

Unit I Member Manual

WORKING WITH WOOD & TOOLS



National 4-H Wood Science Series

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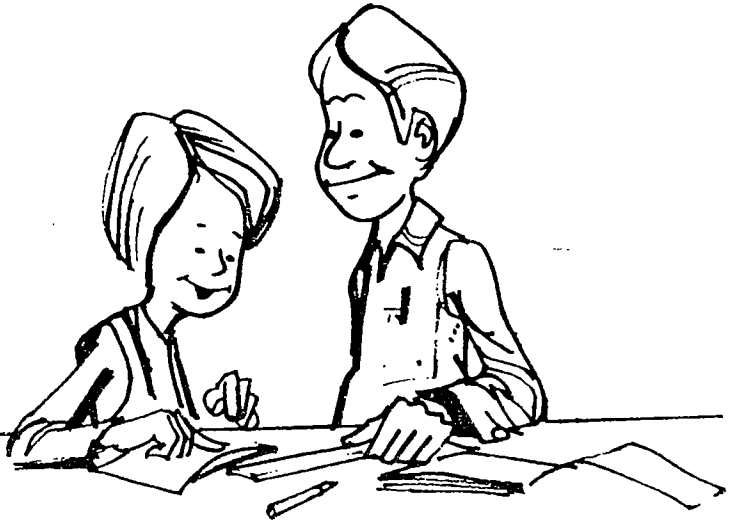


Note to Parents

and Home Helpers

You, as parents or home helpers, are the most important and influential persons in your children's lives. You can nurture and cultivate their interest in this project by guiding their planning, helping them carry out their projects and recognizing them for a job well done.

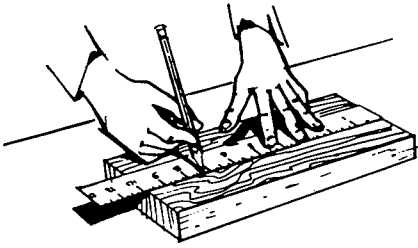
The information in this manual can provide significant learning experiences for your children. Helping them plan the things they will learn and do, followed by assessing their progress based on these plans, will make their experience more worthwhile. Your children's project leader usually helps them plan and evaluate their work. If this is not possible for some reason, you could fulfill this need too.



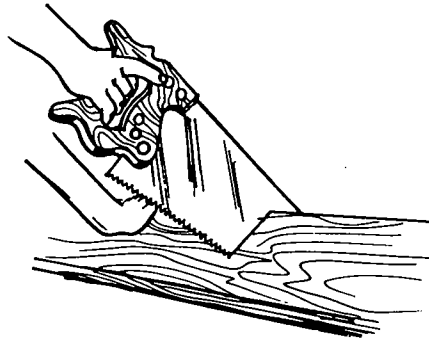
Help the children get the most out of this project:

- Become familiar with the material in this manual.
- Work with them to decide what tools, equipment and supplies they will need and what they can realistically expect to obtain.
- Thoroughly review the tasks they are expected to complete, making sure they understand them. **DO NOT DO ANY OF THE WORK FOR THEM.**
- Assist them in scheduling their time.
- Discuss their progress with them from time to time.
- Help them distinguish between a good job and a poor one.
- Help them to get to know themselves, including their strengths and weaknesses, and to improve on their abilities.
- Review their accomplishments based on what goals they have for themselves. Avoid comparing the progress of any one child with that of other members who may have different goals and equipment.

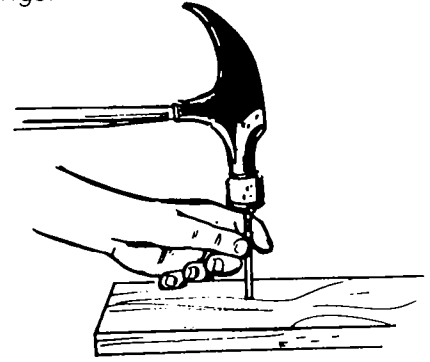
The 4-H Wood Science Program gives you the chance to do some fun things!



MEASURE AND MARK



SAW BOARDS



DRIVE AND PULL NAILS

Introduction

Hi, Woodworker! This is the first unit of the 4-H Wood Science series. This manual will tell you some important things about using wood tools and building objects with wood.

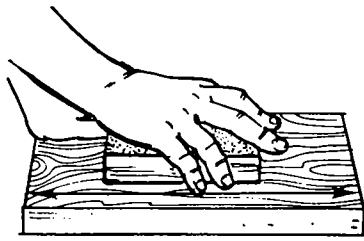
Remember that the wood you will be using was once trees in the forest! We know that the forest keeps growing, year after year. It keeps giving us a rich harvest of wood. Many people work with the forest and with forest products.

The forest can also be a fun area as well as a work area. Make a list of fun things people can do in the forest, like watching animals and camping.

Building things out of wood and wood products can be fun, too. In the back of this manual are plans for some items you may want to make. There are also many other easy-to-build items that you could make. But before you start building anything, discuss your project with your parent or your leader. Make sure you have the materials and tools and work area that you will need. Your parent or leader may be able to provide you with a good place to work.

There is a lot to say about wood and wood products! Remember this tip: the more you know about wood, the better you can use it. So get permission to tour places where people work with wood, such as lumberyards, carpenter or cabinet shops, forest areas or lumber mills.





SAND WOOD

... and learn how to use wood tools to help you do these things correctly and easily.

Get a notebook and be prepared to jot down drawings, ideas and important information about wood and wood tools. If you keep a good notebook, you will remember more things about wood as you go along!

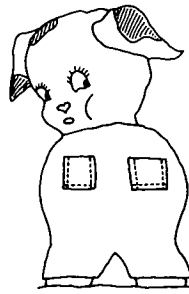
The wood that you will be working with may be in the form of lumber, plywood, particle board or fiberboard. Even though all of this wood comes from trees, each product looks different and has different uses. In Unit I you will be working more with lumber and plywood. You will work with other kinds of wood in later manuals.

Some types of wood will cost more than others. Wood comes in different grades. The better the grade, the higher the price. You may save money by buying a lower grade and cutting the material you need from the good parts of the piece. Use low-cost lumber if you can find it.

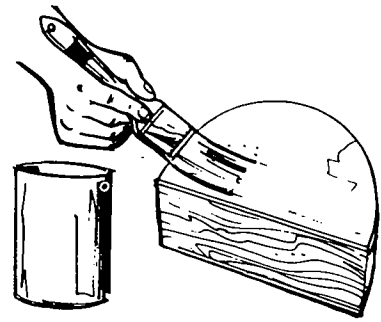
Things you can do

We can divide all kinds of trees into two basic wood groups called **hardwoods** and **softwoods**. Hardwoods have broad, flat leaves, like the oak, maple and cottonwood. They usually turn colors and lose their leaves in the fall. Softwoods have needle-like or scale-like leaves, such as the pine or the cedar, and usually keep these leaves through the entire winter. Make an exhibition showing the two major groups of wood. Show what kinds of trees are in each group.

Have your leader, or someone who works with wood, show you how plywood is made.



BUILD THINGS



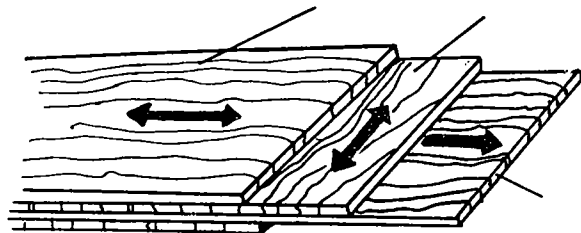
USE GLUE AND FINISHES

Other things being equal, the heavier the wood the harder and stronger it is. Some woods are more likely to split than others. Some woods are easier to cut, sand and finish. Ask your parents, your leader or the people at the lumberyard about suitable materials.

Lumber and plywood

Lumber contains a lot of water when it is cut. Much of this water evaporates into the air. When this happens the size of the wood begins to **shrink!** If the wood becomes wet again, it will get bigger, or **swell**. When wood loses water it can also **warp**, or change its shape.

Plywood is made by gluing together thin layers of wood. (See the picture below.) The grain in each layer goes in the opposite direction, shown by the arrows. Plywood does not shrink and swell as much as lumber. It does not crack or split as easily, either. But the edges on plywood are harder to smooth and finish.



Plywood has three or more layers of wood. The grain of each is placed in the opposite direction of the layer below it.

Some plywood is made for outdoor use. If you use the indoor plywood outside, it may come apart when it gets wet.

Plywood is normally sold in sheets 4 feet x 8 feet. But, many lumberyards do sell smaller pieces. It comes in many thicknesses. Plywood called 1/4 inch plywood is 1/4 inch thick. 3/4 inch plywood is 3/4 inch thick.

Marking and Measuring

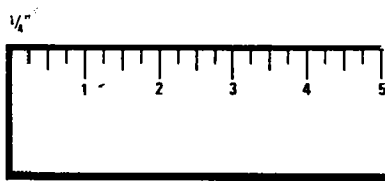
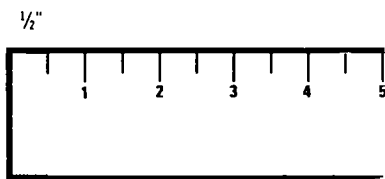
English measure

If you want to make pieces of a certain size, you will have to measure and mark them before you do any cutting.

Examine a rule and find an inch mark. The mark (") shows inches. Find the number that relates to the inch mark. (1", 2", and so on).

Can you find a long mark that is halfway between the inch marks? This is called the half-inch mark. If the half-inch mark is equally divided into two parts, what is the correct name for each of those parts? If these parts are divided in two again, what would those parts be called? If they were divided still one more time, what would these tiny sections be called?

Look at the drawing below. The inch is divided into a number of smaller sections, all of which are labeled. Check your answers against the labels on the drawings.

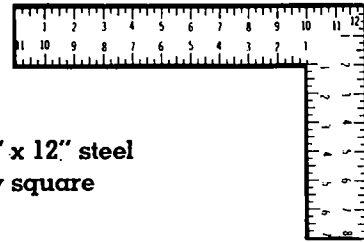


(Above drawings not to scale.)

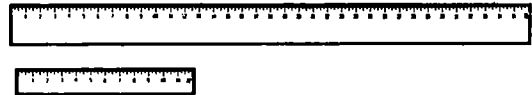
Let's practice a bit. Find the following points on your rule or square: 2", 5", 7 1/2", 3 1/4", 6 1/8", and 10 3/16". If you have any trouble, ask your parent or leader to help you.

The unit of measurement larger than an inch is a foot. The mark (') shows feet. There are 12 inches in a foot. Some six-foot rules will number the inches from 1 to 72. Others will number the inches from 1 to 11, the next number being one foot; the next numbers are 1-1, meaning one foot, one inch, or 13 inches.

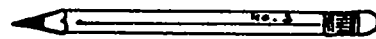
TOOLS YOU WILL NEED:



An 8" x 12" steel utility square



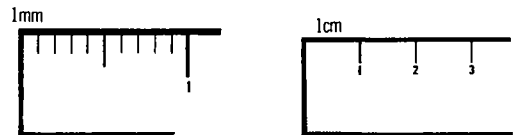
A straight rule, yardstick, folding rule or steel tape



A No. 2 or No. 3 common pencil, kept sharp

Metric measure

The metric system, which is coming into wide use, uses a pure base ten arithmetic. Each one of the counting units is ten times larger than a smaller one. Find a metric rule. The smallest unit of measure on the rule is a **millimeter**. Can you find two of the short marks on your rule that mark the beginning and the end of a millimeter?



(Above drawings not to scale.)

Ten millimeters form a **centimeter**. A centimeter is actually about this long (_____). See if you can find the nine marks between the two larger centimeter marks. These marks divide the centimeter into ten millimeters.

Ten centimeters form a **decimeter**. A decimeter is not shown in the measurement of most rules. Ten decimeters, or 100 centimeters, form a **meter**. A meter is about 39.37 inches long. One thousand millimeters form a meter.

Measuring wood

To build things well, you will need to measure the correct width and thickness of a piece of lumber. For example, if you buy a piece of 2x4 at the lumber yard, you should measure it to see how wide and thick it really is. Remember, the wood may have shrunk due to evaporation. If you do not measure the wood, you might find that you bought a piece that is actually too small for your project.

Let's practice measuring on a piece of scrap lumber. Measure and mark spots $3/4''$, $1\ 5/8''$, $3\ 1/2''$, and $5\ 5/8''$ from the end. Have your parent or leader check your measurements. Did you use a sharp pencil or a dull pencil to mark the spot? Would that make any difference in how accurate your measurement is?

Hold the edge of the rule on the wood and make your mark at the exact spot. You may have watched a cabinet maker marking his spot with a knife or scratch awl. Why does he use these tools instead of a pencil? Because his measurements will be more accurate.

If you have to measure a long distance, use a long rule. You increase the chances of a mistake if you move a short rule several times to complete the measurement.

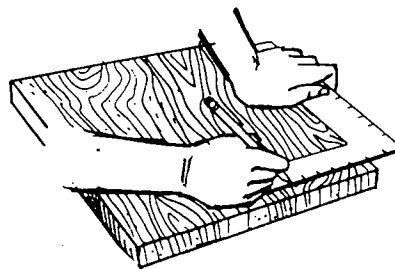
Keep practicing until you can measure a certain distance from the end of the board and accurately mark the spot. The next thing to learn is how to make a line squarely across the board.

Squaring a line

A square line makes a perfectly square corner with the edge of the board. If you would tip the board on edge so that the line pointed upward and the board was level, this line would look perfectly straight up and down. It would not slant toward either end of the board.

To square a line you may use a tri-square, steel combination frame, utility square or framing square.

Hold the handle of the square firmly against the edge of the board. Mark along the blade or the other part of the square with a sharp-pointed pencil. Make only one mark with the pencil. Don't go over it a second time.



When squaring a line, use your utility square to see that the line is straight.

Just to see what happens, try holding one end of the handle of the square about $1/8''$ away from the edge of the board. What does this do to the direction of the line?

Some beginning woodworkers like to make lines across the edges and the back of the board as well. You could try this and see if it helps you make a straighter cut with your saw. To mark an edge, hold the handle of the square tightly against the face of the board with the blade of the square over the edge. Mark along the edge of the square.

To make the square line across the back of the board, hold the square handle against the same edge as when you made the mark on the face or the top side.

CAUTION! Remember to:

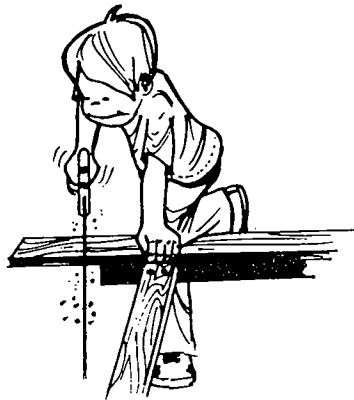
1. Make sure the end you measure from is square to begin with.
2. Examine the end of the board. If you see cracks or other defects, re-square beyond the damaged area.

Things you can do

Practice squaring lines on a piece of 2 x 4 until you can make two perfect squares on the surface of the board.

Measure a piece of 2 x 4. Mark down how wide and how thick it is. Start from the opposite side of the wood and make your measurement again. Is your measurement the same?

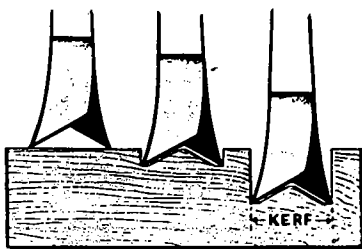
Cutting Wood



When sawing a large board, use both your hand and your knee to brace it while you cut, or use a clamp.

Are you ready now to practice making a square cut with a hand saw along the marks that you drew on the board? Before you do any actual cutting, make sure you read this section very carefully.

If you look closely at the end of your piece of board, you will notice that it is made up of a collection of extremely fine fibers grown together. You could compare these fibers to broom straws that have been glued together.



Sharp points cut wood fibers
The kerf is the slit made by a saw.



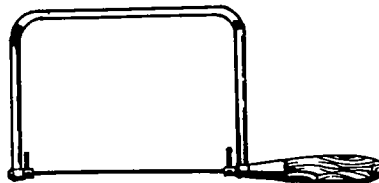
Top view of crosscut saw teeth

TOOLS YOU WILL NEED:



A crosscut hand saw (20 or 22" 10 or 11 point hand saw) to cut off boards crosswise and to cut plywood in any direction.

A rip saw is recommended for cutting with the grain, not to cut end pieces.



Coping saw
for cutting curves
in thin wood



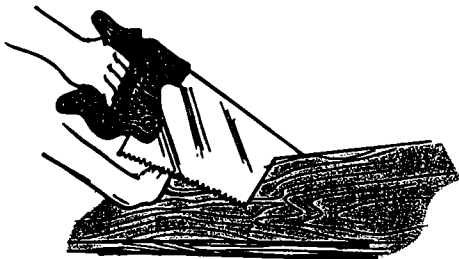
Safety goggles
to keep sawdust and chips
out of your eyes

The **crosscut saw** is a tool used to cut across the fibers of the wood. The teeth of a crosscut saw are filed and bent so the teeth act as a row of knife points on each side of the saw. The teeth are bent slightly as they go along, the first one to the right, the second to the left, and so on. This bending of the saw teeth is called "setting". This design makes the saw cut a strip wider than the blade so the saw can move back and forth easily.

What would a carpenter or cabinet maker say about making a true and square cut? He would say to hold the saw straight up and down, or "square" with the board. What would happen if you held the saw at an angle so the top of the saw would slant to the left or right? Try it, just to see!

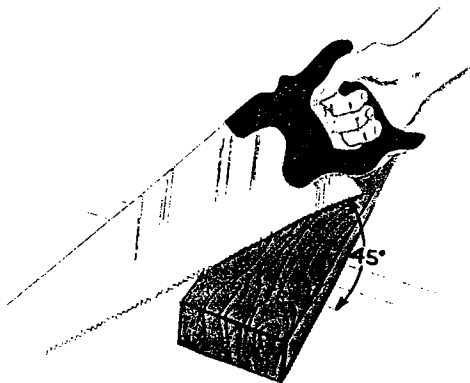
Saw on the waste side of your line. If you saw right on the line, your board may be too short.

Remember, each time you cut the wood you remove some of it. The wood that is removed should be to the outside of the line.



Youth grip

Sometimes you may have to hold the saw flat so the teeth come in contact with the entire surface of the board at the same time. This may be necessary when using a miter box or other



45° for lumber and 15° for plywood

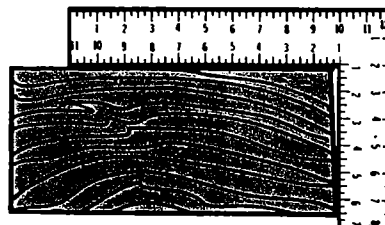
guiding device. When you do not have to do this, raise the handle of the saw so the saw blade is at about a 45 degree angle with the surface of the board on ordinary lumber. When sawing plywood, a flatter angle (about 15 degrees) is best.

Try cutting a board in this manner.

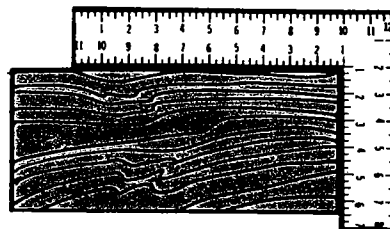
Do you have a true, accurate square cut? Did you push down on the saw? The weight of the saw will make it cut fast enough. Did you hold the

cut-off piece so it did not fall on the floor? If it is not held, the last little uncut portion of wood may break off. What could happen to the nice corners of your piece of wood if it fell on the floor or the ground?

How would you use your square to check the accuracy of the saw cut? Hold the handle of the

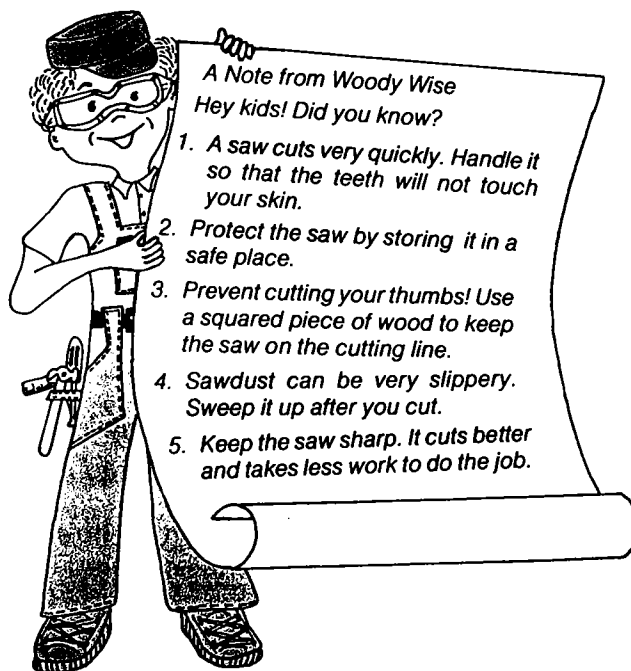


Poor Cut



Square Cut

square tightly against the board and the blade of the square along your new cut. If you can see light between the square and the board, the cut is not square (See the illustration on this page.) Remember to check both crosswise and edgewise of the board.



A Note from Woody Wise
Hey kids! Did you know?

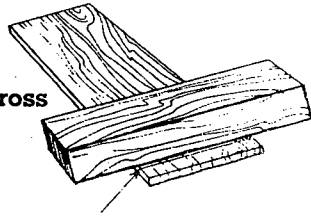
1. A saw cuts very quickly. Handle it so that the teeth will not touch your skin.
2. Protect the saw by storing it in a safe place.
3. Prevent cutting your thumbs! Use a squared piece of wood to keep the saw on the cutting line.
4. Sawdust can be very slippery. Sweep it up after you cut.
5. Keep the saw sharp. It cuts better and takes less work to do the job.

How to make a saw guide

- Materials:** A 2 x 4, about 12 inches long
A board 3/4" thick and 15-16 inches long
(or other lumber to be cut)
- Tools:** A hammer or a block of wood
A pencil
Two C-clamps
A saw

Instructions:

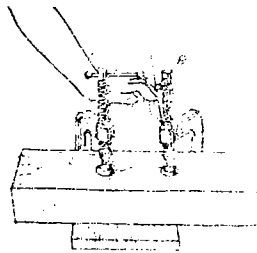
1. Make a square line across the board.



Illus. 1
2 x 4 close to the line

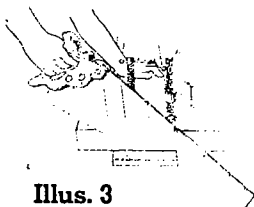
2. Position the 2 x 4 saw guide:

- a. Place the 2 x 4 flat on the board surface close to the marked line (Illus. 1).
- b. Place the clamps in position with slight pressure. (Illus. 2). Be sure to have the thumb screws up! (If they are down, you may hit them while sawing.)
- c. Use a hammer or block of wood to tap the 2 x 4 gently until it lines up along your pencil line.
- d. Now tighten the clamp enough to hold the 2 x 4 in place.



Illus. 2.
C-clamps in position—
thumb screws up

3. Place the flat side of the saw blade against the 2 x 4. Pull the saw backwards for a few short strokes to start the cut. Keep the saw rubbing against the 2 x 4. (Illus. 3).



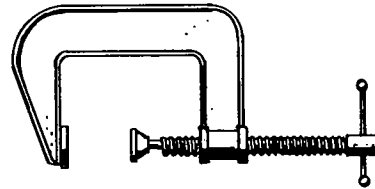
Illus. 3
Keep saw against
2 x 4

4. After the cut is started, continue sawing. Move the saw slowly back and forth. Use little or no downward pressure on the saw.

Using a 2 x 4 and C-clamp saw guide

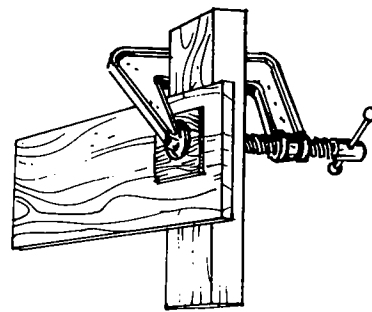
Are you having problems keeping your hand steady enough to make an accurate cut all the way through the wood? Would something to guide your saw help to improve your cuts? Maybe a piece of 2 x 4 held in position along your line would help you make a better saw cut. Clamp this piece of 2 x 4 to a board, and make a saw guide. Directions and illustrations on how to make a saw guide are featured on this page. Or ask your leader or your parent to help you make a jig.

You could also make an accurate square cut using a **miter box**. Ask your leader to show you this tool. If you work with a miter box, hold the piece of wood to be cut tightly against the back of the miter box. Do not try to twist the saw. Let it slide back and forth freely. If the miter box has metal saw guides, keep the saw teeth from touching them.



C-clamp

To prevent clamps from denting the wood, place a thin piece of scrap lumber between your good board and the clamps, as shown below.



Thin piece of scrap under clamp

SAFETY TIPS

Do not let the C-clamps fall on your feet.

After use, place your saw where it will not be bumped by other tools.

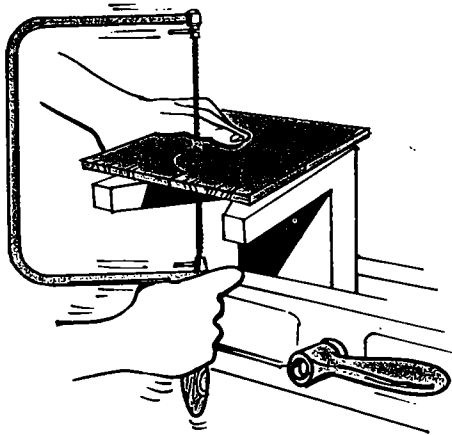
Do not touch the C-clamps with the saw.

Cutting curves

The **coping saw** is commonly used for cutting curves in wood. It is a small, inexpensive saw with a narrow blade.

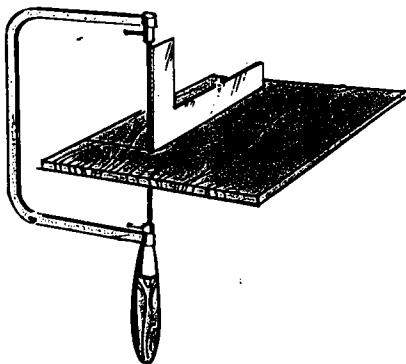
The blade is held in place by spring action of the frame. You bend the frame of some saws to put in the blade. On other saws you loosen or tighten the blade by turning the handle.

As the saw cuts, it tears and breaks fibers on one side of the board. This happens where the



Coping saw in upright position

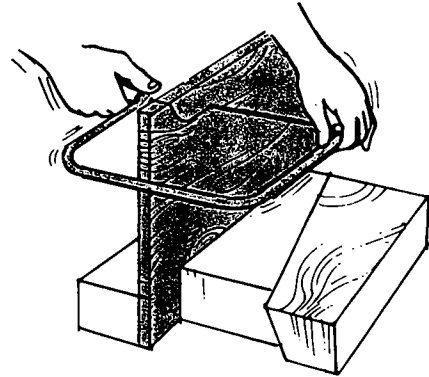
teeth come out of the wood on the cutting stroke. Place your pencil mark on the good side of the board. The wood fiber tears will be on the back side. The fiber tearing can be reduced by firmly pressing transparent or masking tape over the area where the teeth come out of the wood.



Saw square with the surface

If you position the blade with the teeth pointing toward the handle of the saw, you will be less likely to break your blade. It will be cutting on the pull stroke instead of the push stroke.

For wood that is 1/4" or less in thickness, use a blade with 15 or 20 teeth per inch. This is called a **fine tooth blade**. On wood 3/4" thick use a blade that has 10 teeth per inch. This blade is a **coarse tooth blade**.



Coping saw in horizontal position

The coping saw can be used to cut a hole in a small piece of wood. The frame of the saw must go around the outside of the board to do this. Have your leader help you bore a hole through the wood with an **auger bit** or a **twist drill**. Remove the saw blade from one end of the saw. Put the saw blade through the hole, and then put the saw blade into the handle again. A utility saw, compass saw or keyhole saw is frequently used for this purpose.

Things you can do

Saw two pieces of wood, one with the saw straight up and down, the other with the saw at an angle of 45 degrees. Use your square to check your cuts. Write down in your notebook how the two cut pieces are different, and which cut looks better.

Make a saw guide, as shown in the illustration on page 10.

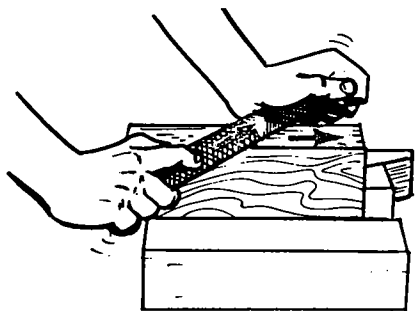
If you have a coping saw, show how you can cut out a curved section in a piece of wood or how you can cut a hole from the center of a board. When cutting a hole, remember to bore a hole through the wood with a bit or drill. Take the saw blade off the handle and put it through the hole by itself before re-attaching the handle.

See "Coping Saw Puzzle", page 20 in the Working Plans.

Sanding and Smoothing

Sometimes when you are sawing curves, they will become off-square across the length of the wood. They will be rough on the edges and will need to be smoothed. You can use a round file, a half-round wood rasp or sandpaper on a dowel to do the job.

You may also want to smooth out a straight, square crosscut saw cut. For this type of cut you can use multi-blade wood forming tools, rasps or sandpaper. You can also smooth the saw cuts of the pieces in a kit or pre-cut unit.

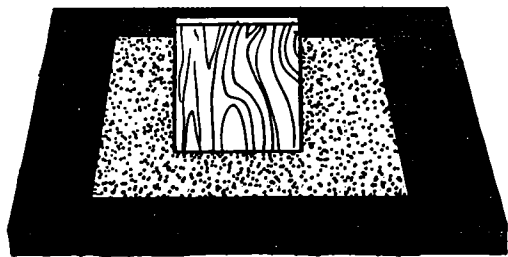


Crosswise and lengthwise stroke

When you use a **rasp**, move the tool lengthwise and diagonally. If you move it crosswise, you will be more likely to break off the edge of the wood.

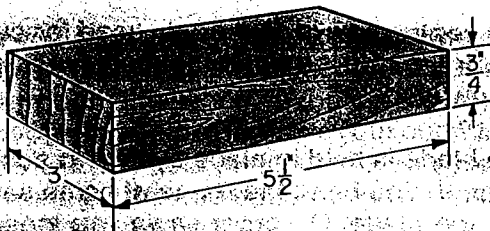
When sanding the edges or sides of the wood, sand in the direction of the grain of wood. If you sand across the grain, scratch marks will show.

Use either a part of a sheet of sandpaper on a block of wood, or glue a full sheet of sandpaper to a piece of flat plywood. Move your piece of

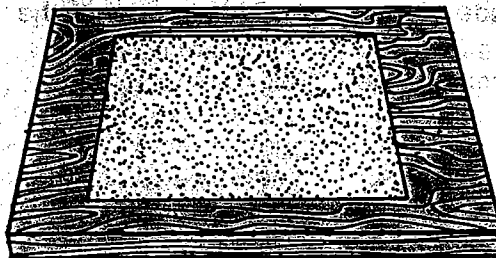


Keep board straight up and down

TOOLS YOU WILL NEED:



Sanding block to hold your sandpaper (commercial type may be used)



Sandpaper, available in various grades of fine, medium and coarse grit (Garnet paper is good especially for hardwoods. It costs more than flint paper, but cuts faster and lasts longer.) Shown above is a full sheet of sandpaper glued to plywood.



Wood rasp



Shoe or utility rasp

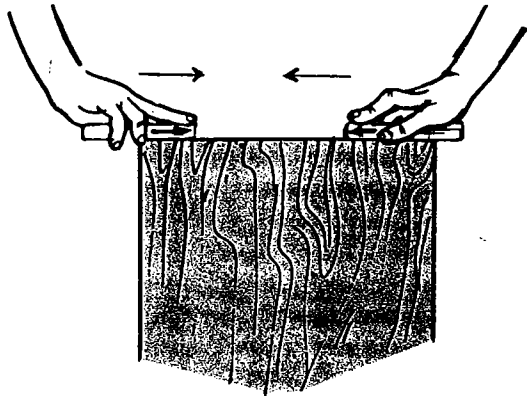


Multi-blade wood forming tool to smooth and improve saw cuts

wood across the full sheet of sandpaper which you attached to the plywood. For rough cutting use coarse grit flint paper or 50 grit **garnet paper**. For easy smoothing use fine grit paper or 150-200 grit garnet paper.

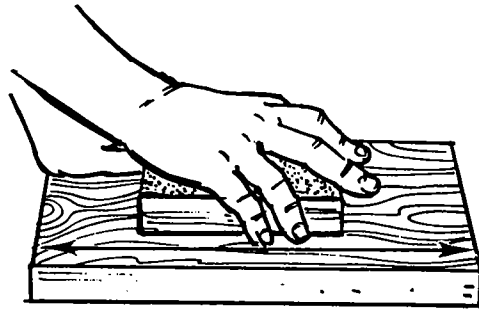
Smoothing wood for a finish

Smooth the ends, edges and sides of your pieces prior to putting together your project. Then it will be ready for a finish. You may have to do a little touch-up sanding after assembling it. This depends upon how you intend to use the article you have made.



Prevent corner chipping

To smooth an end grain with sandpaper or rasp, work from both edges towards the center to prevent the grain from chipping off the corners.

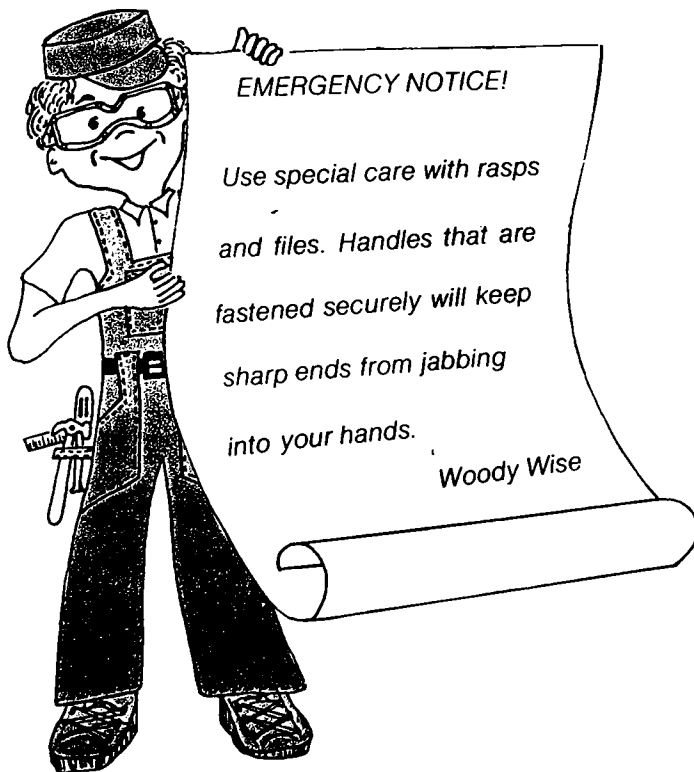


Sand with the grain

For most exterior use, lumber and plywood as they come from the lumberyard are good enough for finishing. But if the wood is dirty or oily, clean these spots either by sandpapering or washing them with a damp cloth that is not too wet.

If you are making a toy, a game or an article for the home, you may want to sand it. Some plywood is sanded at the factory and will require only a small amount of additional sanding with fine sandpaper. Lumber is not factory sanded. If you look carefully, you may see straight lines or small ridges going across the board which were made by the planing mill. Your sanding will cut these ridges, producing a flat surface when they are sanded away. You can remove these marks using medium and then fine sandpaper.

Prior to completion always finish with fine sandpaper. Then carefully wipe off the dust with a clean cloth.



Things you can do

Name some tools that are used in smoothing and sanding, and show these in an exhibit.

Show what motion should be used when filing with a rasp, and when rubbing with sandpaper or a sander.

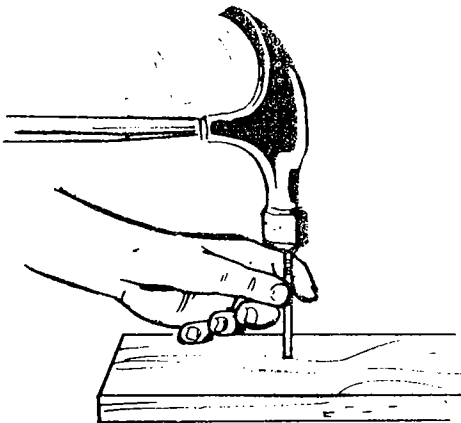
See "Sandpaper Block", page 21 in the Working Plans.

Driving and Pulling Nails

There are many kinds and lengths of nails. Each is designed to do a special job. There are shingle nails, roofing nails, carpet tacks and ring-shanked nails. Common nails, box nails and wire nails have flat heads and are used where neatness is not important. Wire brads and finishing nails are used where neatness is important.

Most nails are ordered by "penny" size. The letter "d" is usually written instead of the word penny. One pound of six penny nails may be written as 1 lb, 6d nails. The length of 2d to 10d nails can be figured out by multiplying the "d" number times 1/4 inch and then adding 1/2 inch to that number. How long is a 6d nail? To find out, we multiply 6 times 1/4, which equals 1 1/2. To that we add 1/2, which gives us 2. So a 6d nail is two inches long.

To drive nails we generally use a hammer. A hammer can also be used to pull and straighten nails.

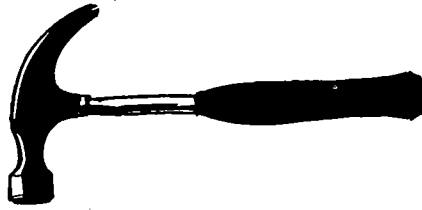


Grasp nail
near the head

See if you can drive several nails into some scrap wood without bending them, and without making hammer marks on the wood. If you do not strike the nail squarely each time with your hammer, what will happen?

If you had to show someone who has never held a hammer before how to drive a nail, how would you teach him?

TOOLS YOU WILL NEED:



A curve claw hammer with a small handle to pull, drive and straighten nails (You could also use a tack hammer.)



Safety goggles



Wire and common nails



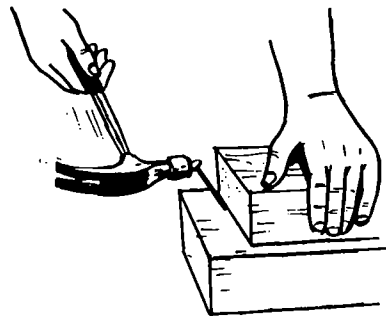
Brads and finishing nails



Nail set to drive nails into surface of the wood without leaving hammer marks

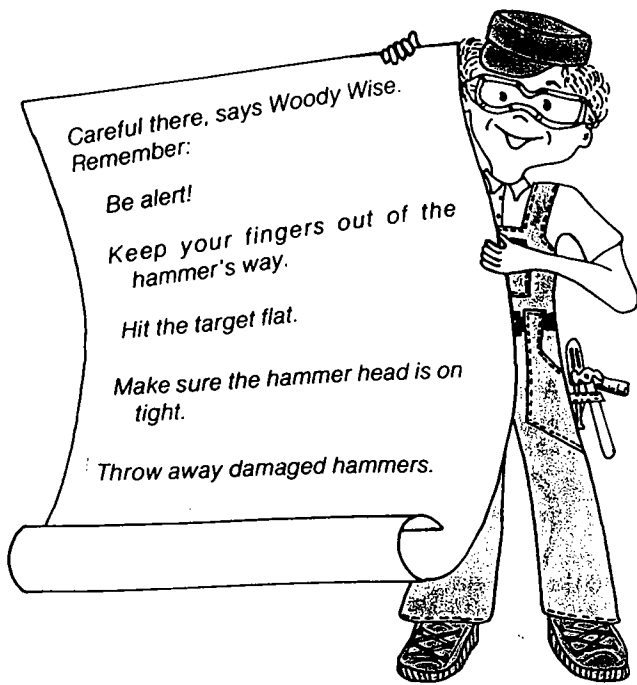
Most beginners start off holding the hammer near the head, then move their hand further back as they gain experience.

Bent nails may be straightened by holding a hammer or a block against the nail and pounding the leaning side of the nail against the object with another hammer.



Straightening a long nail

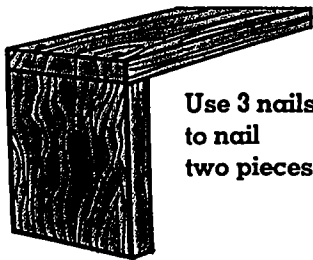
Sometimes a short nail can be straightened without holding anything against it.



Nails which are too large, too close to the end of the board, or driven into lumber that is too thin can split the wood. If you must nail near the end of the board or into thin wood, use a small nail or drill a hole a little smaller than the nail.

Things you can do

Practice driving nails into scrap wood. Keep the nails straight and the wood free of hammer-marks. Also practice driving in nails that are near the end of the block of wood.



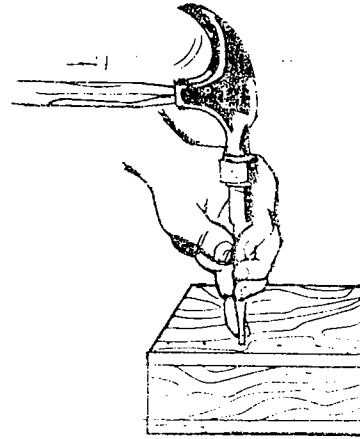
Use 3 nails to nail two pieces together

Drive nails of different lengths into a block of wood. Stop hammering before the head of the nail reaches the surface of the wood. Then practice pulling out the nails without bending them

See "Nail Point Design" and "Letter Holder", pages 22-23 in the Working Plans

Using a nail set

To drive down the nail so that it is even with the board, you may use a **nail set**. It is often used to drive or set the head of the nail below the surface of the wood. Use a nail set smaller than the head of the nail. Place the nail set directly over the

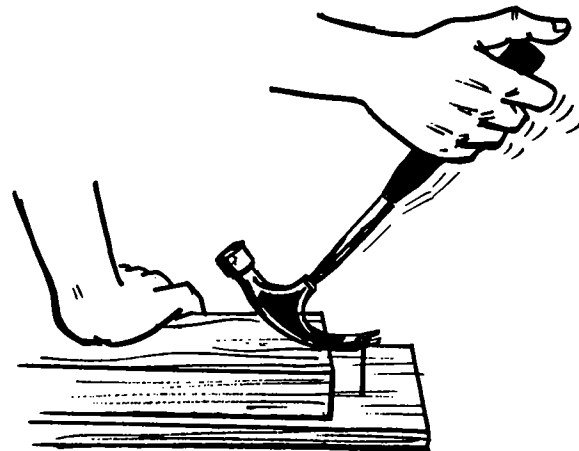


Using a nail set

head of the nail. Tap it with a hammer rather gently, especially if the nail is a small-sized one.

Pulling nails

The claws on the hammer are designed to pull nails. Slide the claws under the nail head, then grasp the hammer handle near the opposite end and apply a firm steady pull until the nail is out.



Pulling a long nail

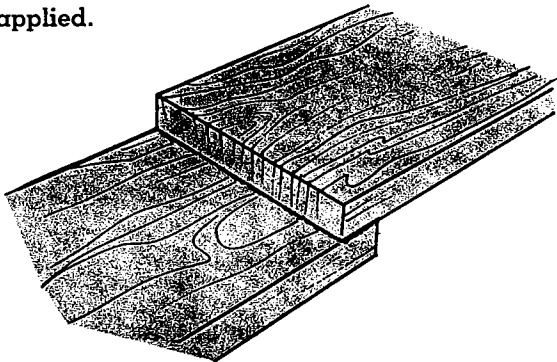
When pulling long nails, put a block of wood under the hammer head close to the nail.

Using Glues and Wood Finishes

Working with glue is an interesting and important part of woodworking. The advanced units of the 4-H Wood Science Program have information on several different kinds of glue. For now, you will do well to use the polyvinyl-resin glues. People know them as "white" or "yellow" glues, which you can buy in a hardware store in plastic squeeze bottles. Although they work well indoors, most of these kinds of glues will fail to hold if they remain outdoors in humid weather. For wood materials that will be used outdoors use a special glue that is prepared for that purpose.

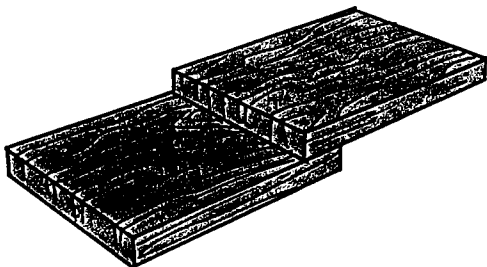
Make sure always to read the directions on the label and follow them carefully.

A
Correct amount of glue applied.




Apply the proper amount of glue, as shown in Illustration A. When the joint is fastened together a small amount of glue should squeeze out at the edges. No squeeze-out indicates a shortage of

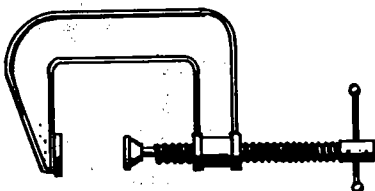
B
Not enough glue! Apply a little more.



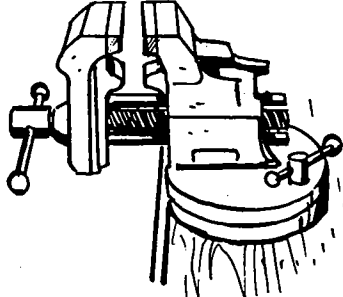
TOOLS YOU WILL NEED:



A one-inch paintbrush to apply interior or exterior finishes



One or two 3-inch C-clamps to hold pieces of wood together for gluing, or to clamp boards together when boring holes



A homemade bench vise or a factory-made vise

glue (B). Too much squeeze-out indicates a waste of glue (C). Wood covered with glue will not accept stain and finish in the same way as the natural wood and looks sloppy.

C
Oops! Too much glue!
Wash it off before it dries.

