

Safety First

General Safety Rules

In a technology course, you have many opportunities to design and build products. You can apply your creativity and problem-solving skills. It's very important that you also apply common sense and practice safe work habits.

Develop a Safe Attitude

- Read and follow all posted safety rules.
- Take the time to do the job right.
- Consider each person's safety to be your responsibility. Avoid putting others in danger.
- Stay alert. Be aware of your surroundings.
- Work quietly and give your full attention to the task at hand. Never indulge in horseplay or other foolish actions.
- Stay out of danger zones as much as possible. These are usually marked with black and yellow striped tape.
- Put up warning signs on things that are hot and could cause burns.
- If you bend down to pick up an object, use your legs, not your back, to lift up. Keep your back straight. To keep better control, get help to lift or move long or heavy items.
- Handle materials with sharp edges and pointed objects carefully.
- Report accidents to your teacher at once.

» Notice the safety jackets worn by the students working on this solar-powered car.



Have Respect for Tools and Equipment

- Never use any tool or machine until the teacher has shown you how to use it and has checked the setup.
- Before using any tool or machine, make sure you know the safety rules and make sure you get your teacher's permission.
- Use equipment only when the teacher is in the lab.
- Do not let others distract you while working.
- Do not use electrical tools or equipment if the cord or plug is damaged.
- Always use the right tool for the job. The wrong tool could injure you or damage the part you are working on.
- To avoid injury, use the right machine guard for the job. Check with your teacher for the appropriate guard.
- Keep hands and fingers away from all moving parts.
- Before you leave a machine, turn it off and wait until it stops. If you are finished, clean the machine and the area around it.
- When you have finished working, return all tools and unused supplies to their proper places.

Prevent and Control Fires

- Store oily rags in a closed metal container to prevent fire.
- Know where the nearest fire extinguisher is and how to use it, *if that is your school's policy.*



Wear Appropriate Clothing and Protective Equipment

- Always wear eye protection. Special eye protection may be needed for some activities, such as using a laser, welding, or using chemicals.



- Wear hard shoes or boots with rubber soles.
- Use ear protection near loud equipment.
- Do not wear loose clothing, jewelry, or other items that could get caught in machinery. Tie back long hair.
- Do not wear gloves while operating power tools.



Have Respect for Hazardous Materials and Waste

- Products with major health risks should have a Material Safety Data Sheet (MSDS) available. Ask your teacher about the MSDS before you use materials that may be hazardous. Know how to read the MSDS. You can find more information about Material Safety Data Sheets on page 559.
- Other common chemicals will have safety information on the labels. Check the labels of materials before you use them.
- Wear appropriate personal protective equipment (PPE) when working with hazardous materials.
- Work in a well-ventilated area.
- Follow your teacher's instructions for disposal of hazardous materials and waste.



Maintain the Lab

- Keep the work area clean. Keep the floor and aisles clean at all times.
- If a liquid is spilled, clean it up immediately as instructed by the teacher.
- Always use a brush, not your hands, to clean dry materials from a table or piece of equipment.
- Store all materials properly.





⚠️ This carpenter is nailing roof trusses. *Why should eye protection be worn when using a hammer?*

Safe Use of Hand Tools

Misuse and improper maintenance pose the greatest hazards in using hand tools. Observe the following rules when using hand tools.

- Keep all hand tools clean and in good condition.
- Wipe tools clean before and after use.
- Use only tools that are in good condition. If a tool is damaged, tell your teacher about it.
- Use a hand tool only for the purpose for which it was designed.
- Hold and use the tool in the proper way, following manufacturer's instructions.
- Always wear safety glasses or goggles.
- Cutting tools should be sharp.
- Do not use a screwdriver on a part that is being hand-held. The screwdriver can slip and hit your hand.
- Carry sharp or pointed tools with the point down and away from your body.

Safe Use of Electric Power Tools

Use care and common sense when working with electric power tools. Observe the following safety practices.



Prevent Electric Shock

- Do **not** stand in water while working on equipment.
- Make sure that all electrical cords are free of frays and breaks in the insulation.
- Pull the plug, not the cord, when you unplug a tool or machine. Damaging a cord may cause an electric shock.
- Keep electrical cords away from sharp edges.
- Use only power tools that have been properly grounded or double insulated.
- Make sure that all extension cords are the three-wire grounded type.
- Make sure the three-pronged plug is used in a grounded receptacle.

Work Safely

- Do **not** wear loose clothing, ties, or jewelry that can become caught in moving parts of machinery. Be sure to tie back long hair.
- Do **not** wear gloves while operating power tools.
- Wear the appropriate personal protective equipment (PPE), such as safety glasses or a face shield.
- Never set a hand-held power tool down while it is running or coasting.
- Avoid accidental startups by keeping fingers off the START switch when carrying a tool.
- When you approach a machine, be sure it is off and that it is not coasting.
- Secure the work piece with clamps or a vise. This will free both hands to operate the tool.
- Disconnect the power source before changing accessories such as bits, belts, and blades.
- Keep tools as sharp and clean as possible for best performance.
- Tell the teacher immediately if the machine doesn't sound right or if you can see that something is wrong.

Safe Use of Cutting Tools

Observe the following safety practices when using electric power tools to cut materials.

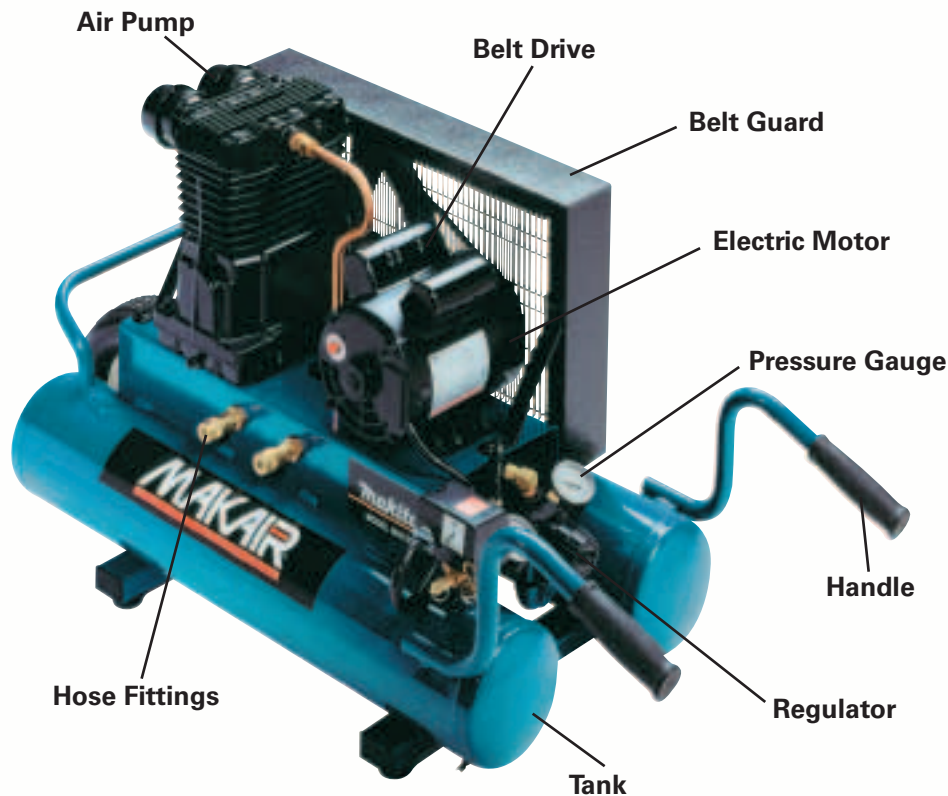


⚠ Check stock before cutting it. Nails, cracks, or loose knots could cause a power saw to kick back or send pieces flying out at high speed. Before starting to cut, put on safety goggles.

- Allow machines to reach full speed before starting to cut.
- Before working on stock (wood or other workpieces), check it for cracks, loose knots, and nails.
- The shortest piece of lumber that can safely be run through most equipment is 12 inches long.
- Keep your balance; don't overreach.
- Support ends of long stock before cutting.
- Wait until the blade stops completely before removing any scraps. Use a brush, not your fingers.

Safe Use of Pneumatic Tools

Pneumatic tools are powered by compressed air. The air is fed to the tool through a high-pressure hose connected to an air compressor.



⚡ The main parts of an air compressor are shown here.

- When using a compressed-air gun, always wear the correct personal protective equipment (PPE). For example, wear safety glasses or goggles and a face shield. Always direct the airflow away from you.
- Always carry a pneumatic tool by its frame or handle, not by the air hose.
- Make sure all pneumatic tools are securely attached to the compressed-air line.
- Never use a pneumatic tool, such as a compressed-air gun, to remove debris from your clothing or body.
- Securely position a pneumatic tool before operating it. These tools operate at high speeds or under high pressure.

Tool and Machine Maintenance

Tools and machines that are well maintained do a better, faster job and are safer to use.

Hand Tool Maintenance

- Keep sharp tools properly sharpened.
- Check edges, sharp points, and other working surfaces for cracks and other defects.
- Keep working surfaces and handles clean and free of dirt and rust.
- Check that any moving parts or mechanisms are working properly.
- Check for loose handles and other loose parts.
- Check wood handles for splinters and other damage.
- Clean the tool following use each day.
- Inspect the tool for damage at least once each day before use.
- Lubricate any tool parts that require it.
- Preserve wood handles regularly with special oils made for that purpose.
- Store tools in their proper places in an organized way.
- Store sharp tools in a safe place with the cutting edge protected.

❖ Clean brushes after each use to keep the bristles soft and in good condition.



» Blades of band saws and other cutting tools should be cleaned regularly to remove resin, pitch, and other debris. A clean blade will cut straighter and smoother.



Power Tool and Machine Maintenance

- Keep sharp tools properly sharpened.
- Check edges, sharp points, hoses, and other working parts for cracks and other defects.
- Keep working surfaces, handles, and hoses clean and free of dirt and rust.
- Check that any moving parts or mechanisms are working properly.
- Check for loose handles and other loose parts.
- Check for broken plugs or lugs removed from grounding plugs.
- Check for split insulation or damaged electrical cords.
- Disconnect and clean the tool following use each day.
- Disconnect and inspect the tool for damage at least once each day before use.
- Lubricate any tool parts that require it.
- Store tools in their proper places in an organized way.
- Store sharp tools in a safe place with the cutting edge protected.

Safe Use of Chemicals

Follow these rules when working with paints, stains, varnishes, paint thinners, adhesives, or other chemicals.

- Read and follow all label precautions.
- Always wear protective clothing and approved eye protection. Use appropriate gloves or tongs when needed.
- Many chemicals produce harmful fumes. Work only in well-ventilated areas. Use a respirator whenever it is required.
- Know where the eyewash station is and how to use it.
- Know where the Material Safety Data Sheets (MSDS) are located.
- Know where the poison-control phone number is located.
- Mix chemicals only as directed. If you need to mix acid and water, get the water first. Then carefully add the acid to it.
- Pay attention to others around you when working with chemicals and report any unusual reactions.
- Clean up spills immediately.
- Clean all tools and equipment properly after using.
- Avoid skin contact with chemicals. Wash thoroughly before leaving the area.
- Many chemicals need to be stored away from heat or away from moisture. Follow label directions.
- Never store chemicals in an unlabeled or incorrectly labeled container.
- Store chemical-soaked rags in an approved container.
- Dispose of chemicals properly.

» Use gloves to protect your hands from contact with chemicals.



Material Safety Data Sheet

OSHA requires that workers be informed about any hazardous chemicals to which they may be exposed. A Material Safety Data Sheet (MSDS) is a form used to communicate information about hazards. The table at the bottom of this page is part of an MSDS for acetylene. There are different types of Material Safety Data Sheets, but they all must include the following kinds of information.

- The **identity** of the hazardous chemical, including both its chemical and common name(s). If the chemical is a mixture, the ingredients are listed.
- **Physical and chemical characteristics**, such as flash point (the lowest temperature at which a vapor may ignite).
- **Physical hazards**, including the potential for fire, explosion, and reactivity.
- **Health hazards**, including signs and symptoms of exposure, and any medical conditions that are generally recognized as being aggravated by exposure to the chemical.
- The **primary route(s) of entry**. For example, a chemical may produce fumes that could be inhaled.
- The **limit of safe exposure**.
- Whether the chemical is **carcinogenic** (cancer-producing).
- Generally applicable **precautions for safe handling and use**.
- Generally applicable **control measures**, such as personal protective equipment (PPE).
- **Emergency and first-aid** procedures.
- The **date** the MSDS was prepared or last updated.
- The contact information of the chemical manufacturer, importer, employer, or other responsible party who can serve as a **provider of additional information** on the hazardous chemical and appropriate emergency procedures, if necessary.

2. Hazard Ingredients and Identity Information

COMPONENT	% VOLUME	OSHA-PEL	ACGIH-TLV	CAS NUMBER
Acetylene	95.0 to 99.6	Not Available	Simple Asphyxiant	000074-86-2
Acetone	Unavailable	1000 ppm TWA	750 ppm TWA 1000 ppm STEL	000067-64-1

3. Physical and Chemical Characteristics

Boiling Point:	-118.8°F	Specific Gravity:	0.906	pH:	N/A
Melting Point:	-116°F	Evaporation Rate:	N/A	Physical State:	Gas
Vapor Pressure:	635 psig	Solubility (H²O):	Soluble		

Appearance and Odor:

Pure acetylene is a colorless gas with an ethereal odor. Commercial (carbide) acetylene has a distinctive garlic-like odor.

How to Detect This Substance: N/A

Other Physical and Chemical Data:

Liquid density at boiling point, 38.8 lb/ft³ (622 kg/m³)

Gas density at 70°F 1 atm, 0.0691 lb/ft³ (1.107 kg/m³)

Safety Color Codes

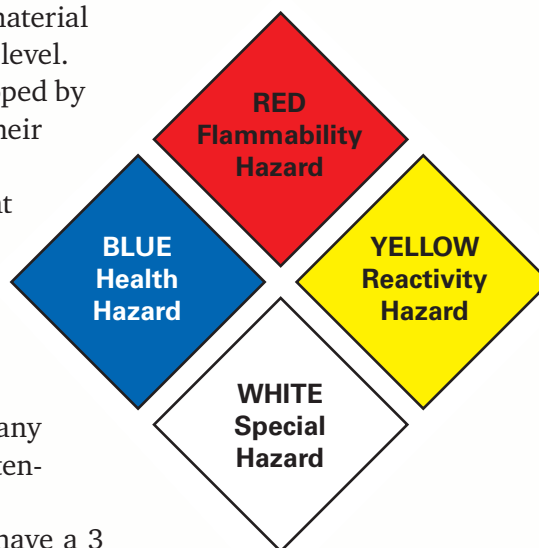
Safety signs and labels are color-coded to signify hazards or to identify the location of safety-related equipment.

Color	Meaning	Examples
Red	Danger, stop, or emergency	<ul style="list-style-type: none">• Fire-protection equipment• Flammable-liquid container• Emergency stop bars and switches
Orange	Be on guard	<ul style="list-style-type: none">• Hazardous parts of equipment or machines that might injure• Safety starter buttons on equipment or machines
Yellow	Caution	<ul style="list-style-type: none">• Physical hazards, such as steps and low beams• Waste containers for combustible materials
White	Storage	<ul style="list-style-type: none">• Housekeeping equipment
Green	First aid	<ul style="list-style-type: none">• Location of safety equipment, such as first-aid kit
Blue	Information or caution	<ul style="list-style-type: none">• Out-of-order signs on equipment• Cautions against using out-of-order equipment

Warning Labels

The warning labels on containers of hazardous material may use colors and numbers to indicate the hazard level. There are several labeling systems. One was developed by the National Fire Protection Association (NFPA). Their label consists of squares arranged into a “diamond” shape. Each square has a different color to represent the type of hazard. Red represents flammability, and yellow represents reactivity. Blue is used for health hazards, and white is for special information. A number on a square indicates the severity of the hazard. Numbers range from 0 to 4, with 4 representing the greatest hazard. However, any category rated 2 or higher should be considered potentially dangerous.

For example, an NFPA label for toluene would have a 3 in the red square, a 2 in the blue square, and a 0 in the yellow square. Toluene is a chemical used in many paints, paint thinners, lacquers, and adhesives. It is flammable, can be harmful if inhaled or swallowed, and is not reactive when mixed with water.



Fire Safety

In order for a fire to burn, three basic things must be present.

- A source of heat
- Oxygen
- Fuel

For example, what if a piece of paper comes in contact with a hot wire and the paper burns? The hot wire provides heat, the paper is the fuel, and oxygen is present in the air.














Most fires can be extinguished by

Reducing the heat The most common way to reduce the heat of a fire is to throw water on it. This has cooling action and also produces steam. The steam helps to exclude oxygen. However, water should not be used to extinguish some fires, such as grease or electrical fires.

Preventing oxygen from reaching the fire A fire can be deprived of oxygen by spraying it with an inert gas, such as carbon dioxide. Carbon

dioxide is contained in many fire extinguishers. Keeping oxygen away is also the method used when a person's clothing catches fire. The person is wrapped in a blanket, which smothers the fire.

Removing the source of fuel If a gas or liquid, such as gasoline, is feeding a fire, it can often be turned off in some way. That removes the fuel. In some cases, the fuel may be allowed to burn until it is used up and the fire goes out.

Class of Fire	Type of Flammable Material	Type of Fire Extinguisher to Use
Class A 	Wood, paper, cloth, plastic	Class A  Class A:B 
Class B 	Grease, oil, chemicals	Class A:B  Class A:B:C 
Class C 	Electrical cords, switches, wiring	Class A:C  Class B:C 
Class D 	Combustible switches, wiring, metals, iron	Class D 
Class K 	Fires in cooking appliances involving combustible vegetable or animal oils and fats	Class K 

Developing a Fire Emergency Plan

Your lab should have a plan for use in a fire emergency. If your teacher has not explained it to you, ask about it. Be sure you know where all the exits are, where the fire extinguishers are kept, and what your responsibilities are in case a fire occurs. Then follow these steps to record the fire emergency plan.

1. Draw a floor plan of the lab.
2. Locate all the fire exits and label them on the floor plan. If the lab has no direct exit to the outside, draw a map of your section of the school. Show the location of the lab, and draw arrows from the doors in the lab to the nearest fire exits.
3. Locate and label any windows that could also be used for escape. (Check to be sure the opening will be large enough for an adult to pass through.)
4. Locate all the fire extinguishers and label them on the floor plan. Indicate on the plan the class of fire for which each extinguisher can be used.
5. Locate places where flammable or explosive materials should be stored and label them. Be sure they are in a location far away from any source of heat and that their cabinet is fireproof.
6. Determine where you and your classmates should meet after you have left the building. This is important so that someone can check to be sure everyone has escaped safely.
7. Ask your teacher for procedures to follow if a fire occurs. If time allows, this may include such things as closing windows, turning off equipment, and grabbing the first-aid kit. Someone should be responsible for reporting the fire. However, human safety is the most important consideration. Fires can spread quickly, and smoke can be just as deadly as flames. Your most important responsibility is to get out alive.
8. Be sure everyone has a chance to study the emergency plan. Then, with your teacher's approval, post it in a prominent place where it can be seen easily.
9. Be sure that you and your classmates are informed as to housekeeping duties that help prevent fires, proper handling of any materials that could catch fire, how to treat burns, and where to report a fire.




Troubleshooting

To “troubleshoot” means to follow a systematic method to find the cause of a problem and fix it. Owner’s manuals often contain troubleshooting charts to help users find and correct problems.

Troubleshooting begins by looking for the most likely causes. Often, the problem is a simple one that can easily be fixed. If that turns out not to be the case, then the troubleshooter looks for more unusual causes. It is also a good idea to look at a system’s parts and test each part one by one. For example, when your computer is unable to read a new CD, you might follow a procedure like the one outlined in this table.

Symptom	Possible Cause	How to Check
Computer cannot read CD.	1. CD is not formatted for your computer system.	1. Read label of CD for hardware and software requirements.
	2. CD is not properly inserted in drive.	2. Reinsert CD into drive, being careful to place it correctly.
	3. CD is damaged.	3. Insert a different CD into the drive to see whether it will work.
	4. CD drive damaged.	4. Replace or repair CD drive.

Here is a simple troubleshooting table to use in the school lab.

Symptom	Possible Cause	How to Check
Electric tool is not working. 	1. Cord is not plugged in.	1. Plug in the cord.
	2. Switch is turned off.	2. Turn on switch.
If the tool still does not work, report the problem to your teacher. The tool may need repairs, or there may be a problem with the electric power supply.		