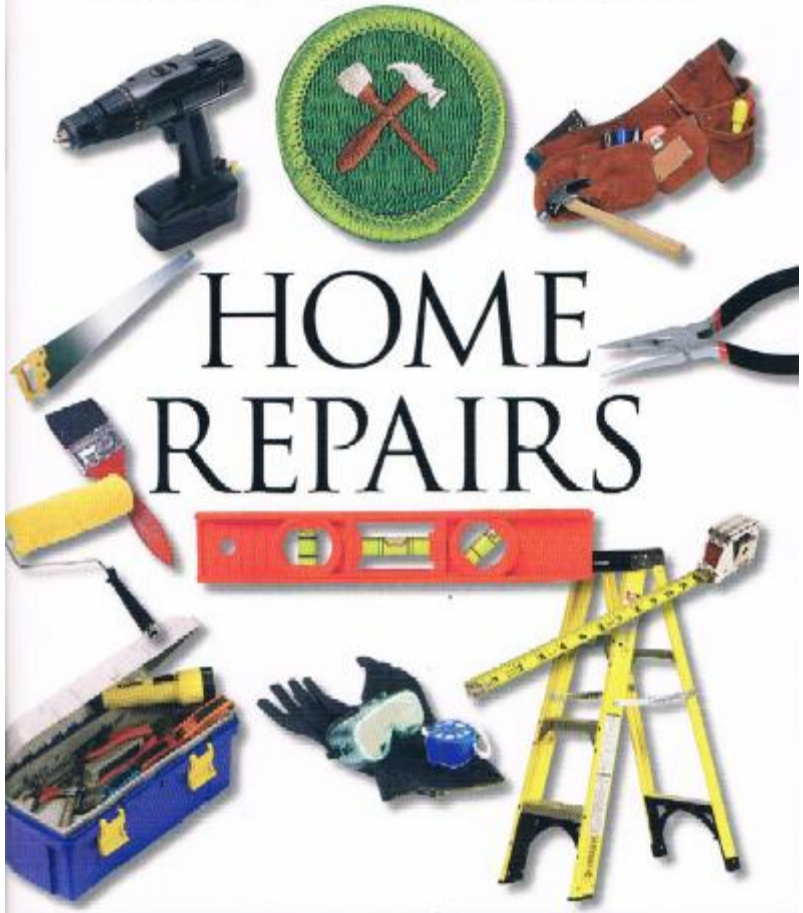
MERIT BADGE SERIES



# HOME REPAIRS

BOY SCOUTS OF AMERICA®

## How to Use This Pamphlet

The secret to successfully earning a merit badge is for you to use both the pamphlet and the suggestions of your counselor.

Your counselor can be as important to you as a coach is to an athlete. Use all of the resources your counselor can make available to you. This may be the best chance you will have to learn about this particular subject. Make it count.

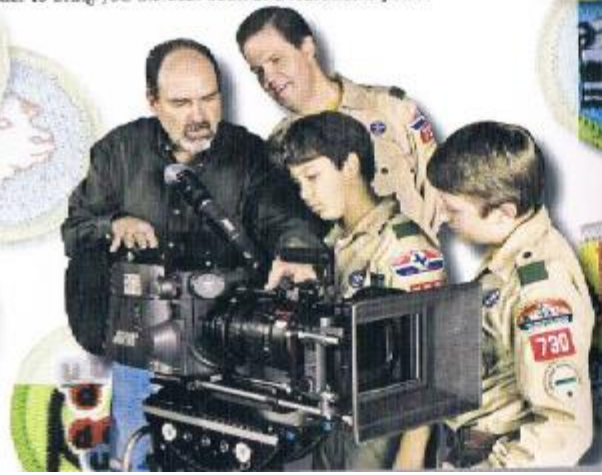
If you or your counselor feels that any information in this pamphlet is incorrect, please let us know. Please state your source of information.

Merit badge pamphlets are reprinted annually and requirements updated regularly. Your suggestions for improvement are welcome.

Send comments along with a brief statement about yourself to National Advancement Committee, S209 • Boy Scouts of America • 1325 West Walnut Hill Lane • P.O. Box 152079 • Irving, TX 75015-2079 • merit.badge@Scouting.org.

## Who Pays for This Pamphlet?

This merit badge pamphlet is one in a series of more than 100 covering all kinds of hobby and career subjects. It is made available for you to buy as a service of the national and local councils, Boy Scouts of America. The costs of the development, writing, and editing of the merit badge pamphlets are paid for by the Boy Scouts of America in order to bring you the best book at a reasonable price.



BOY SCOUTS OF AMERICA
MERIT BADGE SERIES

# HOME REPAIRS

*"Enhancing our youths' competitive edge through merit badges"*

BOY SCOUTS OF AMERICA®

# Note to the Counselor

Nothing encourages pride in one's surroundings more than being able to improve them through one's own initiative and resources.

That is why the Home Repairs merit badge can be so important to the development of a young person. Once a Scout learns basic home repair skills and applies them to his own environment, he will have a lifetime resource: his ability to learn new skills.

Home repair, however, can be intimidating at first, especially if the Scout lacks a role model for such activities. If possible, provide one-on-one or group activities that will get the Scout off to a good start.

Encourage each Scout to acquire a good set of basic tools, and help Scouts learn to keep their tools in one place and in good repair. That way, they will "be prepared" to handle repairs as needed.

There is no time limit for completing the requirements. Major tasks, such as waterproofing a basement, may be completed in tandem with another Boy Scout working on the requirement, and/or with the assistance of an adult. The majority of the work, however, should be performed by the Scouts earning the badge.

This book provides a good overview of home-repair projects, but it is by no means a complete reference. For some requirements, space does not permit going into construction details or listing all possible repair variations. Therefore, any new construction or installation or completion of a similar project (for example, any toilet repair or adjustment) qualifies as achieving the requirement so long as the Boy Scout understands and demonstrates the basic concepts involved.

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# Requirements

1. Do the following:
   a. Explain to your counselor the most likely hazards you may encounter while working on home repairs and what you should do to anticipate, mitigate and prevent, and respond to these hazards. Describe the appropriate safety gear and clothing that should be used when working on home repairs.
   b. Discuss general precautions related to home repairs. Name at least 10 safe practices that every home repairer should exercise.
2. Under the supervision of your merit badge counselor, do FOUR of the following:
   a. Maintain or recondition a yard tool and show that you know how to clean up and properly store this equipment.
   b. Weather-strip a window or door.
   c. Caulk cracks or joints open to the weather.
   d. Waterproof a basement.
   e. Repair a break in a concrete or asphalt surface.
   f. Repair the screen in a window or door.
   g. Replace a pane of glass.
   h. Solder a broken wire or metal object.
3. Under the supervision of your merit badge counselor, do THREE of the following:
   a. Install or build equipment for storing tools.
   b. Build a workbench.

Either a parent or the merit badge counselor may supervise the Scout's work on any Home Repairs requirements.

c. Repair a piece of furniture.

d. Paint or varnish a piece of furniture, a door, or trim on a house.

e. Repair a sagging door or gate.

f. Repair a loose step or railing.

g. Repair a fence.

4. Under the supervision of your merit badge counselor, do TWO of the following:

a. Locate a main electrical switch box and know how to replace a fuse or reset a circuit breaker.

b. Replace an electrical cord or repair a plug or lamp socket.

c. Install a single-pole light switch.

d. Replace an electrical wall outlet.

5. Under the supervision of your merit badge counselor, do TWO of the following:

a. Clear a clogged drain or trap.

b. Repair a leaky water faucet.

c. Repair a flush toilet.

d. Repair a leaky hose or connector.

e. Clean or replace a sprinkler head.

6. Under the supervision of your merit badge counselor, do THREE of the following:

a. Paint a wall or ceiling.

b. Repair or replace damaged tile, linoleum, or vinyl flooring.

c. Install drapery or curtain rods and then hang drapes or curtains.

d. Replace window blind cords.

e. Repair or replace a window sash cord.

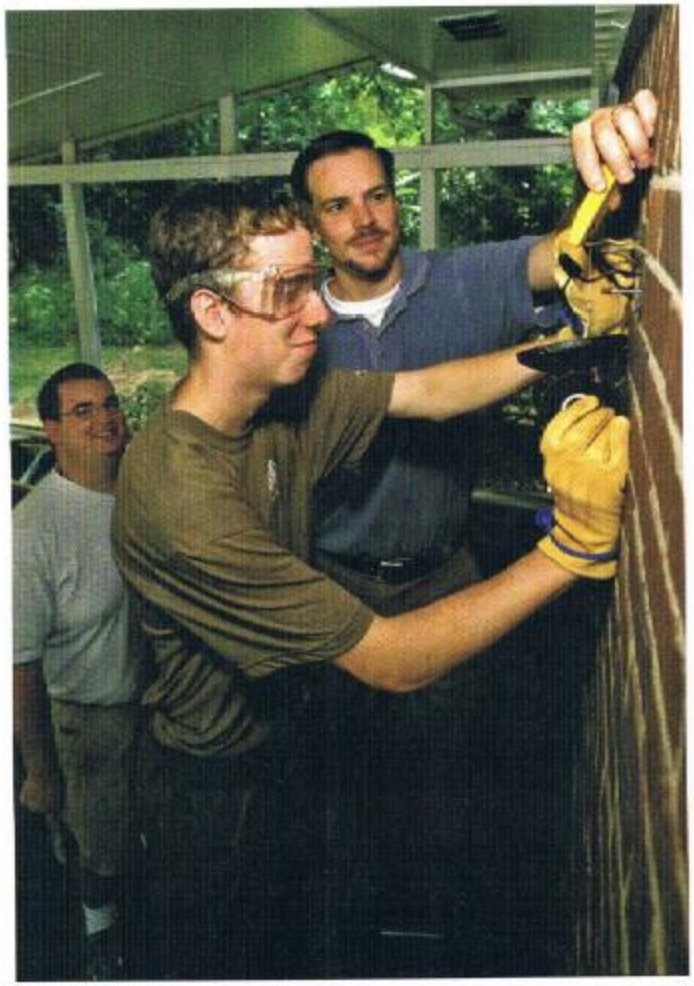
f. Reinforce a picture frame.

g. Mend an object made of china, glass, or pottery.



## Contents







# Be Prepared for Home Repairs

There is no better way to be prepared for everyday living than earning the Home Repairs merit badge. Successfully completing this badge's requirements can lead to a lifetime of personal and financial rewards.

Doing basic home repairs will give you a sense of personal pride in your achievements and increased self-confidence. In addition, safe and successful do-it-yourselfers can easily save a family thousands of dollars in repair bills over the years.

## Safety First: General Precautions

Throughout this book, you will find safety tips specific to the task being described, but here are some general precautions that every home repairer should keep in mind. Strive to incorporate safe practices into every project. In time, safety will become second nature to you.

### General Working Tips

- Always have enough lighting for the project.
- Keep long hair pulled back and avoid wearing jewelry or loose clothing when working with power tools or machinery with moving parts.
- Keep your work area clean and free of clutter.
- Choose the right ladder for the project (step ladder or extension ladder? how long? metal, fiberglass, or wood? etc.). Lean the top of the ladder against something solid and place the ladder at the proper angle (one foot away from the wall for every four feet of working ladder height) with the base on firm, level ground.

Your first concern during any repair or maintenance project should be safety. In the long run, endangering your health or safety, or that of your family, is much more costly than paying a qualified person to do the work.

When climbing, face the ladder and use both hands—don't carry anything in your hands. Don't overreach when you are on a ladder, as it may tip and fall. Never stand on the top two rungs of a ladder.

- Never drop tools or other objects from a height—lower them with a rope.
- Always wear safety glasses when working with dust, heat, flying objects, or power tools.
- Wear a disposable mask when working with odorous materials, dusts, or mists. Use a special respirator when working with toxic substances.
- Store containers of flammable and volatile liquids, such as paint thinner and gasoline, carefully. Keep the containers tightly closed and away from heat or flames. Don't use power tools near flammable or volatile liquids; sparks from the tools could ignite the vapors, even at a distance.
- Make sure to have working smoke detectors and fully charged fire extinguishers in the garage and workshop, as well as in the kitchen. They should be listed with Underwriters Laboratories, a safety testing and certification organization.

## Asbestos Hazards

Asbestos is a mineral fiber that has been used for many years in some building construction materials for insulation and as a fire-retardant. It is most commonly found in older homes, in pipe and furnace insulation materials, asbestos shingles, millboard, textured paints and other coating materials, and floor tiles. Many remodeling activities can release airborne asbestos fibers, which can cause serious lung and breathing diseases. Therefore, when planning a project that involves any of these materials, you should have them checked to see whether they may contain asbestos. If they do, have the work done by someone who is specially trained to work with asbestos. Contact the Environmental Protection Agency for more information (see the resources section in this pamphlet).





### Working With Tools

- Avoid working with power tools when you are tired or taking any medication.
- Always read the tool manufacturer's instructions, especially warnings, before using a tool.
- Never carry sharp objects in your pockets; put them in a utility belt with secure pockets and holders.
- Make sure your power tools are in good condition, and don't disable safety guards on power tools. When possible, plug power tools into outlets protected with ground fault circuit interrupters (GFCIs).
- Always work away from your body; that is, never point a sharp object, such as a screwdriver or a chisel, toward you as you are working.
- Never support a work piece with your leg or other body part when sawing or using a power tool.
- Keep your hands and fingers away from the business end of blades, cutters, and bits.
- It's best to cut small pieces of wood or pipe off of a larger piece. If you must work with small pieces, clamp them to a steady work surface when sawing or drilling; use a holder or pusher when working on a table saw or miter.
- Always remove the key from a drill chuck before starting the drill.

**Safety First**

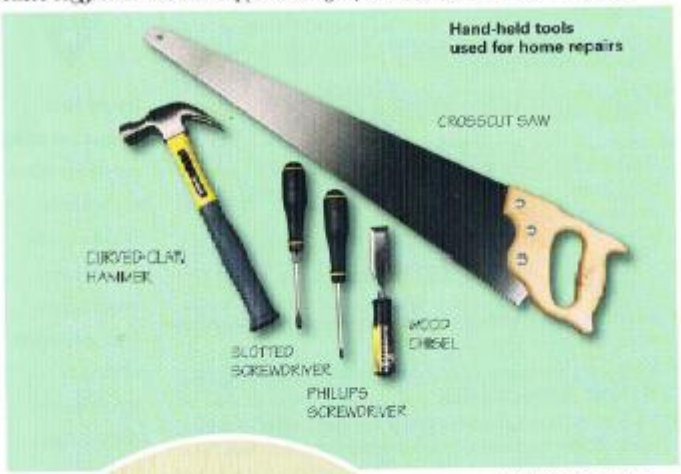
Appropriate safety gear is as important as good tools! The responsible home repairer should always wear appropriate safety gear—including safety glasses, masks, heavy gloves, and even ear protection—when needed. A heavy-duty safety light will ensure that you always have enough light while working.

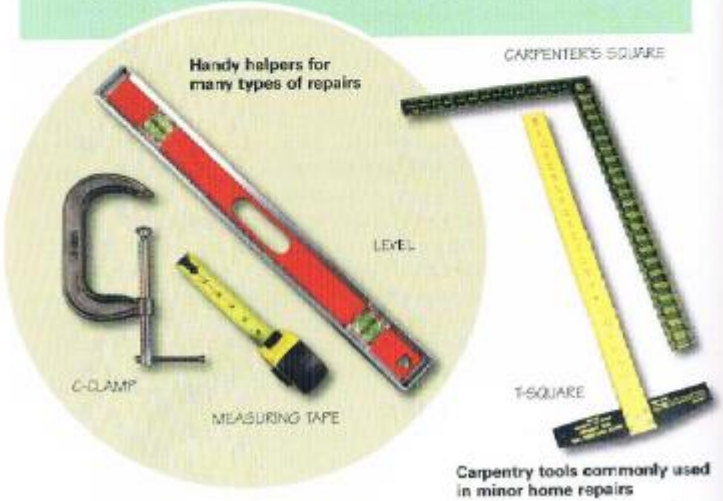
### A Few Good Tools: Basic Equipment for Home Repairs

The home repair beginner needs only a few basic tools, but they should be of good quality. Well-made and well-maintained tools can serve you a lifetime, whereas cheap tools often make work more difficult and need to be replaced more often.

## Tools

These suggested tools and supplies will get you started on most home repairs.




Carpentry tools commonly used in minor home repairs






Hand and power tools used for carpentry, electric work, and other repairs


Household tools handy for minor repair projects

### Supplies

- Flashlight
- Can of lubricating oil
- Assorted nails, screws, bolts, and washers
- Sandpaper in assorted *grits*, or textures
- Steel wool in assorted *grades*
- Electrical tape and masking tape
- All-purpose white glue and wood glue [Buy special glues for specific tasks.]

## Nail Types

**Common.** The old standby for general construction work.

**Box.** Looks a lot like the common nail but has a narrower shank. Used with thin wood so the wood doesn't split.

**Finishing.** For finished construction work. The head can be driven flush with the work, or countersunk (driven below the surface) and completely hidden with filler.

**Casing.** Also for finished construction work, with a head that lends itself to countersinking and a finished look.

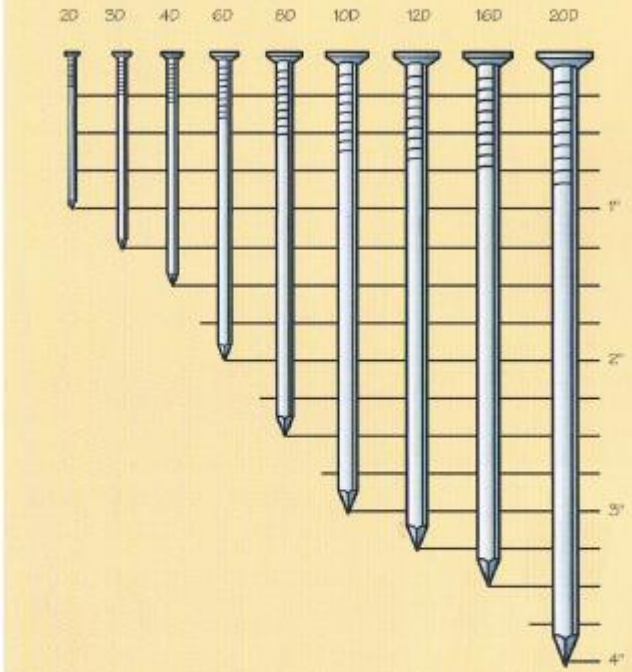
**Roofing.** The broad head will not pull through shingles, keeping them from tearing loose.

**Concrete.** For fastening in masonry. Should be set in one blow with a hefty (64-ounce) hammer.



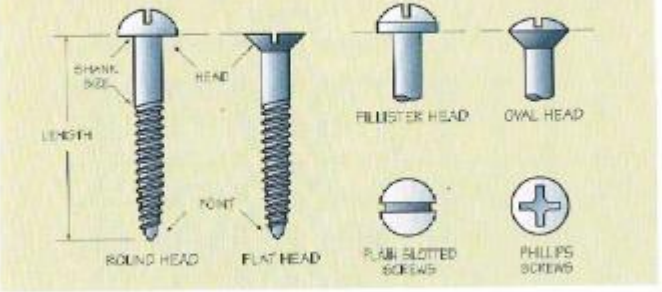


## Nail Sizes




**The lengths of common nails are expressed in "penny" ratings—a number followed by the letter "d," which is the symbol for "pence" in the old monetary system in England, where this rating system began. Nails used to be sold by the number of pence (pennies) you needed to buy 100 nails; therefore, you needed six pence to buy 100 6d nails.**

## Wood Screws




**DRILL BITS**

**1. Twist bit.** All-purpose bit.

**2. Spade bit.** For drilling large holes in wood.

**3. Masonry bit.** For boring into brick, concrete, or plaster at low speeds.


## Maintaining Yard Tools

As with all tools, yard tools that are sharp and well-maintained will make your work easier and safer. Avoid rust by cleaning excess dirt from tools with a wire brush, then spraying tools with a spray lubricant or wiping them with an oily rag after each use.

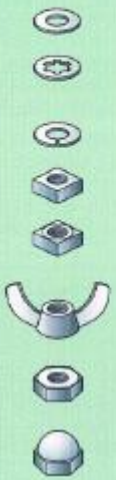
When sharpening tools with a whetstone or file, hold the stone or file at an angle and move away from the cutting edge. Be sure to maintain the factory-set *bevel* (the slant of the edge). It's best to have a professional sharpen saws and other cutting tools with serrated edges.

Always replace broken or split handles on tools. You can get replacement handles at a hardware store. To remove the old handle, file off the head of the rivet that holds the handle in place. Secure the new handle with the appropriate type of glue and let it dry completely before using the tool again.





**WASHERS AND NUTS**



- **Flat washer.** Protects the surface.
- **Toothed washer (internal).** A lock washer that yields a finished look because the teeth are hidden by the bolt head or nut.
- **Spring lock/split washer.** The most common lock washer, used to prevent loosening by vibration.
- **Square nut.** Four-sided general-purpose nut.
- **Flat square nut.** Four-sided nut, smaller than a square nut.
- **Wing nut.** Hand-tightened with the fingers instead of a wrench. Ideal to use when something needs to be removed frequently.
- **Hexagonal nut.** Six-sided general-purpose nut that is sturdier than a square nut.
- **Acorn nut/cap nut.** Protects threads from the elements.

## Storing Tools and Equipment

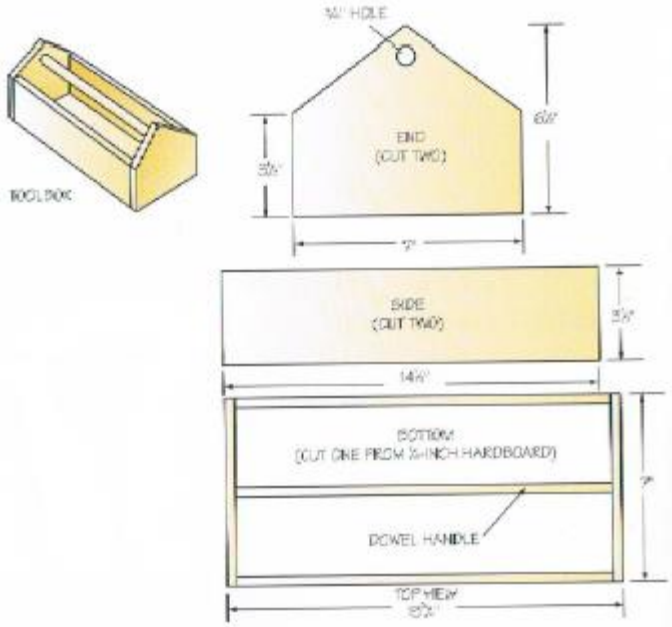
Storing your tools in a safe, secure place is the best way to take care of them. Hardware stores sell an assortment of prefabricated toolboxes, hangers, and pegboard that you can use to store your tools and equipment. If you return your tools to their proper place as soon as you are finished with a project, you will always know where to find them again.

If your family does not have a workbench or a place to store tools, a good way to begin this merit badge is by making one or both.

Prevention goes hand in hand with mitigation, which means "to lessen in force or intensity" and "to make less severe." By taking precautions to manage risk and the possibility of injury, you can be prepared to anticipate, help prevent, mitigate, and respond to just about any incident that might happen while working on home repairs.

### Toolbox

You can make a simple toolbox with some basic materials and equipment. Use a pencil to mark the dimensions for all the pieces on the plywood, and cut out the pieces with a crosscut saw. Make the holes for the dowel using a spade bit on an electric drill. Be sure that the bit is the same dimension as the diameter of the dowel.





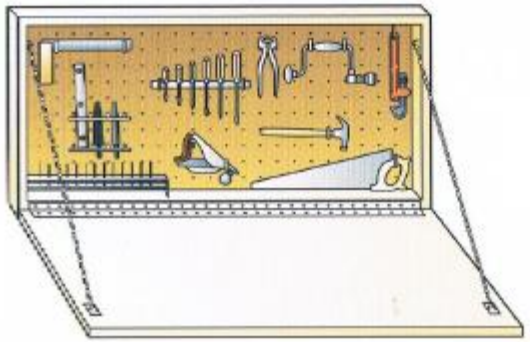



Glue and nail the side pieces to the hardwood bottom. Nail an end piece to the base and sides. Use wood glue to set the dowel in place. Then nail the other end piece in place, using glue again as you set the dowel.

For extra strength, use wood screws instead of nails in this assembly, predrilling holes and then countersinking the screws.

### Pegboard Storage With Work Surface

This project gives you an area for doing light work as well as a place to hang your tools. Start with a pegboard and plywood board of the same size. Make a frame of 1-by-4-inch or 2-by-4-inch boards in the same dimension as the pegboard and plywood board.

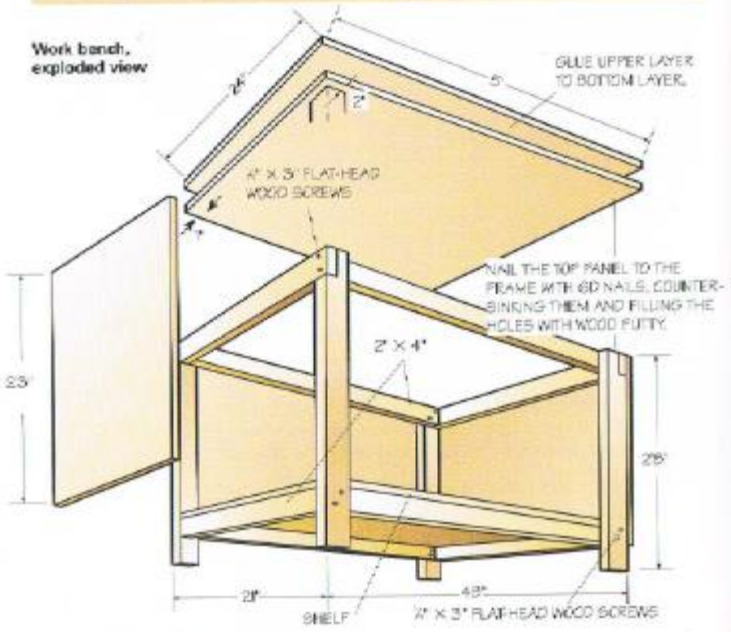


Nail or screw the pegboard to the back of the frame. Attach the plywood work surface to the frame with a piano hinge. Drill holes for chain hooks and secure the hooks with nuts. Add a lightweight link chain for additional support. Use a screen hook-and-eye or hinge clasp to close the case when you are not using it. Secure the box onto wall studs or a staircase with wood screws.

## Materials

- ☐ Top (two): 24 x 60 x ¾-inch plywood
- ☐ Shelf (one): 19½ x 48 x ¾-inch plywood
- ☐ Top side braces (two): 2 x 4 x 21-inch lumber
- ☐ Top front and back braces (two): 2 x 4 x 45-inch lumber
- ☐ Bottom side braces (two): 2 x 4 x 18-inch lumber
- ☐ Bottom front and back braces (two): 2 x 4 x 45-inch lumber
- ☐ Sides (two): 21 x 27 x ¼-inch plywood
- ☐ Back (one): 27 x 48 x ¼-inch plywood
- ☐ No. 14 x 3-inch flat-head wood screws
- ☐ 6d nails
- ☐ White glue
- ☐ Wood putty (optional)

Work bench, exploded view







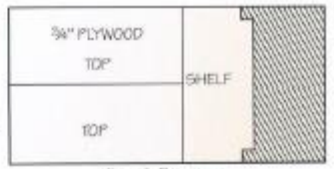

## Workbench

Make a handy temporary bench for heavy work by placing a 2-inch-thick plywood board over two sawhorses. Nail the board to the sawhorses for stability. For a more permanent bench with a storage shelf, make the one shown here. If you use it against a wall, allow 2 feet of clearance at both ends for large work. If you use it in the center of the shop, supply electricity from above so that you won't trip on extension cords as you work.

### Preparing the Pieces

**Step 1**—Mark a 4-by-8-inch sheet of ¾-inch plywood according to the panel diagram shown. Mark the side and back dimensions on ¼-inch plywood.

**Step 2**—Cut out the top and shelf pieces with a handsaw or circular saw. Notch the corners of the shelf. Cut the side and back pieces.




Panel diagram

**Step 3**—Cut the legs and braces according to the dimensions shown. In one end of each of the four legs, cut a notch 3½ inches deep and 1½ inches in. Predrill screw holes for the top side braces (you will countersink the screws).

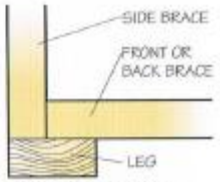
### Assembling the Frame

**Step 1**—Screw the top side braces to the legs.

**Step 2**—Fasten the bottom side braces to the legs with glue, and then screw the braces to the legs.

**Step 3**—Glue and nail one side panel to one leg assembly.

**Step 4**—Glue and screw the front and back braces to the legs at the top and bottom.




Bottom brace corner

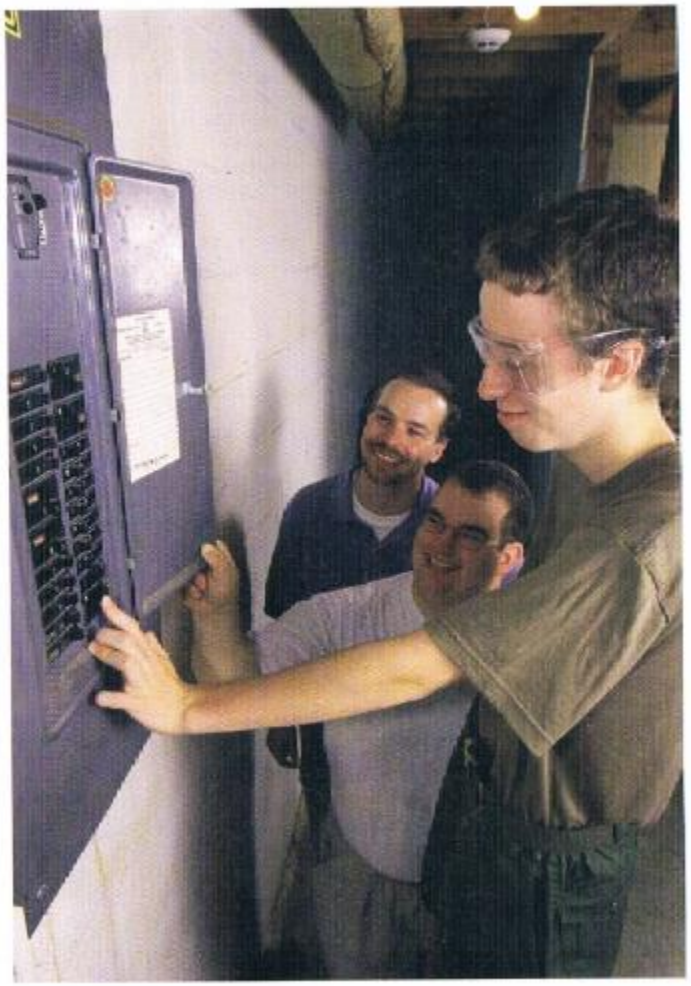
### Completing the Bench

**Step 1**—Install the lower shelf in the frame through the open end. Glue and nail it in place.

**Step 2**—Center the smaller of the two top panels on the frame. Glue and nail them in place.

**Step 3**—Glue and nail the back panel and remaining side panel in place.

**Step 4**—Center the larger top panel on the bench. Glue it, weight it down, and allow it to dry overnight.





# Electrifying Projects

## Safety First

Electricity is dangerous. Respect it by following these simple rules.

### Turn Off the Juice

- Always shut off or disconnect power at the main service panel (fuse or circuit breaker box) before handling wires; working on a switch, plug, or outlet; or opening a junction box.
- Always unplug an electric object or power tool before working on it.
- Never work on a live circuit. Use a meter or tester to check that the circuit you are working on is not live.
- Don't trust labels on circuits; the circuits may have been changed, but the labels may not reflect those changes.
- Never work in the dark; use a flashlight whenever necessary.

### Keep It Dry

- Never stand on a damp or wet floor when working at the fuse or circuit breaker box, or when using power tools. Stand on a rubber mat or a piece of dry wood. Never work with electricity when you are wet; be safe and change into dry clothes.
- Never touch any plumbing when working in or around a fuse or circuit breaker box. Wear rubber-soled shoes.

### Leave Conducting for Trains

- When replacing fuses, work with one hand, keeping the other behind your back or in your pocket to prevent electricity from making a complete circuit through your chest.

**Underwriters Laboratories Inc. (UL)** is an independent, not-for-profit product safety testing and certification organization. A UL label or stamp *(above)* means that the product meets nationally recognized safety standards. Look for this label when purchasing any electrical products.

- Lines coming into service panels remain live even when a main breaker is turned off or main fuses are removed. Never open a service panel. Consult a qualified electrician if you suspect a problem with the service panel.
- Unusually warm or hot switches or receptacles may indicate an unsafe wiring condition. Unplug cords from such receptacles and do not use the switches. Have an electrician check the wiring as soon as possible.
- Never use a metal ladder when working with electricity. Metal conducts electricity; if you touch metal while also touching a live wire, electrical current will flow through your body.

### Watch Your Cords

- Never substitute an extension cord for permanent wiring.
- Never use damaged cords, and be careful not to fold or crimp cords too tightly. Unplug extension cords when you are finished using them.
- Never plug two extension cords together; use one cord that is the correct length. Make sure the extension cord you use matches the cord of the tool (for example, three-prong grounded or double-insulated).
- Never run extension cords through doorways or windows, or under carpets. Never fasten them to walls or baseboards; even though staples are sold for this purpose, it is not a safe practice.

### Think Safety

- Never push yourself when working on any electrical project. Make sure you give yourself the time to think the project through completely; mistakes can happen when you rush projects.
- Above all, use good judgment when planning your project; if you don't feel comfortable, leave the job to a qualified electrician and insist that he or she follow appropriate electrical codes.



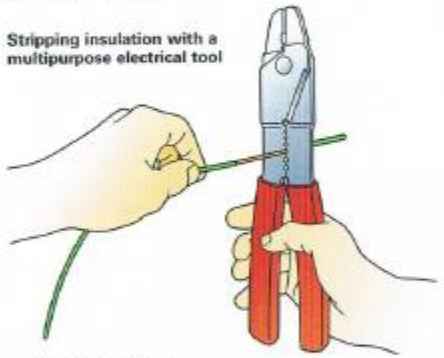


## Good Working Practices

In addition to following the safety rules, it is a good idea to use good working practices. When working with electrical wires, label them as you work to keep track of them. Number them and write down where they are attached and to what. Also, fold wires neatly back into the box when repairing or replacing switches and receptacles. Running electrical tape around the switch under the mounting screws will protect the wire connections.

Always use the proper tools, with *insulated* handles, for the job. For example, use wire strippers or wire cutters (diagonal pliers) to strip wire and avoid damaging wires. A multipurpose electrical tool both cuts wires and strips the insulation from them. Wire gauges printed on the tool show which hole to use so that you don't damage the wire.

**Stripping insulation with a multipurpose electrical tool**



## The Basics of Electricity

The most common electrical service to homes in the United States is 240 volts. The *amperage,* or strength of the electric current, in any home can vary. Modern homes may have 200 amps or more, whereas older city homes may have as little as 60 amps or even less. Your main breaker or fuses will indicate how many amps are in your home.

Electrical *current,* or the rate of flow of electricity, is measured in *amperes;* the pressure that forces the current through a conductor is measured in *volts;* and the power of the electrical current is measured in *watts.*

Toggles in a circuit breaker flip to "off" or to a center position for both short circuits and circuit overloads. To reset the circuit and restore power, flip the switch to full "off" and then back to "on."

Circuit breaker fuses have a reset button or switch. When blown, they can be reactivated with the button or switch. Push the switch to the "off" position, then back to the "on" position.

The main electrical service entrance to your home is through a *service panel* containing fuses, circuit breakers, or both. The panel usually is located in the basement or utility room, or in a closet on an outside wall. An older home can have more than one service entrance, and many homes have additional disconnect panels for outside supplies, such as air-conditioner compressors.

### Replacing a Fuse

Fuses are rated by amperes, or amps. Never replace a fuse with one that has the improper amperage rating or size. A switch box could have several different types of fuses, all of which can be replaced by simply removing the defective fuse and putting a new one in its place. Unscrew the blown fuse by touching only the glass end. Then screw in the replacement, touching the glass end only.

- *Plug fuses* (15 to 30 amps) look like flattened screw-in light bulbs and have a metal filament under a small glass window. If the window is blackened or discolored, the fuse may be defective.
- *Cartridge fuses* are cylindrical. Cap-ended cartridge fuses are rated up to 60 amps and are for circuits with high-current appliances such as stoves, dryers, and ovens. Prong-ended cartridge fuses protect main electrical services and are rated up to 600 amps. It is rare, but possible, for them to fail.
- *Dual-element, time-delay fuses* have a springlike mechanism that allows for brief electrical surge overloads without the fuse blowing. They are useful on circuits that have heavy motors, such as refrigerators and power tools, because they create a brief power surge upon start-up.
- *S fuses* come in two pieces: a separate metal base, which screws into the fuse outlet, and the fuse itself, which matches the base. This system helps prevent the wrong fuse from being used on a particular circuit since the fuse and base must match.





### When the Lights Go Out

When electricity fails in only one part of the house, it is probably because of an overload or short circuit in the system. An *overload* occurs when too many appliances or lights are plugged into one circuit. A *short circuit* is caused by a bare electrical wire touching another bare wire or a piece of metal. In either case, the problem has tripped the breaker or blown a fuse. You can restore electricity by resetting the breaker or replacing the fuse, but first, unplug all appliances and lamps on the circuit. If the electricity fails again while everything is disconnected, call an electrician—the problem is in the wiring.

If the electricity remains on after you have reset breakers and/or replaced fuses, replug appliances and lights one at a time. Check for frayed cords and melted plugs or sockets that could be the source of a short. Do not reconnect any damaged cords or plugs.

Always unplug an appliance or lamp by pulling on the plug; *never* pull on the cord!

## Replacing Electrical Cords

When electrical cords on lamps or small appliances become broken or frayed, replace them with one of the same length, gauge, and type as the original cord. Avoid making a quick fix using electrical tape.

How to replace a wire or cord will depend on the appliance you are repairing. Begin by removing the screw or screws on the appliance housing or backplate to access the internal electrical connections. Disconnect the old cord by unscrewing the terminal or terminals where the cord is attached. Strip ½ inch of the insulation from the wire ends of the new cord, twist the wire strands together, and then hook them clockwise around a terminal. Tighten the terminal screws and replace the housing or backplate.

## Repairing Plugs and Sockets

When sockets or plugs don't work, it is often because a wire has become detached from a connector screw. Fix this problem by simply reattaching the wire and tightening the screw. Worn or damaged sockets and plugs, however, should be replaced. You can buy new ones at a hardware store for a minimal cost.

### Replacing a Standard Plug

Follow these three steps to replace a standard plug:

**Step 1**—Unplug the appliance. Cut through the cord just behind the old plug. Slide the cord through the back of the new plug. Split the wires and tie them into an underwriters' knot by forming a large loop with each wire and inserting the end of each wire through its opposing loop. To tighten the knot, pull on the ends of the wires.

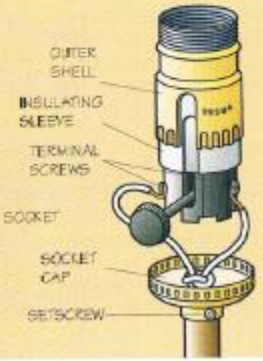
**Step 2**—Pull the knot into the plug's base. Strip ¾ inch of insulation from the end of each wire.

**Step 3**—Wrap the insulated portion of the wires around the prongs to form an S. Wrap the exposed wires around the terminals in the same direction in which the terminals turn. Tighten the terminal screws with a screwdriver. If the plug has a cardboard insulator, slip it in place over the prongs to protect the wires.

## Repairing a Socket

A socket is easy to take apart. If the outer shell doesn't readily slip off the socket cap, apply pressure with a screwdriver where the word "press" is marked. Pull the cap and insulating sleeve away as you press.

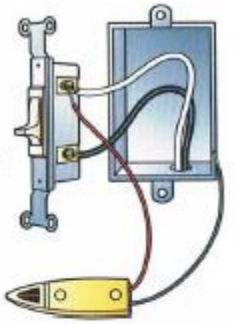
If a wire connection has come loose at a terminal screw, rewrap it clockwise and tighten the screw. If the socket is broken, replace it with a new one.








## Replacing a Wall Switch



Turn off the power before working with any switch.

**Note:** This project is for a single-pole switch controlling a light, not for multiple switches controlling a light.

A single-pole switch that controls a light from one place has two brass-colored terminals on the switch side. Hot wires are connected to these terminals. *Before you begin, turn off the power to that switch at the main service panel.* Remove the coverplate and gently pull the switch out. Don't touch any bare wire ends or switch terminals.

Use a voltage tester to make sure there is no voltage: Touch one probe of the tester to one of the screw terminals and the other probe to a ground source, such as the metal shell of the outlet box. The tester should not light up. Be sure to check both wires connected to the switch.

Disconnect the two switch wires and the ground wire (a bare copper or green wire), if present. Connect the new switch to the two hot wires you just disconnected. Attach the ground wire to the new ground screw using a wire connector. Remount the new switch and return it to the wall. Tighten the screws and replace the switch cover.

## Replacing a Wall Outlet

**Note:** Always replace an outlet with one of the correct amperage and voltage rating.

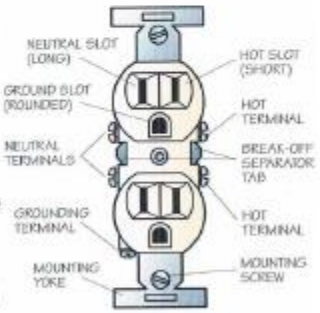
**Step 1**—Turn off the circuit or main power switch, and use a meter or circuit tester to make sure that the power is off.

**Step 2**—Remove the coverplate and unscrew the receptacle (plug).

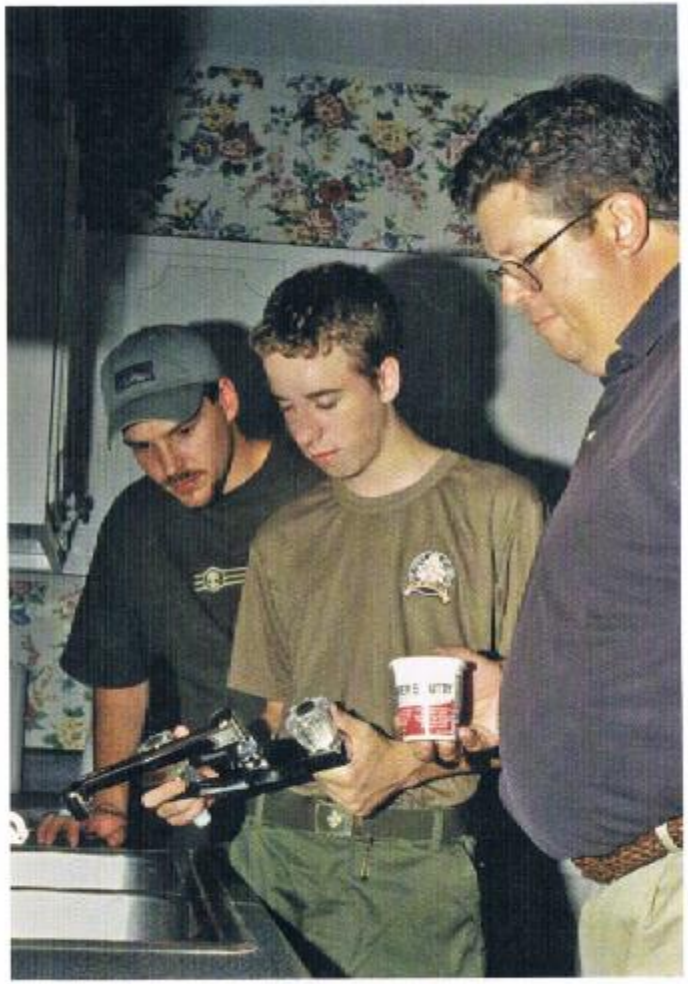
**Step 3**—Remove the wires, noting where they are connected (reconnect them in the same order). If a tab is separated on the line side of the plug, note the wiring, replace the wires, and remove the tab as on the original switch. Remove this tab if a switch will control the plug for a lamp that will be operated by the switch.

**Step 4**—Install the ground wire.

**Step 5**—Install the receptacle and coverplate.




Grounded three-slot 120-volt duplex outlet





# Water Works

When it comes to plumbing problems, the best tools are a "plumber's helper" (a plunger), a little common sense, and a willingness to ask questions at a hardware store. Before you know it, you will be able to handle most basic plumbing jobs.

## Safety First

- If you use chemical drain cleaners to unclog a drain, wear protective gloves and goggles to avoid injuring your skin or eyes.
- Keep power tools away from areas where water has leaked. Try to contain spilled water with towels or a wet-dry vacuum cleaner.
- If a clogged toilet contains raw sewage, or if the sewage has overflowed onto the floor, wear rubber gloves during cleanup to avoid the risk of contamination. Make sure to sanitize the affected areas afterward with bleach or disinfectant.

### Preventing Clogs

Help keep your household drains flowing freely by making sure not to pour grease down them. In the bathroom, keep drains as clear of hair as possible. Use a drain strainer if possible. For regular maintenance, try this noncaustic and safe alternative to commercial drain cleaners: Pour ¼ cup of baking soda and ¼ cup of white vinegar down the drain; let it sizzle for several minutes, and then flush with a kettle of boiling water.

Plumbing bolts, nuts, screws, and threaded connections can be hard to loosen, especially when they are corroded. Remember this saying: "Clockwise is lockwise," and then be sure you're twisting in the opposite direction.

## Clearing Clogged Drains

Use caustic commercial drain cleaner only as a last resort, and never in a completely clogged drain. These products are highly corrosive to plumbing systems.

The drainage systems in homes have two parts: *traps* in the shapes of a drum or J, S, or P, plus pipes to which the traps are connected.

When water or waste won't run out of a sink, tub, or toilet, debris is blocking the route in the pipe or trap. Try these remedies, in the order following:

1. **Remove the stopper or drain cover** and clean off any accumulation of soap scum and hair with paper towels and pipe cleaners.

2. **Try a commercial drain cleaner** on slow-draining sinks or tubs. Give it plenty of time to work—a few minutes longer than specified on the package. If the drain is still slow, don't risk a chemical burn by immediately trying repairs involving augers or trap removal. Continue to use the sink or tub so the chemical will wash away completely. Try further repairs in a day or so.

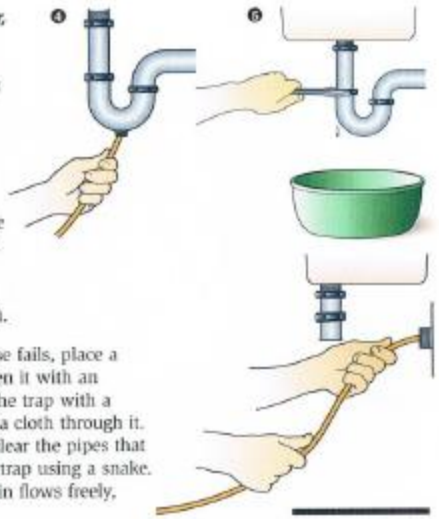
3. **Loosen a clog with suction.** Petroleum jelly applied to the base of a plunger helps seal it to the sink. Block the overflow or adjoining sink drains with rags. Fill a sink with enough water to cover the plunger and create more of a seal. If you are plunging a toilet, leave enough water in the toilet to create a seal (you can't plunge a dry toilet), but not so much that it overflows when you plunge. Use steady, rhythmic, and forceful downward strokes to clear the clog. Stroke 10 times, and then test the flow. Repeat the procedure three to five times, if necessary. Once the water drains freely, flush the drain with hot water for five minutes.

**The bellows-style plunger for a toilet *(left)* has a narrowing plunging end to fit inside the bowl and create a better seal; those designed for flat drains *(right)* have a flat bottom to better seal a drain in a sink, tub, or basin.**





4. **Insert a *"snake,"* or *auger,* into the drain** (or a plug in the pipe) to dislodge a persistent clog. If you don't have an auger, you can make a crude one with a straightened coat hanger. Use towels underneath to protect the surface from chips or scratches. Don't be too forceful with the auger. It could break a plastic pipe, or a homemade one could break off in the drain.



5. **Remove the trap.** If all else fails, place a pail under the trap and open it with an adjustable wrench. Clean the trap with a small brush or by running a cloth through it. Before replacing the trap, clear the pipes that attach to either side of the trap using a snake. Replace the trap. If the drain flows freely, flush it with hot water.

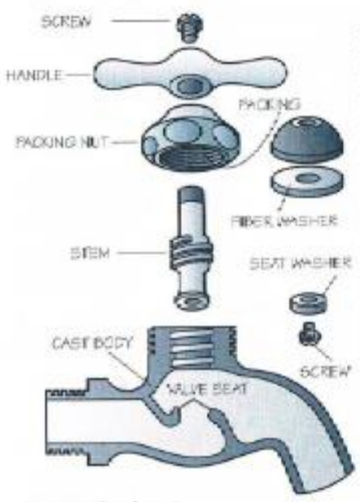
## Fixing Leaky Faucets

Always make sure that water is shut off by opening the faucet. If water does not completely stop running, an experienced adult or a plumber may need to rebuild or replace the shutoffs.

Leaks are the most common problem with faucets. Most leaks are caused by worn washers or packing. Do-it-yourself repairs are simple and inexpensive, unless you forget the first rule of faucet repair: **Turn off the water before you start!** Usually, you will find shutoff valves under the sink. If you don't, or if the water still runs from the faucet after you shut it off under the sink, have an experienced adult or a plumber help you turn off the water supply at your home's main water-supply valve.

There are several kinds of faucets: compression, single-lever, and cartridge (hollow metal or plastic inserts that seal against the spout or faucet body). A *compression faucet* is one of the most common types.

Faucet repair kits are sold by brand and model number at plumbing supply and hardware stores. If you don't know the brand or parts you need, divide the parts into plastic bags, maintaining the assembly and labeling the bags "hot" and "cold." Take the old parts with you to the store.




**Compression faucet**

Parts that can be replaced in most compression bathroom, kitchen, and laundry faucets include the seat washer, washer screw, and packing. Repair kits usually contain all washers, O-rings, and packing string for a faucet, and you should replace all the old parts with the new ones. Begin disassembly by locating the screw that holds the handle. Sometimes the screw is hidden by the *escutcheon*, or decorative cap, which indicates "H" for hot or "C" for cold. Pry the cap off with the tip of a slot screwdriver. Protect chrome finishes by padding them with a cloth while you work.

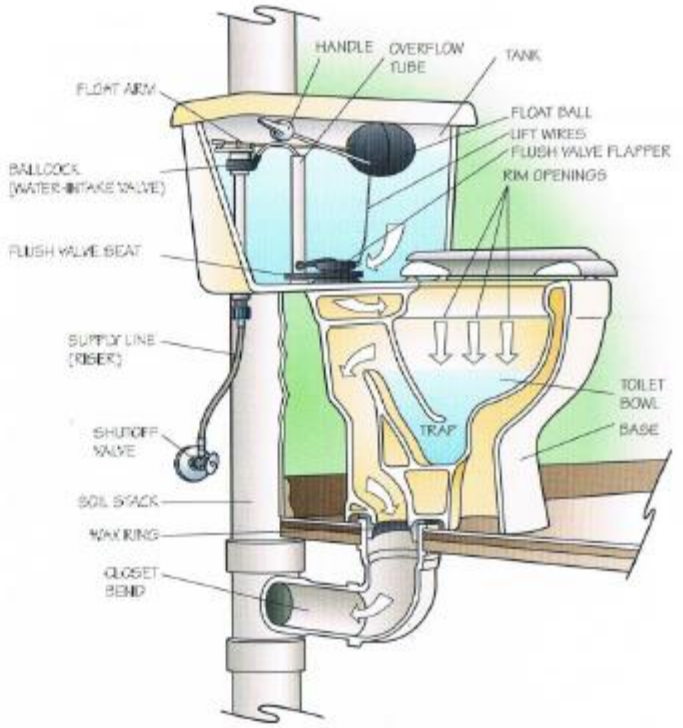
As you disassemble the faucet, carefully lay each piece on a towel in the order that you remove it so you will know how to reassemble the object after you have replaced the old parts. Clean any dirt or corrosion off permanent parts with an old toothbrush or fine steel wool before reassembly. Dip the brush or steel wool in vinegar to help dissolve mineral deposits on parts.

## Easy Toilet Repairs

All *gravity-assist flush toilets* operate basically the same. When you flush the toilet, the handle lifts an arm or chain that raises the flush valve, which can be either a ball (in older toilets) or a flapper. Tank water flows out of this opening to flush the toilet bowl. The float ball rides the water level down the tank and turns on the water-intake valve in the ballcock. At the same time, the flush valve drops back into the opening, sealing it to fill the tank again with fresh water.








**A gravity-assist flush toilet with a float ball**

Another kind of toilet is becoming more popular, especially with federally mandated standards for how much water a toilet can use in one flush. *Pressure-assist toilets* "push" the contents out of the toilet bowl rather than using the pulling action of gravity in the gravity-assist toilet. Inside the china toilet tank, you won't find any standing water, as in a gravity-assist toilet, so one advantage is that the tank of a pressure-assist toilet never "sweats" in heat and humidity.

## Clogged Toilet

If the water in a toilet bowl rises to the rim or overflows, something is probably blocking the channel. Follow these steps to try clearing it with a plunger.

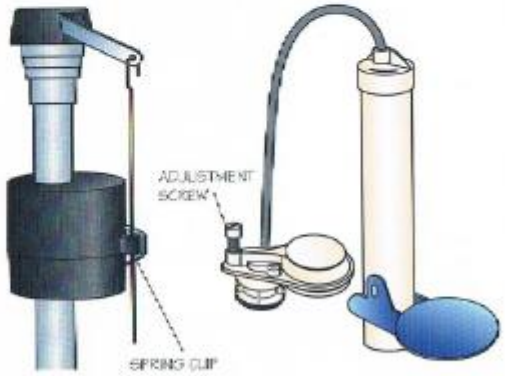
If the clog persists, it's probably time to call a plumber.

**Step 1**—Close the flush valve by hand, putting the flapper or ball stopper back in the closed position. Then turn off the shutoff valve at the side of the toilet.

**Step 2**—Drain excess water from the bowl with an old cup or can. Leave enough water to cover the plunger cup.

**Step 3**—Stand in front of the toilet and plunge vigorously about 10 times.

Sometimes you can see obstructions using a small mirror and flashlight. With the mirror, you can look under the rim to see whether the flush holes are clear. If they aren't, try clearing them with the hook end of a straightened clothes hanger. You also can inspect the top of the trap with the mirror and flashlight—but empty all the water out of the toilet bowl first!



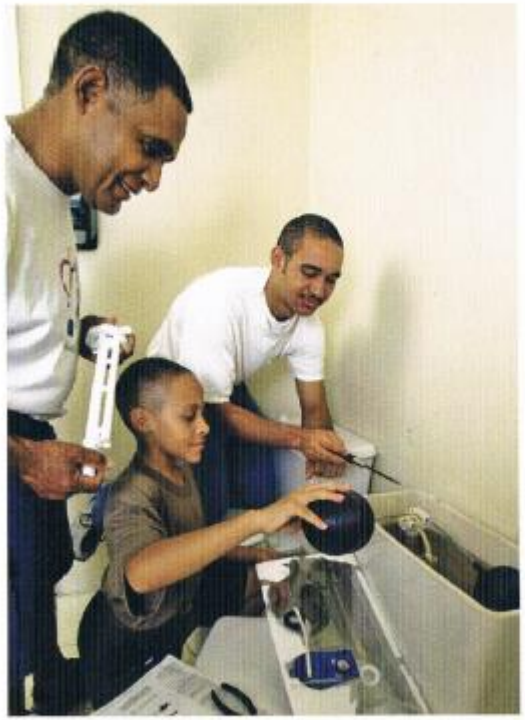

**The insides of gravity-assist toilets may vary. With a floating cup ballcock *(left)*, the position of the floating cup controls the water level. You can adjust the water level by moving the spring clip. To make water-level adjustments with the floatless ballcock *(right)*, simply turn the adjustment screw.**





## Running Toilet

A running toilet, one that is constantly letting water into the tank, is both irritating and wasteful. It is also one of the easiest and least expensive toilet problems to fix. Drain the tank first by turning off the water supply and then flushing. Remember to turn the water supply back on when repairs are done.



Running toilets can have several causes and easy remedies:

| Problem | Solution |
|---|---|
| Leaking float ball | Unscrew the ball to remove it, and install a new one. If a new one is temporarily unavailable, empty the leaky ball, cover it with a plastic bag, and secure the bag with tape or a rubber band. |
| Float arm | If the rod is keeping the water-intake valve open, bend the rod up or down slightly, or adjust its screw. |
| Leaky water intake | Clean corrosion off washers and other valve parts with a tooth-brush dipped in vinegar, or install new ones. |
| Faulty flush valve seat | Raise the valve and buff the seat with steel wool. Remove only corro-sion, not any metal. |
| Worn flush valve (flapper) | A replacement flapper slides over the overflow pipe or hooks onto lugs. If replacing a flush valve ball, unscrew it from the lift wire. Make sure that the new valve ball falls squarely into the seat of the flush valve. |
| Toilet tank overfills | Examine the flush valve; the repair may be as simple as replacing the flap. |
| Water is going over the overflow tube | Adjust the float arm, adjustment screw, or spring clip. If the water continues to fill past the overflow tube, replace the fill valve. |





## Repairing Leaky Hoses

For temporary repair of a pinhole leak in a hose, dry the hose and stop the hole with a heavy coat of rubber-base cement. Wrap the hose with a spiral of plastic electrician's tape.

For a more permanent repair, buy a metal or plastic hose coupling that is the same diameter as the hose. Cut the hose cleanly and squarely; a ragged cut may cause a leak. Install the coupling according to package directions. For some, you will need a hammer, but some are screw-on or clasp-on connections.

To fix a leaky connector, unscrew it, insert a washer, and replace the connector.

### Fixing Sprinkler Heads


Sprinkler heads normally are flush with the lawn so lawn mowers don't come in contact with them. Water pressure raises the center portion of the head when the system is turned on. Turning the small screw at the center of the head increases or decreases the flow of water.

Grass, mineral deposits, and dirt can clog spray heads. To clean them, lift the head by hand and insert a fine wire into the jets. Never use a toothpick because the wood can break off in the jets. Some spray heads unscrew for easier cleaning.

To replace a sprinkler head, remove the old core head with a special core wrench, screwdriver, or adjustable wrench. The threads turn counterclockwise.



# Wall Works, Caulking, and Weather-Stripping

Everyone likes a freshly painted home that's warm in the winter, cool in the summer, and dry all year 'round. Best of all, well-maintained walls hold up longer and keep energy costs down.

## Caulking Cracks and Joints

Among energy-saving products, caulking probably is the least expensive and most effective. All you need is a caulking gun and the proper sealant.

Check your home for missing and cracked caulk. Insert a putty knife into old caulking. If it is still gummy, leave it in place. If the caulking cracks, remove it with a putty knife and wire brush. You want a dry, dust-free surface that's slightly roughened so the new caulking adheres well. Seal all these areas:

- Around windows and doors, fixed storm windows, and cracks between door thresholds and stoops
- On the exterior of your home—along the bottom of siding where it meets the foundation, and around any basement windows
- Between joints, splits, and cracks in siding
- At dormers and roof flashing, gable vents, and roof vents
- At power and cable entrances and exits
- Between dissimilar materials such as wood and masonry, masonry and metal, etc.

When the air inside an insulated home is warmer than the air outside, the warmer air releases moisture as it passes through the insulation and condenses into water when it reaches the colder exterior wall. A *vapor barrier* of aluminum foil or heavy plastic sheeting stops this vapor from moving beyond the interior surface of the insulation, so it never gets to a colder wall and condenses.