

# Construction Safety & Health

## Section 3.1

Job Site Safety

## Section 3.2

Personal Safety & Health

### Chapter Objectives

After completing this chapter, you will be able to:

- **Describe** the purpose of OSHA.
- **Identify** practices for keeping a work site safe.
- **Apply** your knowledge of construction site safety to react appropriately in an emergency.
- **Identify** hazards on the job site.
- **Identify** the hazards associated with different types of tools.
- **Describe** protective clothing and personal protective equipment that suit various weather and job site conditions.



### Discuss the Photo

**Safety First** The construction industry has the highest accident rate of any industry. *List at least two reasons why you think this might be.*



### Writing Activity: Create a List

Create a list of five safety rules and reminders you think might be important for maintaining a safe work environment on a job site. Revise your list after you have read this chapter.

# Chapter 3 Reading Guide



## Before You Read Preview

In construction, working conditions vary widely and can be difficult to control. Workers and supervisors must take care to guard their own safety as well as the safety of others. Choose a content vocabulary or academic vocabulary word that is new to you. When you find it in the text, write down the definition.

### Content Vocabulary

- Occupational Safety and Health Administration (OSHA)
- excavation
- first aid
- conductor
- electrical circuit
- grounding
- musculoskeletal disorder (MSD)
- ergonomics
- repetitive stress injury (RSI)
- wind chill

### Academic Vocabulary

You will find these words in your reading and on your tests. Use the academic vocabulary glossary to look up their definitions if necessary.

- physical
- chemicals
- components

### Graphic Organizer

As you read, use a chart like the one shown to organize key ideas about construction safety and health.

How to Keep the Work Site Safe	How to Work Safely on the Job

Go to [glencoe.com](http://glencoe.com) for this book's OLC for a downloadable version of this graphic organizer.

### Academic Standards

**English Language Arts**  
 Conduct research and gather, evaluate, and synthesize data to communicate discoveries (NCTE 7)

**Mathematics**  
**Geometry:** Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships (NCTM)

**Geometry:** Use visualization, spatial reasoning, and geometric modeling to solve problems (NCTM)

**Science**  
**Unifying Concepts and Processes:** Constancy, change, and measurement (NSES)  
**Science in Personal and Social Perspectives:** Personal and community health (NSES)

**Industry Standards**  
 Basic Safety  
 Hand and Power Tool Safety

**NCTE** National Council of Teachers of English  
**NCTM** National Council of Teachers of Mathematics

**NSES** National Science Education Standards

# Job Site Safety

## Safety Regulations

### What is OSHA?

Most injuries can be prevented. Everyone on a job site has some responsibility for keeping the site safe. The best way to avoid accidents is to develop a safe attitude:

- Think about the consequences of your actions, not only for yourself, but also for those around you.
- Always follow safe procedures, obey the rules, and act responsibly.
- Keep in mind that you cannot rely on luck to protect you from accidents.
- Make safety a habit as you develop your construction skills.
- Learn good housekeeping habits because a clean job site is a safer job site.

Many builders and contractors feel that there is a direct relationship between quality work practices and safety. Workers who take the time to do a job carefully are safer workers. One reason for this is that it takes a lot of concentration to do a job right. A worker who concentrates is less likely to be distracted by other workers and is more alert to possible hazards. Another reason that careful workers are safer workers is that a high degree of craftsmanship slows the pace of construction. Injuries are more likely to occur when workers rush to complete a job.

### OSHA

The purpose of the U.S. Occupational Safety and Health Act is “to assure so far as possible every working man and woman in the Nation safe and healthful working



**Figure 3-1 Supervising Safety**

**Making Inspections** OSHA Inspectors may check construction sites for safety violations.

conditions and to preserve our human resources.” The Act is administered by the **Occupational Safety and Health Administration (OSHA)**, an organization that issues standards and rules for safe and healthful working conditions, tools, equipment, facilities, and processes. OSHA also conducts workplace *inspections* to ensure the standards are followed, as shown in **Figure 3-1**. It enforces those standards and assesses fines against violators.

Everyone has the right to a safe workplace. Under OSHA regulations, an employer must:

- Make sure the workplace is free from recognized hazards that are likely to cause death or serious **physical** harm.
- Provide proper training for all hazardous work and the use of personal protection equipment.
- Comply with OSHA standards, including record-keeping standards and accident reporting standards.

If an employee believes that OSHA standards are not being followed, he or she has the right to contact OSHA and request an inspection. Employees also have responsibilities. They must:

- Comply with OSHA regulations.
- Comply with other occupational safety and health standards that apply.

## Workers Compensation

Even after every effort has been made to ensure a safe workplace, an employee may be injured. Each state has a type of insurance program that pays benefits for work-related injuries and illnesses. These programs are called workers compensation programs. The programs pay for reasonable and necessary medical care if an employee is injured or becomes ill on the job. If an employee is killed on the job, benefits go to his or her family.

Programs in each state vary, but they are designed to handle claims in a prompt and fair way. Workers compensation laws are

complex, but they generally include the following information:

- The employee must be given prompt first aid, as well as necessary medical, surgical, rehabilitative, and hospital care.
- If a work-related injury prevents an employee from working for a certain number of days, he or she must be paid disability benefits during that period.
- If an employer denies compensation to a worker, the worker may appeal to state authorities, usually through the workers compensation program.

If you are injured at work, report your injury to your employer as soon as possible. Afterward, your employer must report the injury to the workers compensation insurance carrier. You should keep receipts for all expenses associated with your accident. You should also maintain records related to your care and recovery.



**Recall** What is workers compensation?

## Keeping the Job Site Safe

### What is good sanitation?

Younger workers are more likely to be injured than older workers. This might be partly due to their inexperience. In addition, new employees have a higher accident rate than long-time employees. This could be because they are unfamiliar with the job. Most apprentices are both young *and* new on the job.

### Housekeeping and Sanitation

A hammer left balanced on a ceiling joist, a bucket left on the stairs, and oily rags thrown in a corner are instances of small acts of carelessness that can result in major injuries or property damage. Always practice good housekeeping on the job.

- Keep walkways clear of tools, materials, and clutter.
- Whenever you see protruding nails, remove them or bend them down.

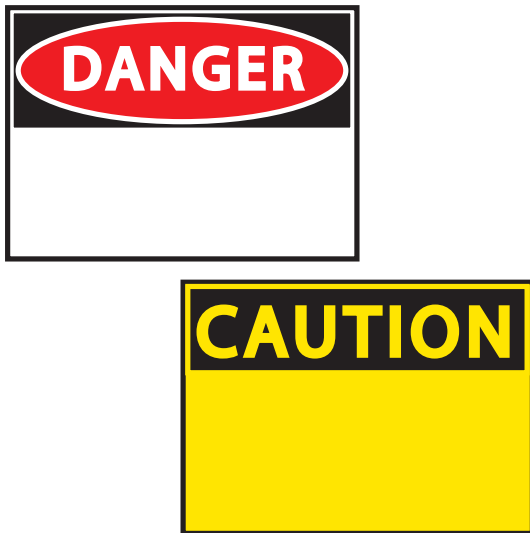
- To prevent fires and reduce hazards, dispose of scraps and rubbish daily. Put oily rags and other highly flammable (able to catch fire easily) waste in approved metal containers.
- When working above other people, place tools and materials where they will not fall and cause injuries.

Good sanitation (cleanliness) helps prevent the spread of disease. Various OSHA and local regulations apply to sanitation. They cover such things as the supply of drinking water, food service and eating facilities, washing facilities, and toilets.

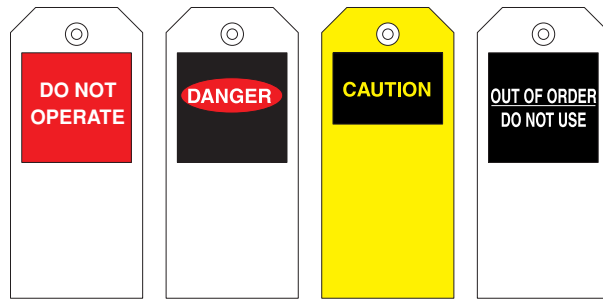
### Signs, Tags, and Barricades

Several kinds of signs and tags are used at construction sites. Danger signs warn people about immediate hazards, such as open stairwells. Caution signs, such as those in **Figure 3-2**, warn about potential hazards or unsafe practices. For example, a caution sign might be used to warn workers entering an area where laser equipment is in use.

If a tool or piece of equipment is defective, a temporary tag should be placed on it to warn people that it should not be used. The tags shown in **Figure 3-3** are examples. A



**Figure 3-2 Safety Signs**  
**Identify Danger** Learn to recognize safety signs and colors. The color of a sign relates to its meaning.



**Figure 3-3 Safety Tags**  
**Identify Danger** Tags are placed on tools to warn of faulty operation or maintenance issues. They should be connected with light wire or some other material that is not likely to come loose.

lockout/tagout procedure may be required. *Lockout/tagout* is the use of lockout devices and/or tags to prevent accidental machine startup or release of stored energy.

Barricades, or barriers, can be set up to prevent people from entering a dangerous area. This is often done to guard the outside edges of holes dug for foundations. It is also done to prevent workers from falling off the edge of flat roofs.

The colors used on signs, tags, and barricades have specific meanings. For example, red means “danger” and yellow means “caution.” See **Table 3-1** for an explanation of the safety color codes.

*Never* use yellow caution tape to identify a dangerous area because yellow means “caution, proceed with care.” Always use red tape to mark a dangerous area because red means “DANGER KEEP OUT.”

Color	Meaning
Red	Danger or emergency
Orange	Be on guard
Yellow	Caution
White	Storage or boundaries
Green	First aid
Blue	Information

## Fire Prevention and Equipment
























Flammable materials are often found at construction sites. These materials include wood, fuel for generators and other equipment, and paint and solvents. Weeds, grass, and *debris* (scraps) around the structure can also catch on fire. To prevent fires:

- Dispose of scraps and rubbish daily.
- Keep the area cleared of weeds and grass.
- Make sure electrical wiring and equipment are properly installed and working correctly.
- Maintain clearance around lights and heaters so that they do not set materials on fire.
- Store materials properly. For example, flammable liquids must be stored in approved, closed containers.
- If a flammable liquid spills or leaks, clean it up promptly and safely.

- Never smoke on the job site, particularly near flammable materials.
- Do not block exits with materials, equipment, or debris. In case of fire, people need to be able to exit quickly.

Construction sites are required to have firefighting equipment on hand. Some fires can be put out with water, so there is usually a water supply available as well as fire pails or hoses. Fire extinguishers are also needed, especially for fires that cannot be put out with water. **Figure 3-4** lists the four types of fire extinguishers. Note that three of the types are suitable for more than one kind of fire. Class D extinguishers are suited only to one special type of fire.

**Using a Fire Extinguisher** Various fire extinguishers might be found on a job site, including models that rely on dry **chemicals**, Halon, water, or carbon dioxide. However, the basic method for using any of these extinguishers is

Types of Fire Extinguishers		
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 metals	Class D 

**Figure 3-4** Types of Fire Extinguishers

**Know Your Icons** Newer fire extinguishers have pictorial icons that explain what types of fire they should be used on. A diagonal red slash through the icon means that the extinguisher should not be used for this type of fire. *Which class of fire is associated with combustible metals?*

similar. Remember this acronym: **PASS** (Pull, Aim, Squeeze, Sweep).

- P = **Pull** the pin at the top of the extinguisher.
- A = **Aim** the nozzle toward the base of the fire. Stand about 8' from the fire.
- S = **Squeeze** the handle to discharge the extinguisher.
- S = **Sweep** the nozzle back and forth, aiming at the base of the fire.



**Define** What does the acronym **PASS** stand for?

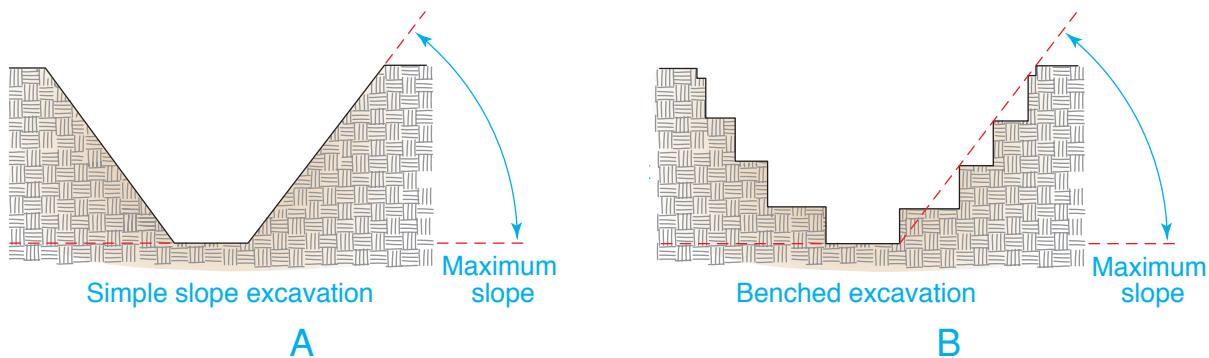
## Excavation Safety

An **excavation** is a cut, cavity, trench, or depression made by removing earth. Excavations are dug to prepare the site for footings and foundations. They are also required when installing pipes for site drainage. Workers near an excavation must be careful not to fall in. For those who are working within the excavation, the dangers include cave-ins and the possibility of equipment falling into the excavation. Excavations should be inspected daily for signs of soil movement or other problems. If an excavation is deeper than 5 feet, OSHA requires that workers be protected from cave-ins by shoring (reinforcing the walls), trench boxes, or by shaping the sides of the excavation to

minimize the hazard. Two basic ways to shape an excavation are called simple slope and benched slope, shown in **Figure 3-5**.

In benching, the soil is excavated to form one or more horizontal levels, or steps. The surfaces between levels are vertical or nearly vertical. Simple slope or benched slope excavations deeper than 20' must be designed by a registered engineer.

- Before starting an excavation, local utilities must be contacted in order to determine the location of existing underground utility lines. *Always call before you dig!*
- To minimize the danger of cave-ins, the sides of the excavation should not be too steep. The proper slope depends on the soil type.
- The soil that has been removed must be piled at least 2' away from the edge of the excavation. Any equipment must also be kept at least 2' from the edge to minimize the danger of falling in.
- Workers should not stand or work directly underneath the loads being handled by digging or lifting equipment.
- There must be a means for workers to get out of the excavation, such as a ladder or a ramp. The ladder or ramp should be no more than 25' away from any worker.
- Standing water must be pumped out of the excavation.



**Figure 3-5 Types of Excavations**

**The Right Slope** The maximum safe slope for the sides of an excavation is determined by the soil type. **A.** A simple slope excavation is quite common on residential job sites. **B.** A benched slope excavation may also be suitable. *Why is it important to shore up the walls of a trench that is deeper than 5 feet?*

**After You Read: Self-Check**

1. What is the purpose of the Occupational Safety and Health Act?
2. What are an employer's basic responsibilities under OSHA?
3. What is the purpose of a barricade?
4. Why is it important to keep exits clear of materials, equipment, and debris?

**Academic Integration: Mathematics**

5. **Finding Perimeter** A 25' by 40' rectangular hole has been excavated for the foundation of a new building. An additional 6' of work area around all sides of the hole has been marked off. What is the perimeter of the work area?

**Math Concept**

The perimeter is the distance around a geometric figure. The perimeter can be calculated using the following formula:

$$\text{Perimeter} = (\text{length} + \text{width}) \times 2, \text{ or } P = 2(l + w)$$

**Step 1:** Draw a picture of the excavation site. Indicate the measurements of the hole.

**Step 2:** Extend the length and width of the hole by 6 feet on both sides. Use the formula to find the perimeter.



Go to [glencoe.com](http://glencoe.com) for this book's OLC to check your answers.

# Personal Safety & Health

## Responding to Emergencies

### *Who should administer first aid?*


**First aid** is the initial help and care given to an injured person on the job site. If a construction site is not close to a hospital or other source of medical help, OSHA requires that a person who is certified to give first aid be at the job site. A first-aid kit must also be available on the job site.

Even if you are not certified to give first aid, you should always respond to an accident or injury. Make sure that you:

- Report all injuries immediately to your instructor or supervisor.
- Know how to summon help. Your instructor or supervisor can give you this information. Many workplaces require this information to be posted.
- Know the location of first-aid equipment. Even if you are not giving first aid, you may be asked to bring the materials to someone else.
- Do not give first aid unless you have been trained to do so. Untrained people can make an injury worse or endanger themselves.



- Use all suitable safety equipment.
- Get into the habit of scanning the work area for potential problems. Take immediate steps to prevent any problem from causing injury. For example, spilled liquid on a smooth surface or a loose railing could cause a person to slip or lose his or her balance.
- Always observe the entire area surrounding the injured person. Identify any life-threatening conditions, such as downed power lines or chemical spills, and react accordingly. For example, a person attempting to give aid to a person who has been electrocuted by a live wire could become a victim also if the injured person is still in contact with a live wire. Fumes from a toxic chemical spill could affect your breathing and eyesight.



**BASICS OF FIRST AID** First aid is the initial help and care given to an injured person on the job site.

- Always perform an initial assessment of the ABCs: **A**irway, **B**reathing, and **C**irculation.
- First aid providers must recognize the signs and symptoms of heart attack and stroke and perform CPR accordingly.
- Controlling bleeding is the first priority in treating an open wound.
- To perform first aid safely, you must recognize the signs and symptoms of job site injuries and emergencies.

 Go to [glencoe.com](http://glencoe.com) for this book's OLC for more on job safety.

## Hazards on the Job Site

### *Why are unprotected openings dangerous?*

Falls are the most common cause of major injury on a construction site. Other common injuries include cuts, puncture wounds, hearing damage, and injuries from falling objects or contact with toxic (poisonous) substances.

### Falls and Falling Materials

Because falling is the most common cause of injury on a construction site, stay alert for possible hazards. Always wear proper footwear, which will help you to maintain traction. Always walk; do not run. Anyone who works at a height, such as carpenters, masons, roofers, and painters, should take extra care. Safety harnesses may be required. OSHA standards on fall protection require that any person working at a height above six feet must be protected by guardrails or wear fall protection and be properly secured.

Stairwells must have a safety railing around them at all times. Unprotected or poorly protected stair openings can lead to serious falls. However, not every railing

is safe, as shown in **Figure 3-6**. When constructing a safety railing, try to imagine how it would perform if someone carrying tools suddenly slipped on a step. Would the railing prevent the person from toppling over the edge?

All connections in a railing system must be strong enough to withstand sudden stresses. Screwed connections are generally better than nailed connections. However, be sure the screws are suitable for the work. For example, drywall screws may snap when subjected to sudden shear forces. Temporary openings in a roof, such as skylight framing, should be covered with a thick sheet of plywood when not being worked on. The plywood should be nailed or screwed in place to prevent it from slipping. Covers over openings must be labeled using red lettering to signify danger to ensure that they are not removed accidentally or left in place longer than necessary. Roof jacks or other scaffolding should be used whenever necessary to prevent falls (see Chapter 7, “Ladders, Scaffolds, & Other Support”).

Many building materials become slippery when wet or frosty. This is particularly true of plastic, plywood, and housewraps. Keep



 **Figure 3-6 A Stairway Hazard**

**Danger Zone** The safety rail at the top of this opening should extend to the end of the opening and should have a full mid-rail. The handrail on the stairway should also include a mid-rail. *What portions of this railing are the weakest?*

workplace floors as clean and dry as possible to prevent accidental slips.

Be sure to dispose of debris properly. Never step on any material that is not nailed down.

Whenever construction debris must be dropped from a height of 20' or more to any point outside the building, an enclosed chute must be used. This reduces the danger of falling objects to workers below. When debris is dropped through a hole in the floor without the use of chutes, the spot where it lands must be completely enclosed with barricades.



### Reading Check

**Explain** What is one way to prevent falling when working on a roof?

## Electrical Hazards

Electric tools are common on the job site. Electrical safety is important because even a small jolt can injure or kill a worker. A



## JOB SAFETY

**BLOOD-BORNE PATHOGENS** If you provide first aid to an injury on the job site, you may encounter blood. Blood and other body fluids can contain microorganisms (viruses and bacteria) that are hazardous to your health. Take precautions to avoid direct contact with blood and other body fluids, and be especially careful to protect your eyes, mouth, and nose from these fluids.



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**conductor** is a material that electricity readily flows through. Conductors include most metals. Materials that do not conduct electricity readily are called insulators. Rubber is a good insulator. However, moisture can cause some materials to conduct electricity, even if they are poor conductors when dry. This is particularly true of wood.

When electricity flows from a point of origin and returns to that point of origin through a conductor, it makes an **electrical circuit**. Most conductors used in circuits are metal wires insulated with a plastic or rubber casing. The insulation protects the user from the electricity. However, if the insulation is frayed or broken, the conductor is exposed. A person can become part of a circuit by touching both wires in the circuit or by touching the "hot" wire and a ground wire. (The hot wire is the one bringing electrical power to a device.) A person can also become part of the circuit if the tool being used comes in contact with a wire carrying electricity. This could be a hand tool, such as a screwdriver, or a power tool. When the body becomes part of the circuit, the electricity that flows through it can cause serious burns, injury, or even death.

For safety, all power tools must be grounded. **Grounding** provides a path for the electricity to flow safely from the tool to the earth. If a person accidentally becomes part of the circuit, electricity will flow through the ground wire, not through

the person using the tool. Any break in the grounding system makes it useless, so it is very important to keep the system working properly.

**Electrical Tool Safety** Electric tools typically rely on one or more of these safety systems:

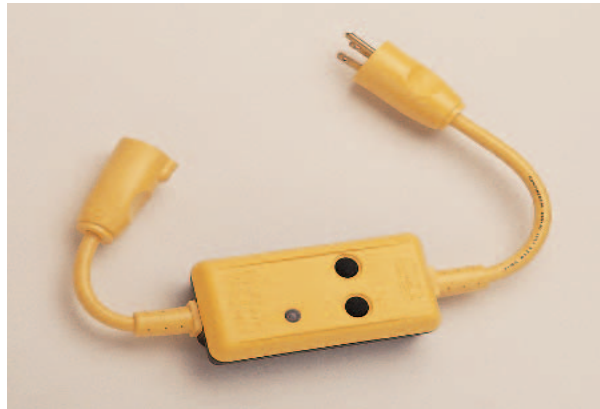
- A three-wire cord with a grounding prong. The grounding prong must never be removed from the plug. When an adapter is used on a two-hole receptacle, the adapter wire must be attached to a known ground.
- A two-wire cord and an insulating plastic shell around the tool's electrical **components**. The tool is then referred to as a double-insulated tool.
- A Ground-Fault Circuit Interrupter (GFCI). A GFCI is a fast-acting circuit breaker that can protect people from electrical shock. One version of this device is shown in **Figure 3-7**. A GFCI can be attached to the cord supplying electricity to a power tool. It is particularly important whenever moisture is present. Employers are required to provide GFCIs for all temporary 120-volt, 15- and 20-ampere receptacle outlets on a construction site. A GFCI should also protect any permanent wiring used during the construction process. OSHA requires that GFCIs be used in addition to, not as a substitute for, grounding devices on tools.

GFCI protection is required by OSHA for any use of electrical tools on a job site. This can be accomplished either at the source by using a GFCI breaker in the electrical panel, using a GFCI outlet, or adding a GFCI pigtail (power cord adaptor) between the power cord and the receptacle.

## Preventing Tool Injuries

Using hand and power tools can create many hazards. However, keeping five basic safety rules in mind can help to prevent many injuries:

1. Use the proper personal protective equipment, including protective eyewear, in the correct way.



**Figure 3-7 A Portable GFCI**


**Safety Precaution** A ground-fault circuit interruptor (GFCI) attached to an extension cord protects workers against electrical shock. *In what kind of weather conditions would a GFCI be particularly important?*

2. Use the right tool for the job.
3. Examine each tool for damage before use. Do not use damaged tools.
4. Operate tools according to the manufacturer's instructions.
5. Keep all tools in good condition by performing regular maintenance.

**General Power Tool Safety** Here are some basic safety guidelines to follow when you are using power tools:

- Avoid damaging cords or hoses. Never carry a tool by the cord or hose. Never yank the cord to disconnect it from a receptacle.

**POWER TOOLS** This section includes general safety rules for power tools. We strongly advise you to check the manufacturer's manual for each tool for any special safety instructions. In addition, follow the suggestions for power tools given in other chapters of this book.

 Go to [glencoe.com](http://glencoe.com) for this book's OLC for more on job safety.

- Avoid accidental starts. Do not hold your fingers on the on/off switch while carrying a plugged-in tool. In addition, be sure the tool's switch is in the "off" position before plugging the tool in.
- Unplug or disable tools when not using them, before servicing or cleaning them, and when changing or adjusting accessories, such as blades, bits, and cutters.
- Always check lumber for knots, splits, nails, and other defects before machining it. Defects can cause a tool to move unpredictably.
- Use guards on power equipment and be sure they are installed correctly. Standard safety guards must *never* be removed when using a portable power tool.
- Keep your fingers away from the cutting edges of tools. For example, do not try to hold small stock while it is being cut, shaped, or drilled. Secure the stock with clamps or in a vise whenever possible. This frees both hands to operate the tool.
- Pay attention to the job. Always keep your eyes focused on where the cutting action is taking place. Do not talk with others while you are working with power tools. Never talk to or interrupt anyone else who is using a power tool.
- Always use a brush, not your hand, to clean sawdust away from a power tool.
- Be sure to keep good footing and maintain good balance when operating power tools.
- Always use the recommended extension cord size when using portable power tools. **Table 3-2** on page 89 provides recommended cord sizes.
- Loose clothing or jewelry can become caught in moving parts. Wear proper apparel for the task.
- Hair can become caught in moving parts. Tie back long hair.
- Keep work areas well lighted.
- Take steps to ensure that power cords will not create a tripping hazard.
- Never leave tools or materials on any piece of equipment while it is in use. This is especially important with table saws.
- When finished with a power tool, wait until the blade or cutter has come to a complete stop before walking away. Make all adjustments with the power off and the machine at a dead stop.
- Report strange noises or faulty operation of machines to your instructor or supervisor.
- Remove all damaged tools from use and tag them: "Do not use."
- Store electric tools in a dry place when not in use. Do not use them in damp or wet locations unless they are approved for those conditions.

**Power Saws** Kickback occurs when the stock being cut or the saw itself is thrown back at the operator at high speed. Because so many workers encounter kickback, the subject is discussed in detail in Chapter 5, "Power Saws." Always keep your hands clear of the cutting line. Never make adjustments while the saw is running. Disconnect the power source before changing a blade.

Always use a push stick to guide any piece of wood through the saw if it is too small to guide safely by hand. Also, never use a saw that does not have a working guard and anti-kickback device. A piece of wood is too small if your hand or fingers are in danger of coming in contact with the saw blade. Never wedge the guard or anti-kickback device out of the way.



**Explain** Why is it important to keep your hands clear of the cutting line when operating a power saw?

## Builder's Tip

**ABRASIVE WHEELS** Before an abrasive wheel is mounted, inspect it for damage and test it. To test a wheel, tap it gently with a light, non-metallic instrument. An undamaged wheel will give a clear metallic tone or “ring.” If you hear a dull “thud” instead, the wheel is cracked or damaged and should not be used. Visually check the edge of the wheel for any sign of damage, such as chipping.

**Portable Tools With Abrasive Wheels** Portable abrasive grinding, cutting, polishing, and wire buffing wheels may throw off flying fragments. They must be equipped with suitable guards.

- Never stand directly in front of the wheel as it accelerates to full speed. An abrasive wheel may disintegrate during start-up.
- Ensure that the operating speed of the tool does not exceed the maximum speed marked on the wheel.
- Allow the tool to reach operating speed before you use it.
- Never clamp a hand-held grinder in a vise.

**Gasoline-Powered Tools** Various construction tools are sometimes fueled with gasoline. These include air compressors, chain saws, and portable concrete-cutters. Fuel vapors can burn or explode, and engines create dangerous exhaust fumes.

- Transport and store fuel only in approved containers for flammable liquids.
- Shut down an engine and allow it to cool before filling its fuel tank. This helps prevent vapors from igniting.
- Never fill the fuel tank of a piece of equipment in an enclosed area. Always clean up any spilled fuel immediately to prevent a sudden fire.
- Provide suitable ventilation when the tool is used in an enclosed area.

This lessens your exposure to carbon monoxide.

- Keep a fire extinguisher nearby.

**Powder-Actuated Tools** Powder-actuated tools, such as the one shown in **Figure 3-8** are used to install various types of fasteners into steel, concrete, and masonry. They operate like a firearm and use gunpowder to propel the fastener into the material with great speed.

These tools must be treated with extreme caution. They should be operated only by employees certified in their proper use. OSHA requires that any person operating powder-actuated tools be trained and licensed. Different tools from different manufacturers require specific training for each. Workers using powder-actuated tools should do the following:

- Wear suitable ear and eye protection.
- Select a powder level that is right for the tool and that is able to do the work without excessive force.



**Figure 3-8 Powder-Actuated Tools**  
**Proper Protection** Powder-actuated tools are powerful. Hearing and eye protection are essential when using them. Never use this tool unless you have been trained in its use.

## Step-by-Step Application

**Determine the Size of Extension Cord** It is important to match a power tool to a suitable extension cord. A power tool connected to an improperly sized extension cord will not work properly. For example, if a tool draws more current than the cord can handle, the cord and the tool may overheat. This could cause a fire.

Wires inside an extension cord are rated by their gauge number. The gauge is a ratio of size: the *larger* the wire diameter, the *smaller* the gauge number: 10 gauge wire is larger than a 14 gauge wire. Use Table 3-2 to choose an extension cord based on the current draw of the tool and the length of extension cord needed. The numbers in the chart represent the different gauges of wire used in extension cords. The thicker the wire, the smaller the gauge.

**Step 1** Check the nameplate on the tool to determine how much current it draws. The *amperage* of a tool is how much current it can carry. This is measured in *amperes*. An *ampere* is a measurement of electrical current or flow. It is often abbreviated as “amps” or “A.”

**Step 2** Find that number in the “Nameplate Amperes” column on the chart. For example, a standard electric drill might draw 4 amps of current.

**Step 3** Determine how long the desired extension cord must be. In other words, how far will the tool be from an electrical receptacle? As an example, assume that you wish to use an electric drill 75' away from the receptacle. In the shaded row under “Cord Length in Feet,” find 75.

**Step 4** Follow the column down under 75 to a number that corresponds to the ampere number. This will be the minimum gauge of wire required for this application. In this example, if a 4 amp electric drill is on a 75' long extension cord, the cord should be 16 gauge or heavier.

 Go to [glencoe.com](http://glencoe.com) for this book’s OLC for additional step-by-step procedures, applications, and certification practice.

**Table 3-2: Recommended Extension Cord Sizes for Use with Portable Electric Tools**

Nameplate Amperes	Cord Length in Feet							
	25	50	75	100	125	150	175	200
1	16	16	16	16	16	16	16	16
2	16	16	16	16	16	16	16	16
3	16	16	16	16	16	16	14	14
4	16	16	16	16	16	14	14	12
5	16	16	16	16	14	14	12	12
6	16	16	16	14	14	12	12	12
7	16	16	14	14	12	12	12	10
8	14	14	14	14	12	12	10	10
9	14	14	14	12	12	10	10	10
10	14	14	14	12	12	10	10	10
11	12	12	12	12	10	10	10	8
12	12	12	12	12	10	10	8	8
13	12	12	12	12	10	10	8	8
14	10	10	10	10	10	10	8	8
15	10	10	10	10	10	8	8	8
16	10	10	10	10	10	8	8	8
17	10	10	10	10	10	8	8	8
18	8	8	8	8	8	8	8	8
19	8	8	8	8	8	8	8	8
20	8	8	8	8	8	8	8	8

*Notes:* Wire sizes are for 3-CDR Cords, one CDR of which is used to provide a continuous grounding circuit from tool housing to receptacle. Wire sizes shown are A.W.G. (American Wire Gauge). Based on 115V power supply; Ambient Temp. of 30°C, 86°F.

- Faulty cartridges can explode unexpectedly. If a powder-actuated tool misfires, hold it in the operating position for at least 30 seconds before trying to fire it again. If the tool still does not fire, hold it in the operating position for another 30 seconds before removing the cartridge according to the manufacturer's instructions. Immerse the cartridge in water immediately after removal.
- Do not load the tool unless it is to be used immediately.
- Do not leave a loaded tool and cartridges unattended, especially where they might be found by someone not trained in their use.
- Never point the tool at anyone.
- Do not fire fasteners into a material they might pass completely through.
- Do not drive fasteners into very hard or brittle material that might chip, splatter, or make the fasteners ricochet.
- If impact tools, such as brick chisels, have a mushroomed head, the head can shatter, sending sharp fragments flying. Be sure heads are properly ground.
- Be sure cutting tools are sharp. If they are not, they require more force to use and are more likely to slip.
- When using a utility knife, consider wearing protective leather gloves. Always cut away from yourself. This simple tool is the source of many injuries.
- Never strike the head of a hammer with another hammer in order to drive the claws under the head of a nail to remove the nail from a piece of wood. The head of a hammer can shatter and strike a person with sharp slivers of metal.
- Always wear safety glasses when working with hand tools to avoid accidental damage to your eyes from flying objects.

**Hand Tools** The greatest hazards posed by hand tools result from misuse, carelessness, and poor maintenance. Because of the great variety of hand tools, it is impossible to provide a complete guide to their safe use. However, the following examples indicate the types of hazards you may encounter. You will also find safety rules in other chapters of this book where specific hand tools are discussed.

- Keep your fingers away from cutting edges.
- Do not hold small stock in your hand while it is being cut, shaped, or drilled.
- Do not use a chisel as a screwdriver. The tip of the chisel may break and fly off, hitting someone.
- If the wooden handle on a tool such as a hammer or an ax is loose, splintered, or cracked, the head of the tool may fly off and strike someone. Do not use tools in need of repair.
- Make proper adjustments to wrenches. If the jaws of a wrench are not adjusted properly, the wrench might slip.

## Musculoskeletal Disorders

Lifting, fastening materials, and other tasks can cause musculoskeletal disorders (MSDs). A **musculoskeletal disorder (MSD)** is a disorder of the muscles, tendons, ligaments, joints, cartilage, or spinal discs. **Ergonomics** is the science of designing and arranging things to suit the needs of the human body. Using ergonomically designed tools can lessen the risks of MSDs. Tool features such as cushioned grips and properly angled handles can improve the safety of a tool as well as minimize physical stress and fatigue. Many hand tools and power tools are now available in versions with ergonomic improvements, such as those tools shown in **Figure 3-9**.

**Repetitive Stress Injuries** A worker's body can be damaged gradually by years of impact or motion. When a task done over and over causes minor irritation to nerves and tissues, the damage is called a **repetitive stress injury (RSI)**. Carpal tunnel syndrome is one type of RSI involving the hand. Repetitive stress can cause permanent damage. A carpenter, for example, can develop RSI in a wrist after long periods of using a hammer. Hammering



**Figure 3-9 Ergonomic Tools**  
**Design for Safety** The ergonomic design of tools increases their usability. Some tools shown here have cushioned handles while others are shaped in a way that reduces wrist strain. *Why do you think the shape of a tool can make a hand tool safer or easier to use?*

with a minimum of wrist movement can help carpenters avoid this problem. Pneumatic nailers also help, although they may stress a body in other ways.

Other workers, such as trim carpenters and tilers, work for long periods on their knees. Special kneepads can protect knees from repetitive stress injuries. In general, whenever work calls for a repeated motion, steps should be taken to lessen its negative effects.

Many protective devices, such as knee pads, feel awkward to use at first. This sometimes causes workers to stop using them. Be patient. Adjust the device for maximum comfort and use it consistently. Eventually, you will not even notice that you are wearing it.

**Back Injuries** Proper handling of materials makes any job site safer. Back injuries when handling materials are among the most common injuries suffered by carpenters and masons. Lifting that occurs with objects held below the knee or above the shoulders is more strenuous than lifting from the body's center.

Back injuries can be avoided or made less severe if you remember this rule: Lift with your legs, not with your back. This means that you should bend your knees and keep your back straight to prevent back muscles from being strained, as shown in **Figure 3-10** on page 92.

Obtain help for lifting loads heavier than you can manage. Whenever possible, stacks of material should be lifted by equipment designed for this task. This relieves workers from having to do tiring work, and it also shortens the delivery time.

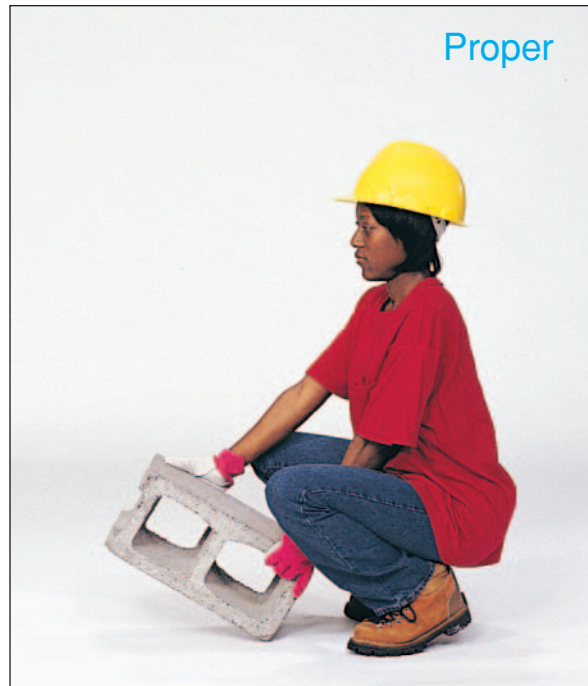
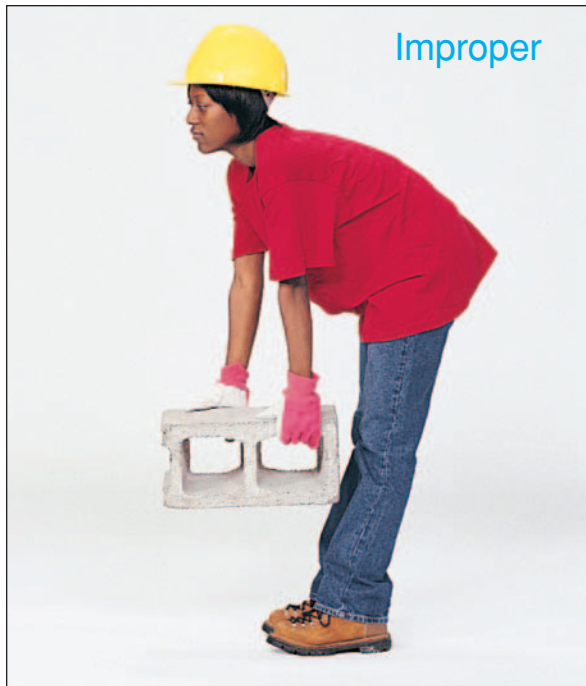
Back muscles can also be injured if they are twisted while carrying a long piece of material. Long pieces of material should always be carried by two people. Proper support while cutting materials is also important. Whenever possible, the material should be supported securely at a comfortable height. Portable sawhorses, such as those shown in **Figure 3-11** on page 92, can be moved around a job site for this purpose. Never stand on sawhorses or use them for scaffolding. They are only meant to support material that you are working on.

### **Hazardous Materials**

Repeated contact with such things as chemicals or dust is often ignored as a threat to a worker's health. However, these materials may affect a worker's health over time. When a worker finally realizes the problem, his or her health may already have suffered permanent damage. Hazardous and toxic substances common on construction sites include dust, fuels, solvents, and chemicals.

OSHA currently regulates many hazardous substances. OSHA's Hazard Communication Standard, also known as the





**Figure 3-10 Lifting Heavy Objects**

**Bend Your Knees** Lifting properly will reduce the possibility of back injury. *Can you name at least two small but heavy construction materials other than concrete?*

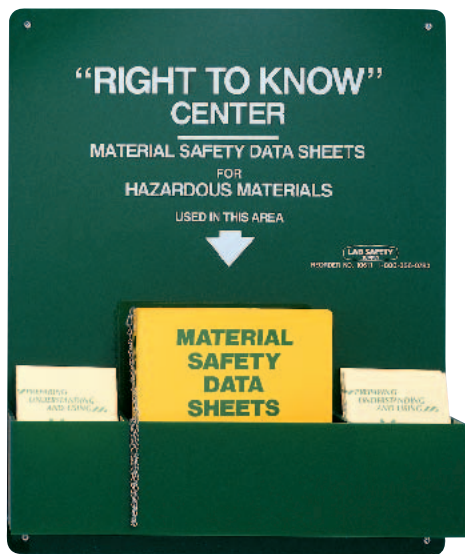


**Figure 3-11 Folding Sawhorses**

**Strong Support** Sawhorses can be used to position materials at the right height for cutting. Some have legs that can be adjusted to various lengths.

Right-to-Know Law, has led to better information about possible hazards. Manufacturers are required to provide Material Safety Data Sheets (MSDS) with shipments of their products. These sheets explain the hazards associated with the products and should be readily available, as shown in **Figure 3-12**. Many materials that are not typically thought of as hazardous are also covered by an MSDS. The sheets include information on physical data, like a material's melting point or flash point; levels of toxicity; recommendations for first aid, storage and disposal, protective equipment; and what to do if a spill or leak occurs. If an MSDS is not available on site, you may be able to locate it on the manufacturer's Web site. MSDS are easy to download.

Every worker must have access to MSDS. Regulations requiring that workers be notified of hazards are often called right-to-know laws. There are many different kinds of hazardous materials that workers may encounter on the job site. Some of the most common of these



**Figure 3-12 Safety Sheets**  
**Explaining Safety** Material Safety Data Sheets (MSDS) should be readily available at the job site. These sheets explain how to handle and use materials safely.

substances include crystalline silica, formaldehyde, asbestos, lead, and arsenic. Have MSDS readily available for the use of emergency medical personnel when they are responding to an accident. The information contained in the sheets could save the life of the injured person.

**Asbestos** Asbestos is a once widely used, mineral-based material that resists heat and destructive chemicals. It is no longer used in most building products, but it is likely to be found in materials manufactured before it was banned. Asbestos is a fibrous material with a whitish appearance. It may release its fibers, which range in texture from coarse to silky, into the air. The fibers may be too small to see with the naked eye. When asbestos fibers are inhaled or swallowed, they can cause *asbestosis* (a scarring of the lungs) and various types of cancer.


Asbestos is highly regulated by OSHA and other federal agencies. It should be handled or removed only by professionals specially trained for asbestos mitigation work. *Mitigation* refers to any process that makes

a harmful material less dangerous. In the home building industry, workers involved in remodeling and demolition projects are the most likely to encounter asbestos.

**Crystalline Silica** When materials such as concrete, masonry, and rock are cut or ground, the dust may contain extremely fine particles of a mineral called crystalline silica. Breathing in these particles can produce permanent lung damage called silicosis. To reduce exposure to crystalline silica, follow these guidelines:

- Always wear a respirator designed to protect against fine, airborne particles. However, do not depend on a respirator as the primary method of protection.
- When sawing concrete or masonry, use saws that spray water on the blade.
- Use a dust collection system whenever possible.

**Formaldehyde** Formaldehyde is found in the urea, phenol, and melamine *resins* used in some construction materials and adhesives. Studies indicate that it is a potential cancer-causing agent. When working with liquid products that contain formaldehyde, take care to prevent contact with your skin. When cutting products that contain formaldehyde, wear appropriate breathing protection. Many manufacturers have taken steps to reduce or eliminate the amount of formaldehyde in their products.



**YOUR RIGHT TO KNOW** The OSHA standard on Hazard Communication requires employers to inform their workers about dangerous chemicals they may encounter on the job. This requirement is often referred to as the workers' right to know. Many states also have their own right-to-know (RTK) laws.

Go to [glencoe.com](http://glencoe.com) for this book's OLC for more on job safety.

**Lead** Many materials containing lead have been eliminated from use in residential building construction because lead has long been recognized as a health hazard. This includes lead-based solders (once used to solder copper-pipe joints) and lead-based paint. However, lead-based materials may still be encountered during remodeling and demolition work.

The removal of lead-based paint can create large quantities of lead-containing dust. Some states require that materials containing lead be removed only by certified lead-abatement contractors.

**Arsenic** Arsenic is a poisonous element that was used for many years to protect certain types of wood products against attack by wood-destroying insects. It was commonly found in preservative-treated lumber used to build decks, fences, and other outdoor structures. Various studies indicated that arsenic could leach out of wood over time and contaminate soil and groundwater. The U.S. Environmental Protection Agency (EPA) eventually banned the use of arsenic-treated wood for use in residential construction. As of January 1, 2004, no such wood could be sold. For more on this topic, see Chapter 35, “Decks & Porches.”



**Identify** What are some hazardous or toxic substances commonly found on construction sites?

## Personal Protective Equipment

Throughout this book, you will find references to the need for personal protective equipment. Generally, this refers to hearing protectors, hardhats, safety glasses, hard-toe footwear, and dust masks or respirators. Do not think of these devices as inconveniences. They provide a barrier between you and a possible hazard. *They are essential tools that help you get the job done safely.* The protective equipment you choose should be approved for a given use by the American National Standards Institute (ANSI).

**Hearing Protection** Construction workers are regularly exposed to noise. High levels of noise can cause hearing loss. Too much noise may also cause other harmful health effects, such as impaired balance and elevated blood pressure.

Temporary hearing loss results from short-term exposure to noise, with normal hearing returning after a period of rest. Permanent hearing loss is generally due to long exposure to high noise levels over a period of time. Hearing protectors or ear protectors, such as those in **Figure 3-13** are designed to reduce the noise level. Because there are so many types of hearing protectors, you should not have any problem finding a model that is both comfortable to use and appropriate for the type of work you do. Many safety-conscious builders own several pairs so that they are always available. For example, one pair might be near the table saw, and another might be in the case housing a powder-actuated fastening system. If hearing protection is readily available, a person is more likely to use it. Damage to your hearing from repetitive loud noises accumulates over time. You may not realize the damage is being done because it happens



**Figure 3-13 Hearing Protection**  
**Noise Blocker** There are many types of hearing protectors. This type fits over the ear. Others fit into the ear canal to block noise.



**Figure 3-14 Head Protection**

**Heads Up** The hardhat on the top is designed to withstand a blow from directly above. The hardhat on the bottom is designed to withstand a blow from any side.

a little at a time. Then, when you finally realize that damage has been done, it may be too late to reverse.

**Head Protection** If there is an overhead hazard at a job site, OSHA requires the use of *hardhats* (see **Figure 3-14**). An overhead hazard includes something as common as a falling tool. Though many situations do not expose workers to overhead hazards, wearing a hardhat all the time is a reasonable precaution to take. On some job sites, the project manager requires everyone who enters the area to wear a hardhat.

**Eye Protection** Eye hazards are particularly common in construction for workers in all trades. Many eye injuries are caused by sparks, by flying particles smaller than a pinhead, or by chemicals or liquids that splash into a worker's face.

Because you never know when you might be exposed to an eye hazard, you should wear eye protection, such as the



**Figure 3-15 Eye Gear**

**Essential Eyewear** Always wear adequate eye protection for the job you are performing. Note the side shields on this pair of safety glasses. They provide additional protection against debris that might be deflected toward a worker from an unexpected angle.

pair of safety glasses shown in **Figure 3-15**, whenever you are on a job site. To be effective, the eyewear must be the right type for the hazard associated with the job. It must fit properly and be in good condition. For example, scratched and dirty lenses reduce visibility, cause glare, and may even contribute to accidents. Sometimes it is necessary to wear a full face shield for operations that generate large quantities of sawdust. There are now many sources of good-fitting, attractive, and comfortable safety glasses.

**Respiratory Protection** A standard dust mask can filter out large particles, such as the sawdust created by a circular saw. It cannot protect you against very fine dust. For very fine dust, use a *dust respirator* or a full



**Figure 3-16 A Cartridge-Type Respirator**

**Extra Protection** This partial-face respirator is fitted with replaceable cartridges that protect against specific hazards. Cartridges are often color coded to ensure proper use.



## Science: Spontaneous Combustion

**Disposing of Oily Rags** Oily rags soaked with solvents used to stain wood or clean equipment are common around a construction site. If these rags are not properly disposed of, they can pile up in an enclosed area such as a corner or an uncovered bucket. When the oils in the rags evaporate, heat can sometimes build up to the ignition point of the material used to make the rags. If enough oxygen is present, the rags can catch fire without any spark or flame to set them off. Cotton rags will catch fire if the temperature reaches about 430 degrees Celsius. What is the equivalent temperature using the Fahrenheit scale?

**Starting Hint** Solve for  $F$  using the following formula:

$$F = \frac{9}{5}C + 32$$

respirator. Respirators should be approved by the National Institute for Occupational Safety and Health (NIOSH). Respirators that contain replaceable filter cartridges, such as the one in **Figure 3-16**, can be used to protect against fumes. Be sure the cartridges you are using are designed to protect against the specific hazard you face. Many tools can also be equipped with a dust collection bag or connected to a vacuum system. Both catch dust before it becomes airborne, a great advantage in enclosed workplaces.

**Suitable Clothing** What you wear depends partly on the weather. However, you should choose suitable clothing for construction work, just as you would for any job.

- Avoid wearing pants or overalls that are too long or baggy. They tend to catch on your heels and cause falls. Avoid cuffs because they can collect debris such as sawdust and metal shavings.
- Upper-body clothing should not be so loose that it catches on nails or dangles near power tools. Keep the sleeves of shirts or jackets buttoned, or roll them up.

- Keep long hair tied back or cut it short.
- To protect feet from protruding nails, wear work boots with thick, sturdy soles. When working on a roof, wear boots with slip-resistant soles. Boots with safety toe caps protect feet from injuries caused by falling tools and materials.
- Rings, wristwatches, neck chains, and other jewelry can catch on tools or materials. Avoid wearing them.

## Protection from the Environment

Most construction workers work at least part of the time outdoors in a variety of climates and weather conditions. These conditions may vary a great deal from region to region. It is important to take precautions to protect your health and comfort.

**Heat** Four factors affect the amount of stress a worker faces in hot weather: overall temperature, humidity, radiant heat (such as from the sun or a furnace), and air movement. The body reacts to high temperatures by giving off excess heat through the skin and by sweating. If a person cannot dispose of excess heat, various problems such as heat rash, cramps, exhaustion, and heatstroke may then occur.

**Heat Rash** *Heat rash*, also known as prickly heat, may occur in hot and humid environments where sweat does not easily evaporate. When extensive, heat rash can affect performance or cause temporary disability. It can be prevented by resting in a cool place and allowing the skin to dry.

**Heat Cramps** *Heat cramps* are painful spasms of the muscles caused when a worker drinks large quantities of water but fails to replace salt in the body. Tired muscles are usually the ones most susceptible to cramps.

**Heat Exhaustion** *Heat exhaustion* results from loss of fluid through sweating when a worker has failed to drink enough fluids, take in enough salt, or both. A worker who has heat exhaustion still sweats but

experiences extreme weakness or fatigue, giddiness, nausea, or headache. The victim's skin will be clammy and moist and the body temperature will be normal or slightly elevated. The victim should rest in a cool place and drink an electrolyte beverage. Electrolyte beverages are those used by athletes to quickly restore potassium, calcium, and magnesium salts.

**Heatstroke** Heatstroke is the most serious heat-related health problem. It occurs when the body can no longer regulate its core temperature. Sweating stops and the body cannot rid itself of excess heat. Signs of heatstroke include the following:

- mental confusion or delirium
- convulsions
- loss of consciousness or coma; a body temperature of 106°F (41°C) or higher
- hot, dry skin that may be red, mottled, or bluish.

Heatstroke can be deadly. Summon medical help and move the victim to a cool area while waiting for help to arrive.

Most heat-related health problems can be prevented or the risk of developing them reduced. Follow these basic precautions:


- Wear suitable clothing.
- Install portable fans when working indoors.
- Drink plenty of water. You may need as much as a quart per hour.
- Alternate work with rest periods in a cool area. If possible, schedule heavy work during the cooler parts of the day.
- Get used to the heat for short periods. New employees and workers returning from a lengthy absence may need five days or more to adjust to the heat.

**Sunlight** Sunlight is a source of ultraviolet (UV) radiation known to cause skin cancer and various eye problems. People who have fair skin and light-colored hair are more sensitive to UV radiation than others.

Skin cancers detected early can almost always be cured. The most important warning sign for skin cancer is a spot that changes in size, shape, or color over a period of one month to two years. The most common skin cancers often take the form of a pale, waxlike, pearly nodule; a red, scaly, sharply outlined patch; or a sore that does not heal. The most serious type of skin cancer, called melanoma, often starts as a small, mole-like growth.

When working outdoors, take the following steps to protect yourself from UV radiation:

- Cover up. Wear clothing that protects as much of your skin as possible.
- Use sunscreen. A sunscreen with a Sun Protection Factor (SPF) of at least 15 blocks out 93 percent of the burning UV rays (UVB rays). The SPF number represents the level of sunburn protection. The higher the number is, the stronger the protection from burning rays will be.
- Wear a hat. A wide-brim hat is ideal because it protects the neck, ears, eyes, forehead, nose, and scalp. A baseball cap provides some protection for the front and top of the head, but not for the back of the neck or the ears, where skin cancers commonly develop.



**CPR BASICS** If you come across an unconscious person on the job, cardiopulmonary resuscitation (CPR) may be necessary. CPR is a procedure that is used to restore normal breathing and heart rhythm after cardiac arrest. It includes the clearance of air passages, the mouth-to-mouth method of artificial respiration, and heart massage done by exerting pressure on the chest.

Go to [glencoe.com](https://www.glencoe.com) for this book's OLC for more on job safety.

- Wear sunglasses. UV-absorbent sunglasses can block 99 to 100 percent of UV radiation. The UV protection comes from an invisible chemical applied to the lenses, not from their color or darkness. Choose a lens that is suitable for the work you do.
- Limit direct sun exposure. UV rays are most intense when the sun is high in the sky, between 10 a.m. and 4 p.m.

**Cold** When body temperature drops even a few degrees below 98.6°F, a worker is exposed to much stress. The four factors that cause cold-related stress are low temperatures, high/cool winds, dampness, and cold water. **Wind chill** is a combination of temperature and wind speed and increases the chilling effect. For example, when the actual air temperature is 40°F (4°C), a wind of 35 mph creates conditions equivalent to a temperature of 11°F (-12°C).

One of the most extreme conditions to result from exposure to cold is frostbite. When someone has frostbite, his or her skin tissue actually freezes. Initial effects include uncomfortable feelings of cold and tingling, stinging, or aching in the exposed area followed by numbness. Ears, fingers, toes, cheeks, and noses are commonly affected. Frostbitten areas appear pale and cold to the touch. If you suspect frostbite, seek medical assistance immediately.

Hypothermia occurs when body temperature falls to a level where normal muscle and brain functions are impaired. The first symptoms are shivering, an inability to make complex movements, lack of energy, and mild confusion. In severe cases, the person seems dazed and fails to complete even simple tasks. Speech becomes slurred and behavior may become irrational. Treatment of hypothermia calls for conserving the victim's remaining body heat and



## Estimating and Planning

### Clothing Costs



This estimating and planning exercise will prepare you for national competitive events with organizations such as SkillsUSA and the Home Builders Institute.

### Protective Clothing

If you are a builder who lives in an area in which weather extremes are common, you will have to invest in the appropriate work clothing. In warm climates, the investment may be small. Outfitting for cold weather, however, can be expensive. For example, in the Midwest, if you work outdoors, your winter clothing may include the garments shown in the table in addition to your everyday garments.

### Estimating on the Job

What is the climate like in your area or in an area in which you would like to work? Determine the most extreme weather conditions for that area. Then, using a catalog that features

Item	Approximate Cost*
Steel-toe insulated boots	\$75 – \$150
Thermal top and pants	\$50 – \$75
Thermal socks	\$7 – \$10
Flannel-lined jacket with hood	\$85 – \$125
Wind- and water-resistant insulated pants	\$60 – \$80
Insulated bib overalls	\$100 – \$150
*Costs are for moderately priced items.	

work clothing or by visiting a local store, estimate the cost of the clothing you would need on a day of bad weather.

providing additional heat sources. Seek medical assistance immediately.

The proper use of protective clothing as shown in **Figure 3-17** is important in avoiding cold-weather health problems. Pay special attention to protecting feet, hands, face, and head. Wear at least three layers of clothing:

- An outer layer to keep out the wind yet allow some ventilation.
- A middle layer of wool or synthetic fabric to absorb sweat but insulate against dampness.
- An inner layer of cotton or synthetic weave to allow ventilation.



**Figure 3-17 Beating the Cold**

**Insulating Layers** Multiple layers of clothing provide the best cold-weather protection. Choose clothing that will not interfere with the work you have to do. *What kinds of cold-weather clothing would be unsuitable for workers on a job site?*

## Section 3.2 Assessment

### After You Read: Self-Check

1. What is the most common cause of injury on a construction site?
2. How does a conductor differ from an insulator?
3. What is an MSDS, and why is it important?
4. List at least three symptoms of heat exhaustion.

### Academic Integration: Science

5. **Protective Gear** Overexposure to the sun's ultraviolet rays can cause different types of skin damage, from sunburn to premature wrinkling to skin cancer. Research sun-protective clothing that can minimize exposure to these harmful rays. Write one or two paragraphs describing the design features and materials used in this type of clothing that makes it protective.

Go to [glencoe.com](http://glencoe.com) for this book's OLC to check your answers.



# Review and Assessment

## Section

## 3.1

## Chapter Summary

The purpose of OSHA is to assure safe and healthful working conditions in the workplace. Workers must take responsibility for safety and know how to handle emergencies. Workers compensation helps workers financially after an injury. Keeping a work site safe includes good housekeeping and sanitation; proper use of signs, tags, and barricades; knowing about fire prevention and equipment; and following proper excavation procedures.

## Section

## 3.2

To protect personal safety and health, workers need to take precautions against falls and falling materials, electrical shock, injuries from tools, development of musculoskeletal disorders, and harm from hazardous materials. They should wear appropriate clothing and personal protective equipment, and they should protect themselves from environmental conditions such as heat, sunlight, and cold.

## Review Content Vocabulary and Academic Vocabulary

1. Use each of these content vocabulary and academic vocabulary words in a sentence or diagram.

### Content Vocabulary

- Occupational Safety and Health Administration (OSHA) (p. 79)
- excavation (p. 82)
- first aid (p. 83)
- conductor (p. 85)
- electrical circuit (p. 85)
- grounding (p. 85)
- musculoskeletal disorder (MSD) (p. 90)
- ergonomics (p. 90)
- repetitive stress injury (RSI) (p. 90)
- wind chill (p. 98)

### Academic Vocabulary

- physical (p. 78)
- chemicals (p. 81)
- components (p. 86)

## Speak Like a Pro

### Technical Terms

2. Work with a classmate to define the following terms used in the chapter: *inspections* (p. 78), *lockout/tagout* (p. 80), *barricades* (p. 80), *debris* (p. 81), *slope* (p. 82), *first aid* (p. 83), *ground-fault circuit* (p. 86), *asbestos* (p. 93), *mitigation* (p. 93), *resins* (p. 93), *hardhats* (p. 94), *dust respirator* (p. 95).

## Review Key Concepts

3. Explain the rights of employers and employees under OSHA.
4. Describe two methods used to keep a work site safe.

5. Define first aid.

6. Recall the most common cause of major injury on construction sites.

7. List the five basic safety rules for hand and power tools.

8. Identify five types of personal protective equipment.

## Critical Thinking

9. Apply What could you do as you work with gasoline-powered tools to avoid carbon monoxide poisoning?

## Academic and Workplace Applications

### STEM Mathematics

- 10. Line Graphs** The chart below shows wind chill, the effect of wind on how we experience temperature. For example, when the wind is blowing at 10 mph and the temperature is 30°F, it feels like 21°F. Create a line graph to display the information in the charts.

Wind Chill Effect with a 10 mph Wind					
Temperature °F	0	10	20	30	40
Windchill °F	-16	-4	9	21	34
Wind Chill Effect with a 30 mph Wind					
Temperature °F	0	10	20	30	40
Windchill °F	-26	-12	1	15	28

**Math Concept** **Line Graphs** A line graph is a good way to show how two pieces of information are related and vary depending on each other.

**Step 1:** Draw and label a coordinate grid with an  $x$ -axis and a  $y$ -axis. Mark a scale that fits the data you are going to plot. Hint: mark off every 10 degrees.

**Step 2:** Plot the points and draw lines. Use the same coordinate grid to plot lines for both tables.

### 21st Century Skills

- 11. Media Literacy** OSHA makes available posters that can be displayed at construction worksites to promote safety. The safety messages that follow are taken from actual OSHA posters. Which do you think would be most effective in encouraging worker safety on the job? Which is least effective? Write a few sentences explaining your choices. Write a message of your own that could be used on an OSHA poster.
- Uncle Sam Wants You to Be Safe
  - Be a part of safety... Together Everyone Accomplishes More
  - Don't Be a Fool! Being Safe Is Being Cool.
  - Safety's Intention Is Accident Prevention

- It wouldn't "Kill" you to attend a safety meeting . . . Would It?
- A Clean Environment Is a Safe Environment
- When there is a question. . . Wear your eye protection.

### STEM Science

- 12. Heat Exposure** Prolonged exposure to heat can cause heatstroke and heat exhaustion. Research these two conditions. Find out what causes them, how people working in construction can protect themselves from these conditions, and how to treat people who develop these conditions. Summarize your findings in a one-page report.

### Standardized TEST Practice



#### Multiple Choice

**Directions** Choose the word or phrase that best answers the question.

- 13.** Which of these materials is considered a good insulator?
- water
  - a GFCI
  - wire
  - rubber
- 14.** Which colors are used most often on caution signs?
- red and blue
  - yellow and black
  - orange and black
  - black and white
- 15.** What information about a material would not be found on an MSDS?
- levels of toxicity
  - melting point
  - price
  - recommendations for disposal

#### TEST-TAKING TIP

Look for key words in test directions. For example, choose, describe, compare and contrast, and write a sentence are key words and phrases that tell you how to answer the questions.

\*These questions will help you practice for national certification assessment.


# UNIT 1

## Hands-On Math Project

### Green Construction in the Community

#### Your Project Assignment

For this project, you will estimate costs for green and standard construction.

- Find a local organization, such as YouthBuild U.S.A., that builds or renovates homes in your community.
-  **Build It Green** **Research** green alternatives to standard home construction methods.
- **Prepare** the basic activity schedule for a home construction project by your organization.
- **Calculate** the cost differences in construction labor and materials for using a minimum of three green alternatives.
- **Create** a three- to five-minute presentation.

#### Applied Skills

Some skills you might use include:

- **List** the steps in planning to build a house.
- **Research** the factors involved in making construction cost estimates.
- **Define** and select three green alternatives you recommend to build this house. (Tip: Green alternatives can be found at nearly any stage of construction—be creative!)
- **Describe** the steps you use to make your basic cost estimate. (Tip: Don't forget to include your measurements!)
- **Compare** the costs for your green and standard construction operations.



#### Math Standards

**Number and Operations:** Compute fluently and make reasonable estimates

**Measurement:** Apply appropriate techniques, tools, and formulas to determine measurements.

**NCTM** National Council of Teachers of Mathematics

#### The Math Behind the Project

The traditional math skills for this project are estimation and measurement. Remember these key concepts:

##### Estimation

For quick estimates, round measurements up for lengths and quantities. For example, if you were calculating the area of a concrete slab that was 24' 4" × 15' 9", you could use the numbers 25' × 16' for your estimate.

##### Percentage

To calculate percentage change in cost for materials, subtract the cost of green product from the cost of the standard product. Divide the difference by the cost of the standard product. For example, if wood studs cost \$123.50 and steel studs cost \$145.87, to find the percentage difference, use the following steps:

1. Subtract the costs.	$\$123.50 - \$145.87 = \$-22.37$
2. Divide the difference by the standard product price.	$\$-22.37 \div \$123.50 = \$-0.181$
3. Convert the decimal number to percentage.	$-0.181 \div 100 = -18\%$

This means that the green alternative (steel) costs 18% more than the wood stud construction.






**Mission:** Unleash the intelligence and positive energy of low-income youth to rebuild their communities and their lives.

➤ Go to [glencoe.com](http://glencoe.com) for this book's OLC for more information on this organization.

## Project Steps

### Step 1 Research

- Contact your organization to find out the average cost for their standard home construction projects.
-  **Build It Green** List several green methods that could be used in place of standard construction methods.
- Select a minimum of three green methods you recommend be used.
- Determine the factors that influence price differences between your green methods and the standard ones.
- Confirm the cost and installation differences between green and standard construction.

### Step 2 Plan

- Choose the basic design plan for your home.
- Measure the proposed dimensions of your home and calculate the total square footage.
- Determine the basic materials and supplies your organization will use to construct the home.
- List the types of skilled labor this construction will require.

### Step 3 Apply

- Use your research to create a cost comparison of the two methods of construction.
- Create a material take-off for green methods and standards and calculate the cost differences.
- Make a CPM flow chart showing the construction process. Use general system terms such as rough plumbing, foundation, and wall framing.

### Step 4 Present

Prepare a presentation combining your research and cost calculations using the checklist below.

#### PRESENTATION CHECKLIST

##### Did you remember to...

- ✓ Organize your research by step and topic?
- ✓ Use a calculator or spreadsheet for the cost calculations?
- ✓ Create visual aids
- ✓ Create notes you might need for your presentation?
- ✓ Focus on your recommendations for green methods?
- ✓ Explain the cost differences between green and standard methods?

### Step 5 Technical and Academic Evaluation

Assess yourself before and after your presentation.

1. Did you plan your steps carefully?
2. Is your research thorough?
3. Were your cost estimates accurate?
4. Were your green method alternatives realistic?
5. Was your presentation creative and effective?

➤ Go to [glencoe.com](http://glencoe.com) for this book's OLC for an evaluation rubric and Academic Assessment.

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➤ Go to [glencoe.com](http://glencoe.com) for this book's OLC to read an article titled "Q&A with Jim 'ZZ' Zradicka" to learn about the ways this contractor supports his community. Write a summary of the article.