning solvent is used to clean engines. Cleaning solvent has flash point of not less than 1000F. <strong>1910.107(g)(5)</strong></td>
<td></td>
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<tr>
<td>12. Cleaning solvent vats and containers are covered and placed in a safe location.</td>
<td></td>
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<tr>
<td>13. A fire procedure is provided.</td>
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<tr>
<td>14. Spray painting is done using a charcoal mask or air pump; materials are disposed of properly.</td>
<td></td>
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<tr>
<td>15. Paint spray booth has adequate ventilation. <strong>1910.107</strong></td>
<td></td>
<td></td>
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<tr>
<td>16. Paint spray booth has proper (explosion proof) lighting.</td>
<td></td>
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<tr>
<td>17. Explosion proof wiring within 20 feet of spray paint booth. <strong>1910.107</strong></td>
<td></td>
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<tr>
<td>18. No open flames within 20 feet of opening of spray paint booth. <strong>1910.107</strong></td>
<td></td>
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<tr>
<td>19. Spray paint area not littered with combustible materials. <strong>1910.107</strong></td>
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</tbody>
</table>
### IV. Medical and First Aid

1. Emergency telephone numbers placed in the laboratory.

2. Evacuation procedures posted in the laboratory.  
   [1910.38](#).

3. Teacher reviews procedures with students.  [1910.38(e)](#) (iii).

4. Certified/trained person(s) available to render first aid.  
   [1910.151](#).

5. First aid supplies approved by consulting physician.  
   [1910.151(b)](#).

6. First aid supplies readily available.

### V. Personal Protective Equipment

1. Safety test(s) administered to each student before access to the laboratory is granted and a copy of the test is retained on file.

2. Rings and other jewelry are removed when working in the shop.

3. All clothing worn is free from loose sleeves, flopping ties, loose coats, etc.

4. Long hair is controlled by use of hair net or cap.

5. Industrial quality eye protection required to be worn.  
   [1910.132(a)](#).

6. Industrial quality eye protection provided and stored.  
   [1910.133(a)](#) (1).

   [1910.151](#).

8. Respirators provided for areas contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors.  
   [1910.134(a)](#).

9. Face shields provided for each stationary and hand held power tool.  
   [1910.133](#).

10. Bump hats or hard hats provided in areas where impact or falling object hazards exist.  
    [1910.135](#).

11. Leather gloves required for hot metal and rough work.

12. Safety signs are displayed throughout the shop.

13. Battery charging area will provide a functional eye wash station and facilities for flushing and neutralizing electrolyte.  
    [1910.178] [1910.151(c)](#).
## VI. Tools

<table>
<thead>
<tr>
<th>Agricultural Laboratory</th>
<th>Met</th>
<th>Not Met</th>
<th>Improvement</th>
<th>N/A</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Informational safety rules posted near each stationary power tool.</td>
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<tr>
<td>2. Stationary power tools anchored to the floor. [1910.212 (b)]</td>
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<tr>
<td>3. Each power driven tool provided with a positive “Lockout system” to render the machine inoperable. [1910.213 (a)(10)].</td>
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<tr>
<td>4. Electrical control switches on stationary power tools within easy reach of operator. [1910.213 (b)].</td>
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<tr>
<td>5. Stationary power tools equipped with magnetic starters. [1910.213 (b) (3)].</td>
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<tr>
<td>6. Stationary power and non-powered tools color coded. Yellow= adjusting, Orange = cut, crush, shock. [1910.144].</td>
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<tr>
<td>7. Stationary tools arranged so that individuals are protected from hazards of other machines.</td>
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<tr>
<td>8. Table saw equipped with a hood, guard, non-kickback fingers or dogs, and spreader. [1910.213 (d) (e) (2)].</td>
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<tr>
<td>9. Radial arm saw equipped with hood, guard, non-kickback fingers or dogs, rotation sign, automatic return, and table extension or stop. [1910.213 (h)].</td>
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<tr>
<td>10. Installation of radial arm saws shall be such that the front is slightly higher than the rear or an automatic return device is installed. [1910.213(h) (4)].</td>
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<td>11. Radial arm saw with danger sign affixed to the rear of the guard at the approximate level of the arbor, not less than 1 ½” x ¾”, reading as follows: “DANGER” “DO NOT RIP OR PLOUGH FROM THIS END.” The label should be colored standard danger red. [1910.213(h) (5)].</td>
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<td>12. Radial arm and table saws equipped with roller units or stands to assist in moving material to the saw and removal after cutting.</td>
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<td>13. Radial arm saw, table saw, and jointer equipped with push sticks or blocks. [1910.213(a)].</td>
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<td>14. Band saw had an adjustable guard above the blade rolls and the blade wheels are covered. [1910.218(i)].</td>
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<td>15. Each band saw equipped with band tension control device. [1910.213(i) (2)].</td>
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<tr>
<td>Agricultural Laboratory</td>
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<td>Improvement</td>
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<td>Comments</td>
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<tr>
<td>16. Jointer has an automatic guard covering all sections of the cutting head.</td>
<td>1910.213(i).</td>
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<td>17. Planer feed rolls and cutter head guarded by a hood or suitable guard to prevent the operator’s hands from contacting the cutter head or in-running the feed rolls.</td>
<td>1910.213(n)(2).</td>
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<tr>
<td>18. Tool kept sharp, clean, and in good working order.</td>
<td>1910.213(s)(2).</td>
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<td>19. Hand-held circular saws equipped with a pressure switch that cannot be locked in the ON position and will shut power off when pressure is released.</td>
<td>1910.242(1)(2)(i).</td>
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<tr>
<td>20. Portable power tools and equipment properly and securely stored when not in use.</td>
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<td>21. Grinder has guards to cover the spindle ends, nuts, and flanges.</td>
<td>1910.215(a)(2).</td>
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<td>24. Grinder torque guard or spark deflector adjusted within ¼ in. of the grinding wheel.</td>
<td>1910.215(b)(9).</td>
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<td>25. Maximum periphery exposure for stationary grinder 65°. (Exposed distance between tool rest and torque guard or spark deflector).</td>
<td>1910.215(b)(3). Grinders, polishers, and buffers are equipped with an adequate exhaust system. 1910.94(b)(4). The grinder has a safety guard at the point of operation.</td>
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**VII. Welding, Cutting and Brazing**

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<th>Improvement</th>
<th>N/A</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>1. Arc welder cables, electrode holders, and ground clamps in good state of repair.</td>
<td>1910.252(b)(4)(x)(c).</td>
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<tr>
<td>2. Electrode holders hung up, and so placed and fastened securely to the cable so they do not make electrical contact.</td>
<td>1910.252(b)(4).</td>
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<tr>
<td><strong>Agricultural Laboratory</strong></td>
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<td>5. Fire resistant curtains or shields used around arc welding areas or booths.</td>
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<td>6. Arc welding helmets and welding goggles with tempered safety glasses or proper shade and hardened cover lens in good condition.</td>
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<td>7. Adequate ventilation provided for the dissipation and dilution of exhaust gases and welding fumes.</td>
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<td>8. Forge or furnace adequately vented.</td>
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<td>9. Oxyacetylene manifold welding systems installed according to the N.F.P.A.</td>
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<td>10. Gages on O² marked &quot;use no oil.&quot;</td>
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<td>11. Protective caps in place on all cylinders designed to accept a cap except when cylinders are connected for use.</td>
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<td>12. Fuel gas cylinders and oxygen cylinders separated at least 20 ft. or a 5 ft. high wall of ½ hr. heat barrier.</td>
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<td>13. Compressed gas cylinders chained or secured in an upright position.</td>
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<td>14. Portable gas welding equipment cylinder valves turned off when not in use.</td>
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<td>15. Backflow protection shall be provided by an approved device and manifold fluid level checked annually.</td>
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<td>16. Friction lighter available and used to light welding or cutting flame or pilot light.</td>
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</table>

**VIII. Electrical**

<table>
<thead>
<tr>
<th>1. Electrical cabinets and power room accessible (and not blocked from use) only to authorized personnel.</th>
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<tbody>
<tr>
<td>Agricultural Laboratory</td>
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<td>Comments</td>
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<tr>
<td>2. Electrical receptacles, junction boxes, and switch boxes properly covered. 1910.309 N.E.C. All receptacles are to be in good working order.</td>
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<td>3. Electrical outlets and fixtures properly grounded. 1910.309 N.E.C.</td>
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<tr>
<td>4. Stationary power tools and equipment properly grounded. 1910.213(a) (11).</td>
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<tr>
<td>7. Electrical disconnects identified. (Circuit breakers, fuse boxes, etc.) 1910.213 N.E.C.</td>
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<td>8. Signal units for heating, ventilating, and air conditioning are operational. 1910.309 N.E.C.</td>
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<td>10. All light switches are in good working order.</td>
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<tr>
<td>11. Illumination is adequate in the power tool area. 1910.219 (50-75 ft. candles, 100 ft. candles over benches).</td>
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<tr>
<td>12. A keyed master disconnect switch for all power tools.</td>
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</table>

**IX. Compressed Air Equipment**

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<tr>
<th>Met</th>
<th>Not Met</th>
<th>Needs Improvement</th>
<th>N/A</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>1. Pressure gauge in airline. 1910.169(b) (3)</td>
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<tr>
<td>2. Safety valve in air line in good working order and tested frequently. 1910.169(b) (3).</td>
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<tr>
<td>3. Air used for cleaning regulated to not more than 30 psi and chip guarded. 1910.169.</td>
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<tr>
<td>4. Air compressor drained frequently. 1910.169(b) (2).</td>
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<tr>
<td>* National Fire Protection Association</td>
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<tr>
<td>** National Electrical Code</td>
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**AGRICULTURE CLASSROOM**

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<tr>
<th>Met</th>
<th>Not Met</th>
<th>Needs Improvement</th>
<th>N/A</th>
<th>Comments</th>
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<tbody>
<tr>
<td>1. Classroom has adequate ventilation.</td>
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<tr>
<td>2. Floors are kept clean, dry and clear. 1910.22.</td>
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<td>3. Exit doors are clearly marked and unobstructed. 1910.37.</td>
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<tr>
<td>4. Illumination is safe, sufficient and well placed. 100-200 candle power-table height.</td>
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<tr>
<td>Agricultural Laboratory</td>
<td>Met</td>
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<td>Improvement</td>
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<tr>
<td>5. Classroom has a temperature control.</td>
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<td>6. Classroom has an orderly general appearance.</td>
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<tr>
<td>7. Furniture is in safe and dependable condition.</td>
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<td>8. There is an audible fire alarm in the classroom or in its vicinity.</td>
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<thead>
<tr>
<th>INSTRUCTOR’S OFFICE, CONFERENCE AND STORAGE ROOM</th>
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</thead>
<tbody>
<tr>
<td>1. General appearance is orderly. 1910.22.</td>
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<tr>
<td>2. Illumination is safe and sufficient. 100-200 candle power at desk height.</td>
</tr>
<tr>
<td>3. Ventilation is adequate.</td>
</tr>
<tr>
<td>4. Floors are kept clean, dry and clear. 1910.22.</td>
</tr>
<tr>
<td>5. The office has a temperature control.</td>
</tr>
<tr>
<td>6. Adequate and proper storage space available for all teaching supplies. All materials are stored in a safe and orderly condition. 1910.176.</td>
</tr>
<tr>
<td>7. Door is properly labeled (not an exit). 1910.22.</td>
</tr>
<tr>
<td>8. Workbenches and tables are kept clean and orderly. 1910.22.</td>
</tr>
<tr>
<td>9. Floor is kept clean and as dry as possible. 1910.37.</td>
</tr>
</tbody>
</table>

List from: Missouri Agricultural Education Safety Checklist; Missouri Department of Elementary and Secondary Education

[http://dese.mo.gov/divcareered/ag_safety_checklist.htm](http://dese.mo.gov/divcareered/ag_safety_checklist.htm)
Other Resources:

***NIOSA (National Institute for Occupational Safety & Health)-
Potentially Applicable Agricultural Education Checklists may be found at:

Example:

![Personal Protective Equipment (PPE) Self Inspection Checklist](image)

**Guidelines:** This checklist covers the use of personal protective equipment, including, but is not limited to, safety glasses, peoples, hand nets, gloves, safety shoes, and heat or electrically resistant clothing. Electrical protective equipment, respiratory protection, hearing protection, PPE for construction site lasers, and equipment like safety belts, lifelines, lanyards, and safety nets are addressed in separate checklists.

It is important to note that engineering controls should be the primary method of establishing a safe workplace. Personal protective equipment should only be used where engineering controls are not feasible.
***** The following forms were adapted from Bergeson, Dr. Terry. SAFETY GUIDE FOR CAREER AND TECHNICAL EDUCATION. 2002. http://www.cdc.gov/niosh/docs/2004-101/pdfs/Safe.pdf .
Permission Form

_____________________________(student’s name) has our/my permission to operate
the equipment in the Agricultural Education shop/laboratory at
_______________________________School. It is understood that instruction in safe
operation will be given before he/she is allowed to use any piece of equipment and that
he/she will be properly supervised at all times.

Parents/Guardian Name_______________________________________________
Address ___________________________________________
City, St & zip code __________________________________
Home Phone _______________________________________
Mother/Guardian Work/Cell Phone _____________________________
Father/Guardian Work/Cell Phone _____________________________

Family Doctor______________________________________________________
Phone ____________________________________________
Address ___________________________________________________________

If Parents/Guardians cannot be reached, please contact:
Name/Relation__________________________________________
Phone ________________________________________________

Signature/Date ______________________________________________________
Signature/Date ______________________________________________________

All information must be completed and this form returned before a student will be
allowed to operate any power equipment in the laboratories. This information will be
used to make this class as safe as possible and to expedite emergency help if needed.
Confidential Medical Information Form

Does your child have any physical or mental impairment that may be of concern to the instructor?  (  ) Yes (  ) No
If yes, please specify: ____________________________
____________________________________________

During the school year does the student take medication of any type that may limit activities or effect vision, hearing, balance, or other senses? (  ) Yes (  ) No
If yes, please specify: ____________________________
____________________________________________

Do they have any allergies to medicine? ____________________________
____________________________________________

I promise the information above is correct and true. I will inform the instructors of any changes that may occur this year relevant to my child in the safe operation of this course.

Signature/Date____________________________________________________

If more space is needed for comments, please continue below.
AUTHORIZATION TO CONSENT TO TREATMENT OF A MINOR

Name of Minor ________________________________________________

I authorize any of the employees/volunteers of the ____________________________
school to consent to medical treatment of the minor when I cannot be contacted and to consent
such medical treatment to include, without limitation, x-ray examination, anesthetic, medical,
dental, or surgical examination or treatment and general hospital care. No prior determination
of life-threatening emergency or danger of serious or permanent injury resulting from delay of
treatment need be made under this authorization.

I SPECIFICALLY CERTIFY AND AGREE THAT:
Except as indicated at the end of this paragraph, this authorization is given in advance of any
specific diagnosis, treatment, or hospital care being required but is given to provide authority
and power on the part of the adult to give specific consent to any and all examinations,
treatment or hospital care.
Exception(s): __________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

I will indemnify and hold harmless from any expenses or claims of any nature any person or
entity which provide or causes to be provided examination, treatment or hospital care pursuant
to this authorization (except to the extent such person or entity is negligent therein) and
conditionally agree to make or cause to be made, by assignment of third party benefits or
otherwise, full and complete payment for such examination, treatment, or hospital care.

I am the person having the power to consent to medical treatment of such minor.
This authorization shall remain effective for the school year, unless revoked by the physical
destruction of the original hereof, such destruction being the only method of actual notice of the
revocation of it.

_________________________________________________________________
Insurance company & Phone Number

__________________________________________________
Policy Number

All blanks of this authorization were filled in before I signed this authorization.

Parent/Legal Guardian/Date ________________________________
ACCIDENT REPORT FORM

Date of report: ____________________________

Name: ____________________________   Address:__________________________________

School: ______________________________  Sex: _______  Age: _______   Grade: ________

Date and time of accident: ____________________________

Describe the injury in detail and indicate the part of the body affected.

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

What was the student doing when injured?

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

How did the accident occur?

______________________________________________________________________________

______________________________________________________________________________

Name the object or substance that directly injured the student.

______________________________________________________________________________

______________________________________________________________________________

If treated, name and address of the physician or hospital.

______________________________________________________________________________

Prepared by: ____________________________

Principal: ____________________________
STUDENT SAFETY PERFORMANCE RECORD

School: ____________________________
Class: ____________________________
Period: ____________________________
Instructor: _________________________
Year: ____________________________

________________________________ has observed SAFE operating procedures, has
passed the required SAFETY exam with 100 percent, and is permitted to operate the
following items/equipment dated according to accepted SAFETY regulations.

<table>
<thead>
<tr>
<th>Tool/Equipment</th>
<th>Teacher Demonstration</th>
<th>Written Test 100%</th>
<th>Performance Test 100%</th>
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The instructor will keep this record until the student exits the program.
**TEACHER OBSERVATION REPORT OF STUDENTS**

Teacher ____________________________________________

Class/Period ________________________________________

Date/Week __________________________________________

<table>
<thead>
<tr>
<th>Unsafe Acts or Distractions</th>
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<tr>
<td>√-100% Demonstrates safe and good working habits and participation</td>
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<tr>
<td>-20% Failure to wear personal safety gear</td>
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<td>-20% Horseplay</td>
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<td>-20% Poor housekeeping practices</td>
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<td>-20% Improper handling or disposal of hazardous materials</td>
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<td>-10% Poor participation</td>
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<td>-10% Using equipment without permission</td>
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<th>Monday</th>
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Appendix C-
Answers to Safety Questions
General Safety
1. Turn off and/or unplug
2. D
3. A
4. B
5. D
6. B
7. C
8. B
9. B
10. D
11. D
12. C
13. D
14. B
15. A

Automotive
1. carbon monoxide
2. nonflammable gas
3. flammable gas
4. B
5. oxygen
6. C

Electricity
1. B
2. B
3. C
4. Amps, Volts, Watts
5. C
6. D
7. B
8. B
9. D
10. D

Fire
1. Heat, Fuel, Oxygen
2. Stop, Drop and Roll
3. At the base of the fire
4. A-1
   B-3
   C-4
   D-2
5. Door/Exit

Hazardous Materials
1. D
2. 1-C
   2-A
   3-B
3. C
4. A
5. Name of chemical, Properties, Physical Hazards, Health Hazards, Route it enters body, Legal limit in air, Precautions, Emergency and first aid procedures, etc.

Painting
1. Unlabeled
2. Wear eye protection, wear respirator, avoid breathing fumes, wear rubber/vinyl gloves, wash hands when done
3. MSDS Sheets
4. Ventilation
5. D

Plumbing
1. Plumbing is the installation and repairing of water pipes and fixtures.
2. B
3. Pressure that water exerts while at rest
4. Pressure at any point when the water is flowing past
5. Copper, Plastic, Steel
6. C
7. Lead

Tools/Equipments
Band Saw
1. D
2. Turn the power off, wait until machine has come to a complete stop, clean up scraps, return upper blade guide to down position.
3. B
4. C
5. C
6. A
Belt/Disc Sander
1. Abrasive paper
2. Turn off and unplug
3. B
4. C
5. C
6. A
7. B
8. C

Bench Grinder
1. C
2. D
3. A
4. E
5. C
6. B
7. D
8. Face

Buffer
1. D
2. A
3. A
4. Gloves, rags, other clothing
5. C
6. Turn the power off, wait until it comes to a complete stop, brush off machine
7. Corners or openings

Circular saw
1. Stable and stationary can be cut from comfortable position
2. C
3. D
4. Retracting guard
5. B
6. Electrical cord power
7. Completely stopped

8. So do no lose control and injure you or someone else
9. Faster
10. B

Drill Press
1. E
2. C
3. A
4. Hand
5. B
6. C
7. A
8. D

Drill
1. B
2. D
3. B
4. C
5. D
6. A
7. B
8. D
9. C
10. A

General Hand Tools
1. Sharp
2. B
3. Vise or clamp
4. They could break while being used and could cause an injury
5. D
6. A handle
7. Using as a cheater, use file to pry, hammer on or with, screwdrivers as a chisel or pry bar
8. A
9. Instructor
10. Clean and return to proper storage place

Jig Saw
1. A
2. Clamps
3. D
4. Force
Jointer
1. D
2. Smoother cut and better finish
3. If work will bring hand closer than 2" from the blade
4. Pressure
5. Hands
6. Over
7. Push stick
8. Person
9. A
10. B
11. B
12. So they are out of the way and if you slip the fence will catch them

Metal Cut Off Saw
1. Overload machine or damage the blade
2. D
3. Glove and pliers to take it to cool off
4. A
5. D
6. D

Metal Lathe
1. Key
2. C
3. D
4. D
5. D
6. C
7. C
8. D
9. Adjustment
10. Measure

Milling Machine
1. D
2.
3. Back out
4. Use a brush when machine is completely stopped
5. Clear off spills and chips
6. Sharp

Miter Saw
1. D
2. B
3. Making a cut
4. A
5. C
6. A
7. Unplugged
8. B
9. E
10. C
11. D
12. D

Notcher
1. A
2. B
3. A
4. A
5. C

Planer/Surfacer
1. grain
2. B
3. A
4. E
5. D
6. B
7. C
8. A
9. D
10. A

Portable Grinder
1. B
2. B
3. D
4. B
5. D
6. A
7. D
8. off
9. C
10. D

Radial Arm Saw
1. C
2. C
3. D
4. D
5. D
6. D
7. B
8. D
9. B
10. A

Reciprocating/Bayonet Saw
1. work
2. D
3. B
4. electric shock
5. blade
6. B
7. A
8. B
9. break
10. C

Router
1. A
2. A
3. B
4. A
5. C
6. D
7. C
8. D
9. C
10. B

Scroll Saw
1. tensioned
2. awkward
3. B
4. B
5. relief
6. turn saw off
7. firmly
8. D

Shaper
1. C
2. A
3. D
4. A
5. C

Table Saw
1. D
2. D
3. B
4. D
5. D
6. C
7. B
8. C
9. A
10. C

Wood Lathe
1. gloves, ties, loose clothing, ring, watch, jewelry, long sleeves
2. B
3. D
4. grounded
5. locks
6. C
7. A
8. B

Welding
GMAW (Mig) Welder
1. Gloves, closed toed shoes, safety glasses, welding helmet, coveralls
2. C
3. C
4. D
5. Needle nose pliers
6. B
7. C
8. Depends on the weld
9. B
10. A

Oxyacetylene Welder
Plasma Cutter
1. C
2. C
3. A
4. B
5. B
6. D
7. A
8. A
9. D
10. C
11. D
12. B
13. D
14. C
15. B
16. D

SMAW (Arc) Welder
1. C
2. A
3. B
4. C
5. D
6. A
7. E
8. B
9. D
10. A
11. B
12. C
13. B
14. D
15. A

Tig
1. C
2. grounded
3. List 5:
   • Keep cables close together by twisting or taping them, or using a cable cover.
   • Do not place your body between welding cables. Arrange cables to one side and away from the operator.
   • Do not coil or drape cables around your body.
   • Keep head and trunk as far away from the equipment in the welding circuit as possible.
   • Connect work clamp to workpiece as close to the weld as possible.
   • Do not work next to, sit or lean on the welding power source.
   • Do not weld whilst carrying the welding power source or wire feeder
Appendix D-
Additional Resources
NIOSA Agricultural Education Checklists:

Missouri Agricultural Education Safety Checklist:
http://dese.mo.gov/divcareered/ag_safety_checklist.htm

Washington Safety Videos:

Labeled Tool/Equipment Diagrams:
http://www.woodmagazine.com/woodworking-tools/power/woodworking-power-tools/?page=6

Virginia Safety Information and Tests:
http://www.aged.vt.edu/VaAgEd/labsafety.htm

School District of Somerset Safety Tests:
http://www.somerset.k12.wi.us/faculty/mbarron/safety_tests.cfm

Safety Tests-Auto, construction, welding:
http://adultinstruction.org/teachers/safety/

Denver-Info Sheets/Test:
http://cte.dpsk12.org/indtechsafetytests.html

Top 10 Most Dangerous Tools:

Shop Layout Planner:

List of Prohibited and Restricted Chemicals for Colorado:
http://www.cdphe.state.co.us/regulations/consumer/101006schools.pdf

Alaska Education Website:
http://www.eed.state.ak.us/tls/CTE/resources.html#pubs

Washington CTE Website:
https://www.k12.wa.us/CareerTechEd/FormsStandards.aspx

California Agricultural Core Curriculum- Agricultural Mechanics:
Career & Technical Education (CTE) Standards Revision Project:
http://www.coloradostateplan.com/standards/AgMechfinal-rwc5-10.pdf

Rules and Regulations Governing Schools in the State of Colorado:
http://www.cdphe.state.co.us/regulations/consumer/101006schools.pdf

Other Manuals:
CALIFORNIA:
www.agedweb.org/TeacherResources/Safety%20Guide.pdf

WASHINGTON 2002:

PENNSYLVANIA:

WASHINGTON 2009:

ALASKA:
http://www.eed.state.ak.us/tls/CTE/resources.html#pubs

HEADSUP! FOR SAFETY:
http://www.bced.gov.bc.ca/pubs.htm

MASSACUSETTES TEACHER TOOLKIT:
http://www.doe.mass.edu/cte/resources/