EVERYDAY WOODWORKING

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A BEGINNER'S GUIDE TO WOODCRAFT

With 12 Hand Tools

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To my Patrons. You make it possible.

Contents

This Is How It Starts: An Introduction

Someone wants to become a woodworker. They go down to the home center and buy a table saw, jigsaw, router, drill, and sander. At home, the tools are set up and the woodworker just . . . starts. With no one to teach them, the woodworker watches a few videos online and then starts cutting wood. Maybe it goes well. They make a few simple projects, make a few better ones, and then buy better tools and do more advanced work.

Maybe it goes badly. The neighbors are irritated by the noise. The woodworker doesn't like being covered in dust (and is a little bit uncomfortable with all those spinning blades). The machines get used less and less. Eventually, the woodworker gives up.

Maybe it goes *very* badly. The woodworker gets hurt. Cheap table saws can slice right through your finger. You'd be shocked at how often it happens.

I started out with a bunch of power tools and not much experience. I wish I hadn't. Pushing a piece of wood through a table saw is easy, but it doesn't teach you very much. You won't learn about the structure of wood or grain direction. Your hands won't become skilled.

I probably own every power tool out there and I've worked as a professional furniture builder, so I've lived this story. All that time behind machines taught me that power tools separate you from the work. Machine tools teach you to impose your will on the wood. *You* decide on the shape and you *force* the wood to do what you want. Many fine pieces of furniture are built this way, but the craftsperson never learns the material, never trains their hands.

There's Another Way

If I was starting again, I would skip the machinery.

I would buy a few good hand tools and spend time learning how to use them. Instead of rushing to finish my first project, I would learn how to saw a straight line, chop a graceful curve, and carve a little detail.

I would spend a lot of time learning about wood: how trees grow, how wood is cut and dried, and how to read the grain in each new piece I pick up. I would learn how to work *with* the material, exploiting its weaknesses and using its strengths.

My first projects would be simple—and useful. I would build a box to carry my tools, a stool to sit on, and a workbench so small and light that I could just carry it around.

Instead of being trapped in a dark basement, I would make my work space any spot that suited me. I could work in the yard on a sunny day. If I lived in an apartment, I could keep everything in a closet and pull it out when I had time.

I think this is the way most people should get started, so I wrote this book. *You* can get started cheaply and safely. You can gather knowledge and skills that will always be relevant, no matter how you follow the craft. Once you understand wood and know the basic techniques, you can still buy those machines. They're not going anywhere.

Woodwork for Humans

If you ask me about woodworking, I say I like the *human* approach. Some people laugh at this answer because only humans do woodwork. Who else could woodwork be for? Aliens?

When I say *woodwork for humans*, I mean people over machines and knowledge over equipment. I tell woodworkers to hold tools in their hands and learn to cut a straight line or drill a clean hole. I like the human approach because I believe in equipping your brain instead of your shop. If you understand how your tools work, you'll never be limited to what you can buy.

When you invest in knowledge, you can solve any problem. If a tool breaks, you can fix it or build another. If your shop is destroyed by flood or fire, everything will *not* be lost. With the right information, no setback is permanent.

The human approach is affordable. The woodworking world is filled with expensive gizmos to help you perform every operation. Some of them work. Most of them are overpriced. My father once said to me, "Rex, you can solve any problem if you throw enough money at it."

He's right. Many of the gadgets on the market really *will* hide your screw holes or cut your dovetails for you. But if you solve your problems by buying things, you haven't accomplished much. All those things can be lost or stolen or broken. The one thing that's really yours is your

knowledge. With that in mind, I always keep expenses to a minimum. Throughout history, woodwork has been done mostly by working-class people without much money. There's no reason that modern woodworking should be reserved for the rich. The tools I list below can all be bought for around $300. That's less than the cost of a cheap table saw, and most of these tools will last for decades.

As your skills grow, you can slowly add new tools, one at a time. You'll learn how to spot good, affordable tools. You won't waste money. You'll make objects that your friends and family will cherish forever.

That's woodwork for humans.

If you'd like to learn more about the Woodwork for Humans philosophy and get a FREE bonus chapter with an extra project, go to www.woodworkforhumans.com/free.

The 12-Tool Wood Shop

A beginner's tool kit should be small, portable, and affordable, so we're going to focus on twelve quality tools that won't break the bank. Here's a list of the tools along with brand recommendations.

A Hatchet

Most people have used a hatchet at summer camp. You probably never thought that it could be a tool for fine woodworking, but even an inexpensive hatchet can split, carve, and trim wood. You can flip it around and use the back as a hammer for tapping joints together. Throughout this book, I just use an inexpensive Boy Scout hatchet I bought at a flea market. Find an old hatchet at a garage sale and you'll probably have a good tool for little money.

If you can't find a vintage hatchet, try a **Fiskars 378501 Hatchet**. I don't own one myself, but many people like them, especially for the price.

A Knife

Pretty much every woodworking tool is a blade and the best introduction to woodwork is knife work. You can get started with a pocketknife, but these generic blades often have a tiny bevel (the two sloping surfaces that form the edge). Pocketknives are great for opening packages and casual whittling, but most knife work involves riding that bevel against the wood to get a controlled, even cut. For good work, you want the widest bevel you can find. The **Mora Sloyd Knife** has a very wide bevel to give you lots of control. The handle is comfortable, and the knife comes with a sheath. You don't have to buy this model. Any small, slightly curved knife with a wide bevel will work. (Many tool makers refer to this bevel style as a "Scandi grind" so that's what to look for.)

Sharpening Stones

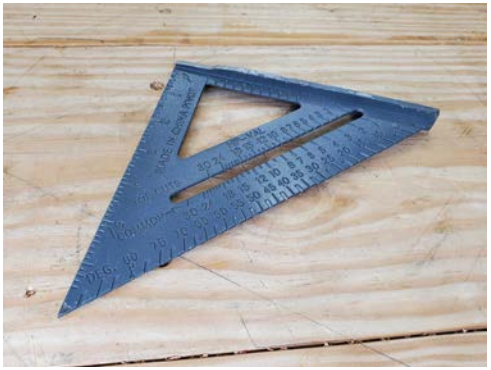
Even good edge tools get dull pretty fast and sharp tools make good work, so you'll need to sharpen. For my own work, I rely on a **Norton Crystolon Combination India Stone**. This stone has a coarse side and a medium side. You really get two stones in one, so it's a good value.

The Norton stone isn't fine enough for really sharp edges like the knife, so I also recommend a fine stone. I prefer hard Arkansas stones like those sold by **Dan's Whetstones**. There are many grades of this stone, like "ultra-fine" and "surgical." None of these is necessary. A simple (and less expensive) **fine Arkansas stone** will do. If you can't get an Arkansas stone, almost any fine stone will work well. Feel free to buy a waterstone or a diamond plate if that's what you can afford. I've always used oilstones, so I'm biased.

Tip: All of these tools can be bought used, especially at flea markets and garage sales. People often don't know anything about their "old junk" and they sell tools for pennies. You can also buy used tools online, but I wouldn't. Until you know a bit more, you want to inspect the tool in person.

The Square

Good woodwork demands accurate marking and measuring. For laying out your projects, nothing beats a carpenter's speed square. This little chunk of metal the lets you draw the lines straight lines across a piece of wood. It also has a built-in ruler and a basic protractor for measuring angles. I recommend the **Swanson 7"** model (or the metric equivalent) For about $10, you get a lot of tool.



A Tape Measure

You'll also need a tape measure. Feel free to buy a cheap one from the dollar store, but if you'd like something more durable, I like the **Stanley Powerlock 16' tape rule**. Sixteen feet is plenty for the projects in this book and this size is compact enough that you can clip it to your belt and forget about it.

The Awl

You can use a pencil for most of your layout, but an awl is handy, too. You can use this tool to scratch a thin line across a piece of wood. Use the point of the awl to make a mark where you want a hole and your drill bit will start in exactly the right place. I use a couple of different awls in this book, but I recommend the **Stanley 69–122 scratch-awl**.

A Contractor's Saw

Sawing is a key skill, and it's good to have a couple of saws. For making fast, rough cuts, I like the **DeWalt 20" Standard Panel Saw**. This saw was designed for contractors to use on the job. It has big, aggressive teeth and an antifriction coating. (I'm not sure that coating actually does anything for your sawing, but it does prevent rust.) This is a "disposable" saw that cannot be sharpened, but the teeth are hardened, and it will be a long time before they get dull.

This saw works well, but there's nothing special about it. Any hardware store or home center will sell some kind of contractor's hand saw. Buy something with a comfortable handle and you'll probably be happy.

A Fine Saw

Your contractor's saw is fast, but it leaves a ragged edge. For more accurate work, you'll need a finer saw. I recommend a Japanese "Ryoba" saw for beginners on a budget. The Ryoba is a versatile tool that will saw with the grain or across it. The Ryoba is lightweight, easy to grip, and combines many functions in a single, affordable tool. I've had good luck with the **Gyokucho 9½" Ryoba for hardwoods**, but you can buy an equally good saw from the Suizan Company. Buy whichever saw you can find.

Like the contractor's saw, the Ryoba comes with hardened teeth that stay sharp a long time but cannot be sharpened. When this saw does get dull, you'll be throwing away the blade. Luckily, the blades on Japanese saws are replaceable, so you get to keep the handle. Replacement blades for these saws are reasonably priced.

A Drill

When most people think of drills, they think of a cordless electric drill. I've owned many of these myself, and I like them. But for general woodwork, I recommend a brace and a hand drill. These are old-fashioned, hand-cranked tools, and they look a little funny to the modern eye, but not so long ago, these were the tools of serious craftsmen. The brace and the hand drill are mechanically simple, easy to use, and require no electricity. Both of these can usually be found cheaply at flea markets and garage sales. Unfortunately, I can't recommend any new models because most of them are awful. Of course, you can also buy a cordless drill and that will work great. Before you buy a drilling tool, read Chapter 10, which covers drills in more detail.

A Bar Clamp

To work on a piece of wood, you have to hold it steady. Even inexpensive clamps will grip your work while you saw it or chop it. A good general-purpose clamp is the **Jorgensen 12" Heavy Duty Steel Bar Clamp**. This clamp works especially well for holding pieces down to a flat surface like a table. The bar clamp is a common design available from many manufacturers. I've had good luck with Jorgensen, but buy whatever you can find and afford. I like the 12" (30 cm) size for general work. The short length doesn't get in the way.

A Hand-Screw Clamp

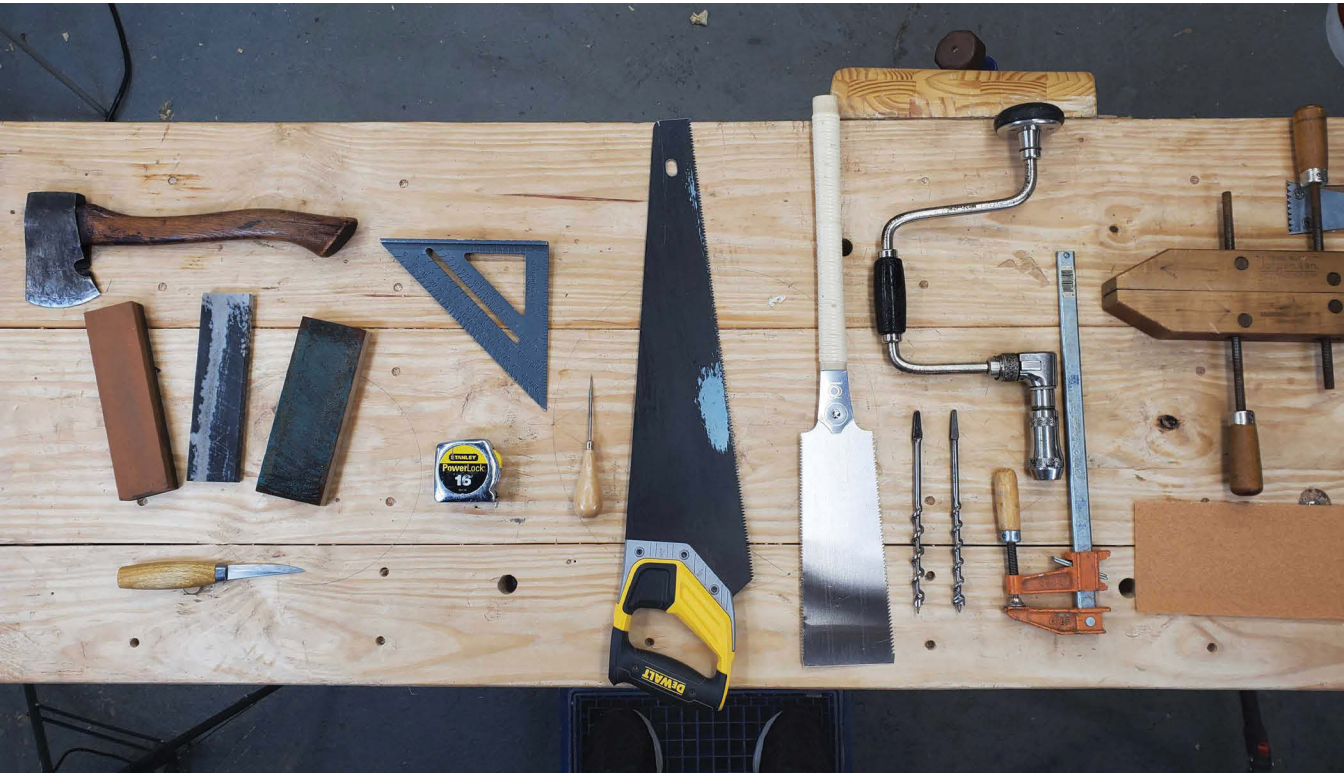
When you need more clamping power, a wooden screw clamp is a great choice. This clamp looks old-fashioned, but it's amazingly useful. Set the width of the jaws by turning the screws,

put your work in the clamp, and the use the rear screw to crank up the pressure. The lever-action of this clamp delivers surprising force and the wooden jaws are less likely to damage your work. You can also use this clamp with your bar clamp to make a quick woodworking vise. Use your bar clamp to secure your screw clamp to a tabletop and leave one jaw hanging off the edge. Now you'll be able to grip boards and work on the ends or grab small stock for drilling or trimming. There are lots of good screw clamps out there, but I like the **Jorgensen 8½" hand-screw clamp**. This model is pricey, but you only need one. Feel free to buy something cheaper if money is tight.

Sandpaper

Sandpaper is usually used to smooth wood and prepare it for final finishing, but we'll also use it for a variety of shaping tasks and even make some simple tools by gluing sandpaper to scraps of wood. You'll need a few different grits of paper, but you don't need to buy anything until you read Chapter 14, which is all about sanding.

Go ahead and start picking up these tools when you see them. We'll do our first project soon, but before we do, let's learn about wood.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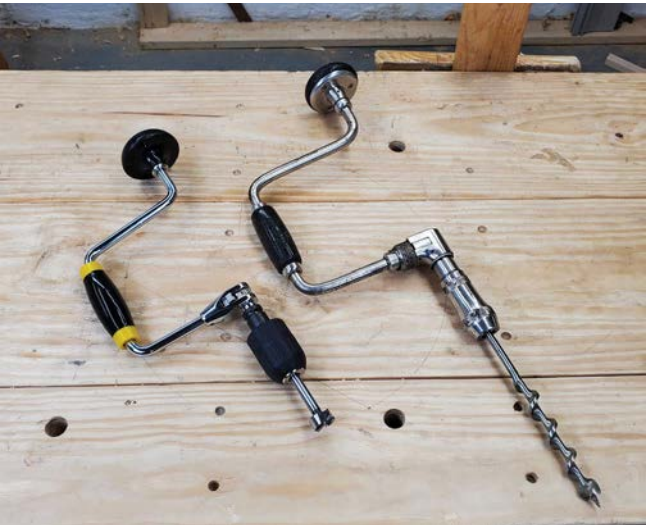
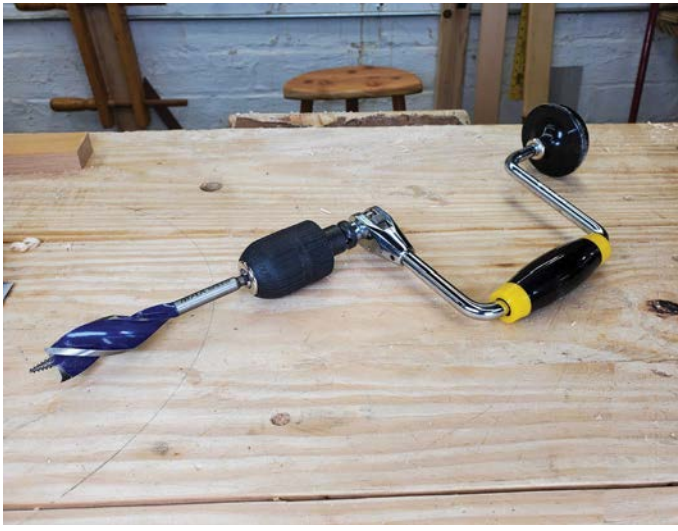




Chapter 1
What Is Wood?

A tree is just a big plant. When it's a young sprout, a tree is like any other plant: soft and flexible. Like all plants, a tree is a collection of fibers. These thin, tough fibers are floppy by themselves, but when you bundle them together, they're surprisingly strong. These fibers are hollow, and they carry water and nutrients up and down, so a plant is a like bundle of straws.

This green twig is flexible because the fibers are wet and soft.

This dead twig splinters instead of bending. Where it breaks, you can see the fibers that make up the wood.

Trees are different from other plants in one way: As the sprout grows into a tree, the middle fibers die and harden. The center of the tree stops circulating sap and turns stiff. The tree lives on, but all the functions of life happen just underneath the bark. The inside of the tree is dead, and these dead fibers are wood.

Even though wood can look smooth and solid, it's just a bundle of straws. Everything we do to wood, from cutting it to finishing it, depends on these fibers, how they are laying, and where they are pointing. Remember this and you can do *anything* with a piece of wood.

Even though this log appears solid, it's just a bundle of small, hollow tubes.

Why Make Things Out of Wood?

The modern world is filled with high-tech materials. Buildings are framed with steel beams. Our pots and pans are made from complex metal alloys. Even the bucket you use to wash your car is made from polyethylene, a material that didn't exist a century ago.

When we're surrounded by cheap and durable synthetics, wood might seem old fashioned, but it's not. Humans have made things from wood for thousands of years, not just homes and furniture, but even wheels, tools, and dinner plates. For some things, wood was the only material available. For others, wood was—and still is—the best material possible.

These wooden spoons are just as good as anything you'd buy in a store, but because I made them myself, they fit my hand exactly.

Wood is easy to work and very durable. A wooden chest can last for centuries, even if it's being used every day. Wood is light, but it can support a lot of weight, so it's good for chairs and

tables. Even more important, wood is *pleasant*. Plastic can feel cheap and metal feels cold, but wood feels warm and solid to the touch.

Wood is also ecologically responsible. Wood produces no toxic chemicals when it's worked. Wood shavings can be used as garden mulch or composted to enrich the soil. Wood is biodegradable, and if you do throw it away, it breaks down like any other plant. And, while metals and plastics require huge amounts of energy to produce, wood makes itself. Trees just keep growing, so there will always be more. Many of the projects in this book can be made with reclaimed wood or green logs straight from the tree. When you rescue these pieces of wood from the dumpster or the side of the road, you keep them from being burned or landfilled, both of which release greenhouse gases. Using wood you find around the neighborhood reduces your carbon footprint, especially with the hand-tool methods we're going to learn.

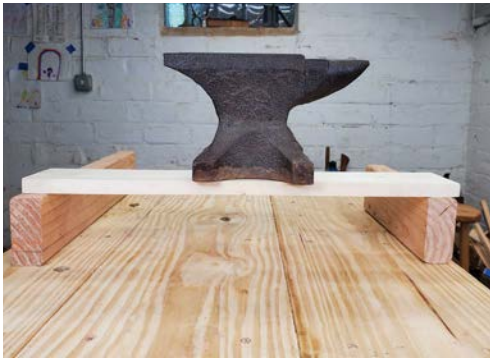
And while we might prefer a lightweight plastic bucket to an old-fashioned wooden one, tables, bookshelves, and chests work best in wood, which is a durable, lovely, and responsible material.

Strong and Weak

Because wood is a bundle of fibers, it has some surprising mechanical properties. Those individual fibers are extremely strong, but the bond *between* each fiber is pretty weak. So if we apply force along those fibers, wood holds up very well. If we put pressure between those fibers, they split apart.

Along the fibers, wood is very strong in compression and tension. If you stand a piece of wood upright, you can put a lot of weight on it and the wood won't even bend. This is why big buildings can be made from wood. You can also suspend weight from a piece of wood, and like

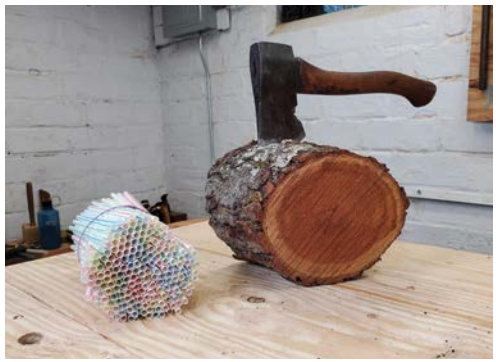
Even though this piece of wood is barely more than ½"(13 mm) square, it easily supports this 30-pound (14 kg) anvil.



This thin piece of soft white pine can support a lot of weight across the grain, but if it were much longer, it would sag.

good rope, wood will easily bear the strain. Wood is also moderately strong perpendicular to the grain, so even a thin bookshelf will hold a lot of books, but if that shelf is longer than a couple of feet, it will bend in the middle.

For all its strength along the grain, wood is very weak *across* the grain (between the fibers). If you've ever split firewood, you know what I mean. Lay a log on its side and chop it hard with an ax. Even a sharp ax will barely penetrate. Now flip that same log up on end and chop down from the top. That log will split right in half.



Wood fibers are very strong. I swung this hatchet hard, but it barely dented the side of this log.

The bond between wood fibers is pretty weak. By chopping down into the end grain, the hatchet slid between the fibers and easily split this log in half.

This peculiar blend of strength and weakness makes wood an amazing material. When we understand wood's strengths, we can build things that will last for decades. When we understand wood's weaknesses, we can exploit them to make building easier. You might be surprised to find out that some of our projects will come straight from a log of firewood. Such a heavy chunk of wood might seem impossible to build with, but it's pretty easy to knock a log into manageable pieces by splitting it along the grain. By understanding the structure of wood, we can save ourselves effort while still making strong projects.

Tip: As you're reading these first chapters, take a trip to your local lumberyard or home improvement store. Just take a look at what woods they sell. What species are available? Is the wood dried?

Wood and Water

Wood is a living thing and when a tree is cut down, it's filled with water. This water-logged wood is called **green wood** and some projects can be made directly with wet wood from the tree. Other projects need dry wood.

If you cut down a living tree, saw the trunk into boards and stack them outside, these boards will dry out until their water content equals about 12 percent of their weight. This process takes about a year and the resulting wood is called "**air dried**." This wood is usually taken indoors, where conditions are warmer and drier, and dried for a few more weeks before it's used.

This fresh-cut log is heavy and full of water. Some projects can be made from this "green" wood, but most furniture is made from boards that have been sawn and dried. The log is resting on a small piece of kiln-dried board.

In large-scale wood production, fresh-cut boards are placed in a kiln, a large metal container that uses heats and vacuum to physically pull water out of the wood. Kiln drying only takes a few weeks and can pull the moisture content of wood down to about 8 percent. If you buy wood in a store, it will probably be **kiln dried.**

But that's not the end of the story. Wood keeps gaining and losing water long after the tree is dead. A piece of wood is always trying to be at **equilibrium** with its environment. In humid weather, wood absorbs water from the air. If the weather turns drier, wood will lose water. Wood and air are always trading water back and forth. Even a finished piece of furniture—even a piece covered in paint—is always pulling water out of humid air and giving it off when the weather turns dry.

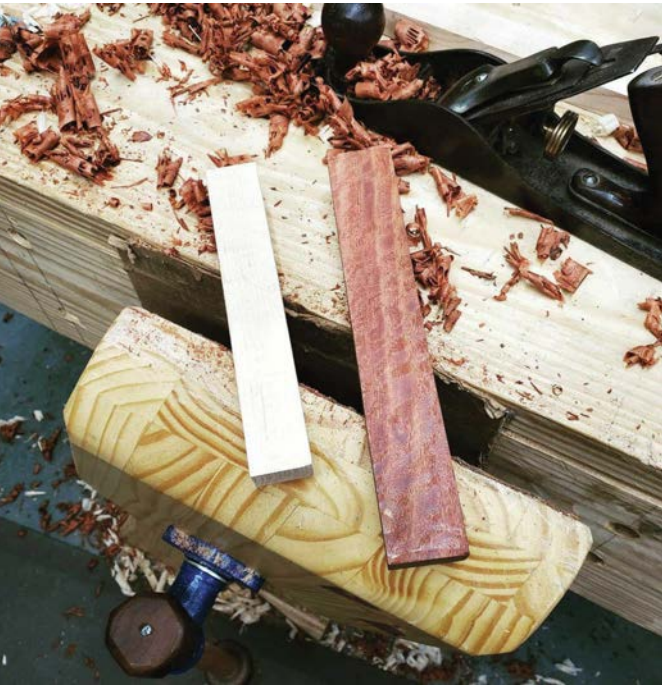
As water comes in and out, wood moves. A dry piece of wood will expand as it takes on water, and a wetter piece of wood will shrink as it dries. Most of the time, this swelling and shrinking is no problem. The furniture in your home has been designed to allow a little movement. But there can be problems. A poorly designed piece of furniture doesn't allow wood to move, and this can lead to cracking and splitting. When things are really bad, a piece of furniture might fall apart from internal stress.

None of this should worry you as a new woodworker. Most of your pieces will be fine. Sometimes, you'll make a mistake, and your work will split or crack. This happens to everyone from time to time, and it's just part of the craft.

When it comes to wood and water, remember: wood is always trying to match the humidity of its environment. It will always swell and shrink, no matter what kind of finish you put on it. This means that you must allow wood to adjust to its environment.

When you buy fresh lumber, even if it's been dried, let it sit in your work space for a few weeks before you use it. If your wood is going to change shape, you want that to happen *before* you start building. Sudden changes in humidity are bad for your woodworking projects. You might build a handsome stool out of green wood straight from the tree, but if you immediately bring that project into a bone-dry house with modern heat, the wood might react violently. These things happen, but if you plan ahead and think about where your projects are going, you shouldn't have any trouble.

The deep cracks at the edge of this board show that it was dried too quickly, and the wood fibers split apart from the stress. Wood that's dried carefully won't split.



Chapter 2
The Hatchet

Now that you know about wood, you're ready to get a tool and do your first project. A hatchet is a great place to start. Even an inexpensive hatchet or an old camping hatchet will get the job done. I use an old Boy Scout hatchet made by the Plumb company. I picked it up at a garage sale several years ago for a few dollars, and it's perfect.

Old hatchets like this one work great and they're easy to find at flea markets and tag sales.

New hatchets often come sharp enough to get started. But if you buy an old hatchet (and the old ones are often better), it will need sharpening. If the tool's edge is very blunt or damaged, don't buy it. Look for something with a smooth, unchipped edge that feels a little bit sharp. You should also find a tool with a solid handle that's seated firmly in the head. After you've been woodworking for a little while, making a new handle will be easy. For now, you want to get straight to work.

Tip: If the head of your hatchet is just a tiny bit loose, try pouring a little Boiled Linseed Oil on the end of the handle where it comes through the head. Let it soak in overnight. A little oil on that end grain might make the wood swell and tighten things up. (See Chapter 22 for more on Boiled Linseed Oil).

A hatchet is pretty easy to sharpen. Buy an inexpensive oilstone. I recommend a **Norton Crystolon Combination India Stone**. You also need a small bottle of **3-in-1 oil**. (If you'd like a list of all the products in this book and where to find them, go to **woodworkforhumans.com**.)

Sit down at a table and place your sharpening stone coarse-side up. If it slides around, put the stone on a little piece of rubber mat (pieces of drawer liners and yoga mats work well). Put a dime-size blob of oil on the stone and rub it around with your finger until the surface is evenly coated. Sometimes new stones absorb a lot of oil, and you might have to put on a bit more. The surface of the stone should be shiny and wet.

Your sharpening stone should be evenly coated with oil. As you use the stone, little particles of metal will come off your tool. The oil will keep these particles out of the stone. Be sure to wipe off the used oil every time you use it.

Grip your hatchet handle in your dominant hand with your fingers just underneath the head and your thumb across the **poll** (the back of the head). Lay the fingertips of your other hand just behind the edge. Set the hatchet on your stone and rock it back and forth. You're trying to feel the **bevel**—the side of the hatchet leading up to the edge. If you rock the head all the way forward, you'll be right on the edge and you'll feel a lot of resistance as you push forward. As you rock the head back toward you, you'll be back on the bevel and the hatchet will be easy to push across the stone.


This two-handed grip will give you lots of control for sharpening.

You sharpen by pushing the tool across the stone with medium downward pressure. Start your stroke with the hatchet just barely up on its edge; you should feel a bit of resistance from the edge. Push the head forward along the stone and slowly drop your hand so you transition from the edge to the bevel. At the end of your stroke, your hatchet should be resting on the bevel behind the edge. By working both the edge *and* the bevel, you will create a keen cutting edge and a flat, slender bevel that will easily penetrate the work.


Your basic sharpening stroke starts with the tool up on its edge at about a 25° angle. As you push forward along the stone, slowly rock the tool back so that you transition from the edge to the bevel. At the end of your stroke, the edge is off the stone and you are only working the bevel.

As you're doing this basic sharpening, you'll need to roll the blade side-to-side. The hatchet is curved and just taking straight strokes will only cover the middle of the tool. Take a few strokes in the middle, then lift the handle up a little and take a few strokes so that you're sharpening the top corner, then dip the handle down so that the lower corner of the hatchet gets sharpened. Work back and forth, changing the angle slightly with each stroke so that you're sharpening the whole tool.

You can also sharpen with the hatchet on your knee. Hold the tool steady and move the stone in circles up and down the bevel.

Another approach is to hold the hatchet vertically with the edge facing away from you. Rest the handle on your knee. Hold your stone in your hand and work it in circles across the bevel and edge. Many people find this technique easier, so see what works for you.

After the first few strokes, stop and look at your edge. You should see shiny scratches where your stone has rubbed away a bit of metal. Look carefully at the scratches. Do they extend all the way to the edge? Do they come back along the bevel at least half an inch (13 mm)? If not, try again and keep adjusting your stroke until you are covering both the edge and the bevel leading up to it. If you have trouble seeing where you have sharpened, color your hatchet's bevel with a black marker. Where the marker gets rubbed away, your stone has removed metal.

If you can't tell where you've sharpened your tool, try coloring the bevel with a marker. In this picture, the marker has been rubbed away where I sharpened the very edge. That's good, but I also want to work the bevel. I'll return to the stone and take several more strokes, adjusting the angle of the tool until all the marker is rubbed away.

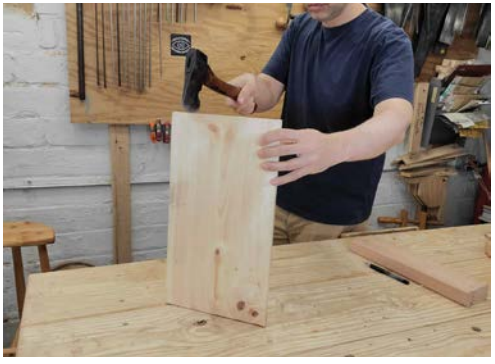
Once you have shiny scratches all along one side of the edge, flip your hatchet over and do the same thing to the other side. Wipe the oil off the stone and flip it over to the fine side. Rub on some oil and sharpen your edge again.

When you're done, your bevels should look even and shiny. The very edge of the tool shouldn't reflect any light. If you rub a finger across (NOT along) the edge, it should feel sharp, kind of like a kitchen knife. Ideally, your hatchet would be sharp enough to cut paper or shave hair off the back of your arm. But you don't need that level of sharpness to get started. If it feels sharp and the whole bevel is shiny, then you're ready to get to work. You will learn to make an even sharper edge as you practice.

An Edge and a Wedge

Your hatchet is several tools in one. If you've ever used one, you probably used it to split wood. This is the tool working as a wedge. Remember our bundle of straws? Splitting is putting the wedge *between* the straws and forcing them apart.

Most us of are used to setting up a log and taking a heavy swing with the hatchet. If the log splits in half, we're happy. But for woodworking, the splits must be more precise. In the past, furniture makers used hatchets to split wide stock down to narrower sizes. This technique can save a lot of sawing, but it's not for beginners. We'll start with some safer techniques.




Instead of sawing the edge off this board, I can split it off with a hatchet. Notice that my hand is far away from the split and my fingers are well out of danger. I only use this technique with a wide board so that I can hold it safely.

Batoning

You can make your splits more controlled through a technique called **batoning**. Put the edge of the hatchet where you want the split, hold the handle parallel to the floor, and hit the back of the hatchet head with a rubber mallet or a piece of wood. This will drive the hatchet down into

the work like a big chisel and give you a very controlled split. Of course, the wood grain has to be straight for this to work. If there's a knot in the wood, the split can go badly.

By placing the edge of my hatchet exactly where I want to split the wood and then striking it with a rubber mallet, I get to choose exactly where the wood splits. This technique is safe to use, even on small pieces of wood.

Hold-and-Hit

You can also make your splits safer by placing the edge on the work, lifting both the hatchet and the work and bringing them *both* down at the same time. This technique is effective and safe.

Another safe and accurate way to split wood is to put the edge of your hatchet where you want the split and then keep it in contact with the wood as you lift them both and strike them against your work surface. Don't expect to make the split in a single hit. Make the split with several, controlled strikes.

Safety

Never forget that a sharp hatchet is dangerous. If you're not careful, you can take off a finger. As you're starting out, never chop a piece of wood that you're holding. Instead, baton it or use the hold-and-hit technique that I just described. Sometimes, I'll hold a piece of wood in my screw clamp before I split it with a hatchet.

You can safely baton small pieces in a screw clamp. Clamps like these are very useful, even if you only have one.

You should also remember your body position. If you hold the hatchet in your right hand, keep your right leg back and rotate your body a little bit away from the work. If you miss your hit, you want the hatchet to move harmlessly past your body, not hit you in the leg. Before you start working, take a few practice swings. Always ask yourself: Where is your body? What's going to happen if something goes wrong? Is this safe?

As your skill and confidence improve, you might chop some pieces while holding

When using the hatchet to shape larger pieces of wood, be sure to stand with your right leg back (if right-handed) and out of the way.

them. This advanced technique is safe if we take precautions. You might split the edge off a wide board, but only do this if your other hand is at least 8" (20 cm) away from the strike. Hold the board from the side so none of your fingers is exposed.

Don't swing hard. Lift the tool off the wood and let it fall. Gravity should give you most of your force. If your first strike doesn't finish the split, don't pull the hatchet out. Lift the tool and the work and bring them down together with several controlled taps until the waste wood falls away. Once the cut is started, you can be surprisingly gentle. Your tool's edge and the weight of the head will do a lot of the work. Remember that you're not a lumberjack, you're a woodworker.

Shaping

After you've mastered splitting, you can learn to use your hatchet as a rough shaping tool. With a little practice, your hatchet can make surprisingly flat surfaces and smooth curves. You can practice these techniques on a chunk of firewood or piece of 2×4.

Trace a curve across the corner of a piece of wood and then remove everything outside the curve. Start with a series of light chops to weaken the fibers.

Pick a corner of the wood and pencil in a curve. (I traced the lid from a pot.) Now, you're going to trim that corner away, leaving a smooth curve in its place. You can't do this with one mighty split. Instead, make a series of gentle chops down into the corner. To keep things safe, hold your work at the top and keep your thumb tucked back. Making several small chops

weakens the fibers of the wood and creates a path for your hatchet to follow. Like perforated paper, your tool will follow that line of little cuts. Now strike *down* along the little cuts you've made. Keep your grip loose and don't hit too hard. Your hatchet should peel away all of that chopped material without much effort.

Once you've chopped into the waste, strike down with your hatchet to shear off a layer of wood. Repeat this chopping and shearing until you've removed most of the waste.

Once you've chopped away your corner, the surface will probably be rough and uneven, but your hatchet is also an effective slicing and shaping tool. Grip the handle right under the head with your thumb pointing up. This is similar to the grip we used for sharpening and it will give you control for trimming. Lay the bevel flat on your work and take short, slicing strokes as you slowly refine your surface and make it smoother. You'll need to rock the tool back and forth to find the best cutting angle: too steep and the edge will bite in and stop, too shallow and it won't cut. At first, you will probably split the wood a little and make chips, but as you practice, you will start to see longer shavings curling off the edge of your blade. Challenge yourself to make the smoothest curve possible. You can follow up with a piece of sandpaper glued to a scrap of wood and smooth out your surface. With just a hatchet and a sanding stick, you can make some very nice shapes.

Grip the head of the hatchet and use it to trim the rough surface left by chopping. Then refine the surface further with a sanding stick. Practice this technique; we'll be using it in our first projects.

This type of woodwork can be fun and relaxing. You can do it outside. You're not trying to make anything specific, so it doesn't matter how much wood you use. Take an afternoon and turn a couple of chunks of wood into a pile of chips and shavings. You'll quickly pick up all your basic hatchet skills. There are serious craftspeople who make spoons, bowls, and other beautiful objects with little more than a hatchet and a few knives. If you learn to use this tool, you'll always keep it close by.

Chapter 3
Your First Projects: Garden Stakes and Doorstops

Materials:

- Small scraps of wood

Tools:

- Hatchet
- Sandpaper

The hatchet is all we need for our first projects. These projects work best with hardwoods—dense and tough species like oak or maple. You can often find great hardwood pieces by pulling the legs off pieces of junk furniture. We'll talk more about wood selection in Chapter 15, but for now just use whatever you have.

Garden Stakes

Let's start by making a garden stake. It's nothing more than a pointed stick, but these little projects are great practice and they're useful. Start with a long piece of wood at least 2" (52 mm) wide. In the picture, you can see me working on a workbench with a scrap of log on top. Your first work area can be even simpler. You could work on an old piece of furniture, like a heavy

desk. Even a tree stump can make a great first work surface. Use a little creativity to find your first work space for now; we'll build a couple of simple workbenches later in the book.

Everything you need to make a garden stake. Be sure your hatchet is sharp!

To make this piece of wood into a stake, all we need to do is sharpen the end into a point. Hold your wood at an angle with one end firmly on the block and your hand far away from the strike zone. Make a few chops starting at the bottom and moving up one corner of the stick, and then strike off these weakened fibers so the whole corner is removed, and a flat spot is left behind. Once you've done this to all four corners, your piece is a hexagon and you can continue to sharpen by taking off the six corners that you have left.

Use the techniques from the last chapter to chop and peel one corner off the stick. Try to leave a flat and even surface. Take off all four corners and you'll be left with a hexagon.

By working the corners one at a time, you can keep your point in the center of your stick, and your finished product won't be crooked. Soon, your piece will have lots of small corners as it starts becoming a cone. Just keep rotating the stick and slowly peeling off the high spots. In the picture, you can see my final stake sharpened to a fine point.

As you work around the point of your stake, you will slowly sharpen it into a fine point with an even taper.

Tip: If you don't have a hammer, just flip your hatchet around and strike with the poll. Lots of people use hatchets like this when camping. As long is you're only striking wood, it won't hurt the tool.

If you have a yard or garden, you'll always find a use for a good wooden stake. They're easy to drive into the ground with a heavy hammer, and a stake that's buried a foot (30 cm) into the ground is surprisingly sturdy. I have a large garden in my yard, and the whole thing, including the sides of the raised bed and all the fencing, is supported by just six oak stakes.

A sharp oak stake is easy to drive, even in the dense clay soil of northern Ohio. Once a stake like this is driven into the ground, it has amazing holding power. My whole vegetable garden is resting on just 6 stakes.

Doorstops

Another easy project for your hatchet is a doorstop. Every house needs one or two doorstops, and you can make as many as you want for no money.

In the picture, I've taken a stick of hardwood and drawn a slanted line up one side. The exact angle isn't important, but a shallow slope works best for holding doors. As you work, you're going to try to get as close as you can to your line without chopping through it. You are practicing control.

The shallow slope of this line will give me an effective wedge. I'll chop away all the wood above my line while being careful not to chop through it.

Just like the garden stake, make a few chops above your line to weaken the fibers, and then strike off the loose wood. Do this as many times as you need to, working closer to your line with each pass. After you've removed the waste, you can choke up on the head of your hatchet and flatten the surface of your wedge. You can also use a sanding stick. (Check out Chapter 12 for details on sanding tools.)

As I shape my wedge, I'll peel off layers of wood until I'm close to my line, then I can flatten my surface with the hatchet or with a sanding stick.

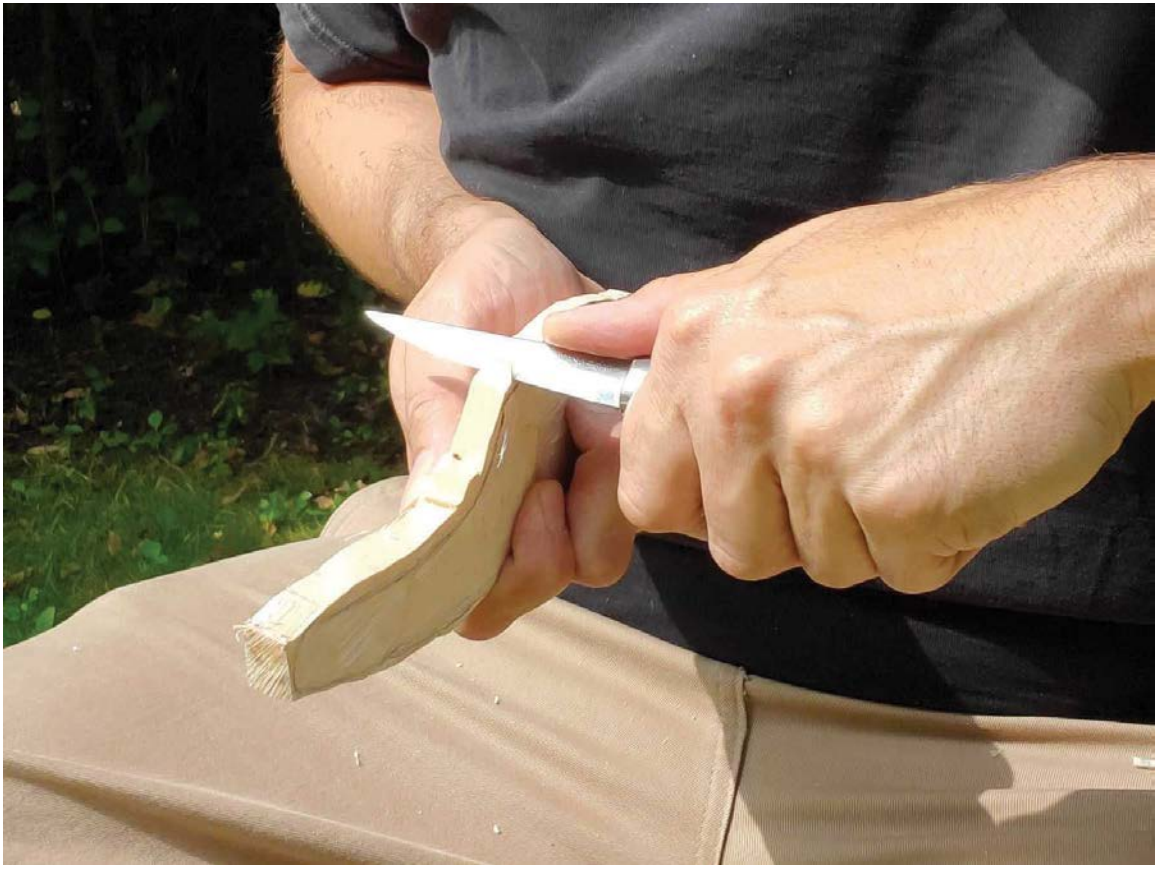
Just like any project with a hatchet, you're working with a long stick to keep your hands away from the blade. Once you've finished, you'll need to cut off your wedge. We'll cover sawing in Chapter 7, but for now, rest your stick on a plastic bucket, kneel on it, and make your cut with any saw you have. Kneeling on narrow pieces of wood isn't very comfortable, but it gives you a solid hold.

A plastic bucket can make a good platform for sawing. Use the weight of your body to keep the wood steady as you saw it free.

Take the finished wedge and kick it under a door that won't stay open. You might be surprised how well it works. Sure, you can buy plastic doorstops at the dollar store, but why bother when you can make your own for nothing and practice your woodworking skills while you're at it?

The finished wedge works just as well as a doorstop you buy at the store.

Congratulations! You've just completed two woodworking projects!



Chapter 4
The Knife

Think of the knife as a refined hatchet. Just like the hatchet, it has two bevels that meet at an edge. Just like the hatchet, it can be used as a wedge to split pieces of wood. Unlike the hatchet, the knife is a fine tool, and it slices instead of chopping. The knife takes thin shavings of wood and lets us slowly work up to our finished shape.

Most people have whittled a stick with a pocketknife, but we need a better knife for woodwork. A pocketknife has a big bevel that's easy to see, but if you look closely at the edge, you'll see another tiny bevel. This is called the **secondary bevel**. This shape allows knife makers to produce a sharp tool that holds an edge for a long time. Unfortunately, this edge isn't much good for woodwork.

The carving knife on the left has a single, wide bevel that's great for woodworking. The pocketknife on the right has a narrow secondary bevel. It cuts, but it's hard to control.

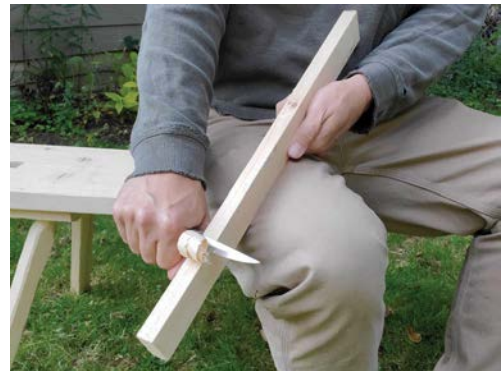
In woodwork and carving, you rest the bevel flat against the wood as the edge slices. Referencing the bevel on the wood gives you excellent control. The tiny secondary bevel on most pocketknives is too small to balance on the work, and this type of knife doesn't cut wood very well.

We're going to use a dedicated carving knife. Instead of a big primary bevel and a little secondary bevel, our carving knife has one flat bevel that extends all the way to the edge. This geometry is called a **Scandi grind** and it's more fragile than a generic knife, but we're not opening boxes with it. The Scandi grind is easy to feel against the wood. It lays flat on the work and gives you control of the cut.

If you buy a new knife (like the **Mora Sloyd Knife**) it will come sharp and you can get straight to work. We'll learn a few cuts, and then worry about sharpening.

The Cuts

I'm no carver, but I know some useful cuts for woodwork.



Planing Grip (also called the "Power Grip"): This is an aggressive cut that removes material in one long stroke and leave a flat surface. I use it most often on edges that I have sawn or trimmed with a hatchet. Hold the work firmly, either between your spread legs or over the side of your lap. Be sure that if the knife slips, no part of your body will be in the way. Skew the blade so the knifepoint is slightly toward you and use the base of the blade, close to the handle. Lean forward and push, using the large muscles in your shoulder and back. Try to take long shavings.

Bevel Cut: This isn't a standard carving cut, but I use it to take a sharp corner off an edge. Grip the knife with your thumb

against the spine and skew the blade so the tip points toward you a little. Push forward with a slow, controlled cut, moving the work along the edge toward the point as you cut. Try to take one long, very thin cut all the way along the board edge. If you'd like a wider bevel on your stock, take several light passes, rather than one heavy cut.

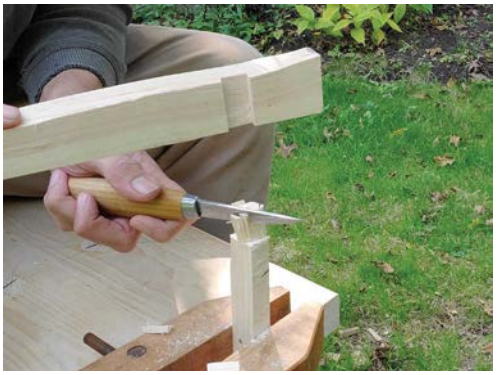
Scissor Grip: This is a common cut for controlled stock removal. Reverse the knife in your hand so the edge points back toward your wrist. Hold the work and your knife in an X shape with your wrists and forearms pressed firmly against your chest. Squeeze your elbows together and use your chest for leverage as you cut away from yourself. By levering your arm against your chest, you can take a heavy, smooth cut. This cut will remove wood aggressively, but I also find it useful for making flat surfaces.

Tip: If you find your knife difficult to grip, try sanding the finish off the handle with fine, 220-grit sandpaper. Then you can apply a light oil finish. (See Chapter 22 for more on finishes).

Thumb Push Cut: This is a detail cut for removing small amounts of wood. Hold the work in your left hand with your thumb extended. Place the knife against the wood and use your left thumb to push the blade forward. Alternately, you can lock your thumb in place and lever the back of the knife around the tip of your thumb. Both of these cuts offer excellent control and added leverage if you need to cut deeply. I often use this cut when working into a tight curve.

Thumb Pull Cut: Hold the knife in your fingers with the edge pointing back toward your thumb. Anchor your thumb against the work and use your fingers to pull the knife toward you. When I describe this cut, it sounds dangerous because you're cutting toward yourself, but

the trick is to keep your thumb below the path of the cut. If the knife slips, it should swing harmlessly *over* your thumb, not into it. I use this cut most often for working outside curves and rounding over ends of handles. This is a very short cut that often takes chips rather than shavings.



Batoning: Just like your hatchet, your knife can be used for controlled splits. Of course, your knife is much more delicate than a hatchet and can only be used to split small pieces. If I'm carving a small tenon (a little joint) on a delicate piece of stock, I'll saw my shoulders and then baton off the waste with my knife and a scrap of wood as the mallet. Remember to take small cuts and strike the spine of your knife gently.

Sharpening

After you've practiced these techniques, your knife will probably need sharpening. It's much easier to sharpen frequently and quickly, rather than letting the blade get very dull. Sharp tools are also safer because they can be used with less force and you're less likely to make a mistake and cut yourself. Sharpen often and lightly and your blade will never get very dull.

Begin with the red ("fine") side of your Combination Stone. This is really a medium grit, but it's handy for quickly straightening out the bevel and reestablishing the edge. Put your stone where it won't slide and coat it with oil. Place the blade flat on the stone and rock it forward until you can feel the bevel. Practice rocking back and forth and get used to the feeling of having the bevel flat on the stone. Grip the handle firmly with your thumb on the back, right below the base of the blade. Use the fingers of your other hand to press the bevel gently down on the stone. Push forward. The hand holding the handle should provide all the forward motion, and your fingertips on the blade will push the bevel down and keep it in contact with the stone. Keep pushing until you reach the end of your stone, and then pull back, keeping the bevel flat on the stone. We're sharpening on both the push *and* the pull stroke. We're also taking long strokes and using the whole stone.

Coat your stone evenly with oil and begin sharpening at the base of the blade. Remember to lay that bevel flat on the stone and keep it there.

After four or five strokes, stop and look at the bevel. You should see a section of blade evenly covered with fine scratches. These scratches should extend all the way down the bevel to the edge. If you run your finger across (again, *not* along) the bevel on the other side, you should feel a slight roughness at the edge. That's the **burr**: a little flap of metal that's created when one metal surface meets another. The burr tells you that you have sharpened all the way to the edge. If you don't feel that burr, take a few more strokes.


On the left, you can see that the first ⅓ of the blade is covered in fine scratches all the way to the edge. On the right, I'm pushing my fingertips across the edge from the underside. As my skin moves over the edge, I should feel the burr.

Once you've sharpened one section of the blade, move across the stone to a new section and repeat the process. As you move toward the tip, the bevel gets small and the blade curves back. At this point, it's helpful to hold the blade at 45° with the handle pointed toward you. This angle puts more of the bevel in contact with the stone and makes sharpening easier. At the very tip, the knife gets thinner, and you may have to lift the handle to get the last little section.

After you've sharpened the first section of blade, move the knife over and sharpen the next section. I can usually sharpen this knife in three sections. As you get near the curved tip, you probably want to skew the blade to put more of the bevel in contact with the stone.

Flip the knife to the other side and repeat, being sure that both bevels are completely covered with fine scratches. You should feel a fine burr along the whole edge. Wipe the oil off your stone and put it away.

Get out your fine stone and give it a coat of oil. Sharpen the blade again using the same technique. The finer stone will leave a different scratch pattern on the bevel, so it will still be easy to see where you sharpened. Work all the way along

Your fine stone will leave a more polished pattern of scratches on the bevel, so you'll still be able to see what you've done.

both bevels. If your stone becomes dry or the oil gets very cloudy with metal particles, add some fresh oil. If you stop after the fine stone, you will have a good edge, but we can make that edge much finer by **polishing** it with a strop.

A **strop** is just a piece of leather on a flat surface. You can buy a strop, but I wouldn't waste the money. I just use any scrap of leather glued fuzzy-side-up to a flat piece of wood. Contact cement, spray adhesive, and wood glue all work well for bonding wood to leather. Once you've made your strop, you'll need to charge it with a honing compound. This compound is a fine abrasive mixed with wax. It comes in bars of different colors, and each color is intended for a specific metal. I like green—chromium oxide compound—which you can buy in small bars. Green compound is intended for stainless steel, but I find it effective for most edge tools. I also have a video on making a strop at woodworkforhumans.com.

To make my strop, I glued a piece of old leather to a piece of MDF (a cheap particleboard) that's very flat. Then I colored it in with green buffing compound.

Rub the compound back and forth across the leather as if you were coloring the whole surface with a crayon. Once the strop is charged with compound, it will be good for weeks of sharpening and you won't need to add any more.

Stropping the blade is a lot like sharpening, except we're only pulling. Set the blade on the strop and rock it forward so you can feel the bevel. Press it down firmly with your fingers and use the handle to pull the knife toward you. When you reach the end of the strop, lift the knife up, place it back on the far end, and pull it toward you again. As you work, you'll see the

surface of the strop slowly turning black as the fine abrasive takes steel off your edge and polishes it. Once you've stropped all the way down both sides of the blade, your bevel should look shiny and polished and you should no longer feel any burrs at the edge.

You can test your sharpening by trying to cut through a piece of paper. You're aiming for a razor-sharp edge, but don't get frustrated if you don't get it on the first try. Sharpening is a skill that takes practice. If you don't like your edge, you can always go back and sharpen again. Relax and take your time. Rushing won't help, and you might cut yourself.

People often ask me when they should sharpen. The answer is: If you think you should sharpen then you definitely should. A sharp knife slices the wood almost effortlessly and it's very easy to tell when your tool is sharp. As your knife gets dull and you have to push harder to make the cut, you'll feel it. Stop and sharpen.

As you get more experienced with a knife, you might not run through the whole sharpening routine every time. Sometimes, you'll start with the fine stone. If your edge just needs to be refreshed, you might be able to simply strop it and get back to work. You won't often use your coarse stone for knife sharpening, but it is useful if you ever get a nick or chip in the blade. The coarse stone will let you quickly grind away material and get to fresh steel.

Place your blade with the bevel flat on the strop and pull it toward you with firm downward pressure. Repeat. In the picture, you can see the middle of my strop getting dark as it rubs steel off the knife.

A really sharp edge will slice effortlessly through paper, but it takes some practice to get to this point.

We've just covered a lot of information about knives and sharpening. Let's put it all into practice with a simple project.

Chapter 5
Wooden Butter Knife

Materials:

- Small log of green wood

Tools:

- Hatchet
- Knife
- Pencil
- Sandpaper

When you use the knife *with* the hatchet, you can remove wood quickly, chop away waste, and carve fine details. Many craftspeople carve bowls, spoons, and other beautiful projects with a hatchet, a knife, and just a few other tools. In this chapter, we're going to refine our knife and hatchet skills and use these tools together to work efficiently. The butter knife we're carving is small and delicate and you can make it to fit your hand. When you're done, you'll have a real kitchen tool that you can really use.

Most of this project will be done with the knife and the hatchet. A good section of branch-wood makes excellent stock.

This project works best with green wood. You only need a small section of branch and these are easy to get from tree-cutters. I'm using maple, but birch, sycamore, and cherry are also good choices. Any tight-grained wood will work. Some woods can cause allergic reactions, so it's good to know which species you're using when you make anything that will touch food.

Splitting the Stock

I'll baton my wood right through the pith (the center of the grain rings). Then keep splitting. The trick is to make a bunch of pieces, pick the best one, and throw the rest away. I picked the piece all the way to the right.

I've got a straight, knot-free section of branch about as long as my hand and I'm going to baton it into thin sections. Put your hatchet in the middle of the piece, right on the **pith**, and strike the back of the hatchet with another piece of wood. Once your hatchet is buried deeply, lift the tool and the wood together and bring them down firmly to finish the split. Take each of the halves and baton them into two or three pieces. You don't need to make one perfect board; make five or six and pick the straightest, flattest one. The rest can be firewood.

Forming the Blank

Take your best piece and flatten it with the hatchet. Make a series of scoring cuts up one face and then cut down to slice off the waste. We're working with a small piece here, and safety is important, so pay attention to how you're holding the work. Work from the bottom up to the halfway point and then flip the piece and work the other half. Sight down the piece

from either end, looking for bumps in the wood. Carefully pare these off until your piece is as flat and straight as you can get it.

Now we're going to taper our piece in both directions. We want our butter knife thick at the spine but thin at the edge, so keep trimming your piece with the hatchet until you have a smooth wedge shape. Our knife should also be thinner at the tip and thicker at the handle, so taper one end like I've done in the picture.

Flatten your stock with the hatchet. Notice how I my left hand is mostly behind the work, and my thumb is on top. This is shorter stock and you need to be extra-careful while chopping.

My stock tapers across the width so I'll have a thick spine and a thin edge to my butter knife. I've also tapered the front end so that the point of my butter knife will be slim.

Shaping

Take a pencil and sketch in the shape of your knife. I've chosen a simple design based on three curves. This shape isn't difficult to carve.

When you're carving, use the hatchet for as long as you can. The hatchet removes a lot of wood with a little effort. It's faster and less tiring than the knife. In any woodwork, do as much work as possible with your coarsest tool. Your finer tools are always slower.

I like to start with convex (outside) curves. Holding the work far away from the strike zone, I work down each curve from the middle of the wood to the end. I'm working *across* the grain here, and there's no danger of splitting the wood.

I just drew this outline freehand. Try for a flowing shape and keep tight curves to a minimum; they're harder to carve.

To cut the outside curves, work from the middle to the tip. As you round each curve, keep the hatchet chops straight up and down and slowly rotate the work.

The most difficult part of this piece is the tight, inside curve. Any way you chop into this curve, you'll hit end grain and split your piece apart, so we'll need a saw cut to make the carving safe. We haven't covered sawing yet, but this cut is easy. Use the small, crosscut teeth on your Ryoba to cut down from the edge to the base of that curve. This is called a **stop-cut** and it will keep our cuts from running into end grain and ruining the work. Brace the work against

the edge of your log and pull back with the saw. (You can really use any saw for this little cut. Even a pruning saw is fine.) Make sure you stop just above your pencil line. (To make the carving easier, I added a second saw-cut to take out a chunk of waste and reduce knife work later.)

We have a large piece of waste next to the handle, but our stop-cut makes that safe to split off. Put the edge of the hatchet right next to your handle line, lift the tool and the wood about an inch (25 mm) and drop them both down together. Even though the edge is close to your fingers, this cut is safe as long as you keep the tool in contact with the wood and work gently. Just let the hatchet and wood fall onto your log and repeat a couple of times until the waste falls off.

With all the waste removed, it's time to switch to the knife. For many of these cuts, I'll use the scissor grip to remove wood quickly and leave a clean surface. This technique works especially well for the back of the handle and the spine of the blade.

The smaller teeth on your Ryoba saw are made for fine little cuts like this one. Now you can chop and carve toward this cut and you won't split the work.

I would never chop this close to my fingers. Instead, I'm lifting the wood and the hatchet together and letting them both fall gently onto the block. One or two taps will split off this big piece of waste.

To finish the tight curve, I work into the stop-cut from both directions with a controlled push-cut. Notice that I'm peeling away thin slices and always keeping my left hand behind the knife.

Next, I have to finish that inside curve. I'll keep my thumb on the back of the knife blade and my other hand behind the cut as I pull the knife toward my stop-cut. Notice how I'm making a series of cuts and working my way down to the line slowly. The knife is a fine tool and it can't remove big chunks of waste. You have to work in small, controlled shavings.

The scissor grip is a good choice for leveling out the flat faces of my butter knife.

Detailing

As I finish up, I want a smooth finish on the faces of my butter knife. I use the scissor-grip again and keep my knife parallel to the surface of the work. I concentrate on taking long, light cuts and slowly leveling out the surface. As I work, I slowly refine the edge so that it will cut cleanly through butter.

I also need to round over the end of the handle for comfortable grip. For these short cuts, I'm using a pull-cut with my thumb for leverage. For this grip, I'm cutting toward myself, but I have my thumb down below the path of the blade. Even if I slip, the knife can only move a short distance, and my fingers aren't in any danger.

Once everything is smoothed out, I need to dry the piece so that I can finish it. Wet wood is easy to carve, but you can't sand it and it won't absorb finish. A piece this thin shouldn't crack as it dries, but you still need to be careful. Wrap the butter knife in a rag and leave it outside overnight. The next day, unwrap it and leave it out overnight again. After that, it should be safe to bring the piece inside and let it sit for another day or two. Wet wood feels cool to the touch, so your piece will gradually feel warmer as the surface dries. After a few days the piece should be dry enough to sand. Start with 100 grit and move up to something fine like 180 grit.

Tip: You can finish your butter knife by rubbing it with vegetable oil or food-grade mineral oil. Don't use furniture finishes; most are toxic until they've dried for at least a month.

Here's another variation on the pull-cut. I have the handle of my butter knife between my thumb and the carving knife. With this big piece of stock in the way, I can pull more aggressively toward myself without any danger.

After carving, the knife is fully shaped, but the surface needs a little smoothing. The wood needs a couple of days to dry before I come back with sandpaper.

Now that you understand the basics of carving green wood, you can make all kinds of kitchen utensils, from spatulas to scrapers to spreaders. The wood is free, and you can make up your own designs and make them fit your bowls and pans. Once you've mastered flat items, you can buy an inexpensive **hook knife** made for hollowing work. Then you can carve spoons. Many people who try carving fall in love with it and it's the only woodwork they ever do.

You need to let the wet wood dry before you can get the final finish. After a little sanding, the butter knife is ready for an oil finish.

Chapter 6
Measuring and Marking

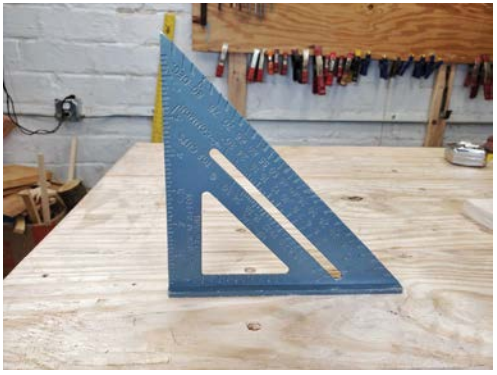
Have you ever looked at a piece of antique furniture with dozens of parts that fit perfectly together? Did you wonder how a craftsman from centuries ago, using only hand tools, could have cut the parts so precisely that they fit together like pieces in a puzzle? What you can't see is that the craftsman drew careful layout lines on his work, sawed or chiseled right up to those lines, and then scraped the lines off before the piece was finished.

Precision work seems mysterious, but most of it comes down to drawing accurate lines on your work and then using those lines to guide your hand and eye as you make your cuts.

First, grab a tape measure. Even a cheap one from the dollar store will get the job done. I prefer a **Stanley 16'** tape; it's large enough to handle all my work, and I can clip it to my belt and forget about it.

You'll also need a square, which is a simple tool that allows you to draw lines perpendicular to the edge of a board. For the projects in this book, you can use an inexpensive **speed square**. This tool is just a metal triangle with a wide lip across one edge and a bunch of numbers stamped into the face.

Good news: you can ignore most of the numbers. This tool is designed for



A basic speed square is a cheap and useful measuring device for the shop.

carpenters installing roof rafters and stairs and most of the numbers relate to that work. The angle we care most about is 90°, and the speed square is excellent at that.

Lay the square flat on a piece of wood so that the lip hangs over the edge to the left. Push the lip firmly against the wood with your left hand and then use a pencil to draw a line across the top of the square. If the edge of your wood is mostly straight, that line will be perpendicular to the edge. A lot of woodworking involves cutting long pieces of wood into shorter ones, and we need to mark perfect 90° lines to guide our cuts.

Hold the lip of your square against the side of a board and strike a line across the edge. Your line will be perfectly square to the edge of the board. Saw along the line, and your cut will be square.

Many times, you want *two* lines that meet at the corner of a piece of wood. These lines make sawing much easier. Make one line across the face of the board, then flip the square so that the lip is on the face and the square is pointing down. Line up the edge of the square with the line you already made and strike another line across the edge of the board. Woodworkers call this **carrying the line,** and you can use this technique to run a line all the way around a board.

Flip your square so that the lip rests against the face of the board and you can use the edge to strike a line that meets your first line. These two lines meet at a perfect right angle and are very useful for guiding your saw through a cut.

Your square also has a handy ruler stamped across the top edge. If you need to cut a 2" notch in the edge of a board, it's easy to make lines that are exactly 2" long and perfectly perpendicular to the edge. For measuring small distances, you won't even need a tape measure.

If you need to make a line *parallel* to the edge of a board, press the lip of the square against the edge, put your pencil at the distance you want, and then drag the whole thing down the edge of the board. Some better-quality squares (like the **Swanson**) even have notches to hold your pencil tip steady.

Your square's built-in ruler makes it easy to mark distances on a board. Here, I've used the ruler to mark out a 2" (52 mm) notch that I'll cut out for a project.

Tip: Some ultracheap squares are made of plastic. These work, but spend a little bit more for a metal one. You won't regret it.

Finally, your speed square is also a quick-and-dirty protractor. The long edge of the triangle is a 45° angle, which is exactly half of the common 90°. The 45° cut is very common in both woodworking and carpentry, but this square will also do other angles. These are the numbers stamped along the square's long edge. Hold the top corner of your square against the edge of a board and then pivot the bottom corner out until the angle you want hits the edge of your board. Then, strike a line across the top edge of the square and it will be at the angle you selected. We'll use this technique when we build the Milking Stool.

By holding my pencil against the ruler and dragging the square, I can draw a parallel line any distance from the board's edge.

Don't worry if all of this sounds complicated. We'll mostly use the square to strike simple, perpendicular lines.

For marking, you can do all the projects in this book with a pencil. A sharp, No. 2 is fine, but I prefer cheap mechanical pencils. They never need to be sharpened and I buy the brightest colors I can find. A hot-pink pencil is easy to find in a pile of wood shavings.

If you have a tape measure, a pencil, a square and an awl, you'll be able to do all the marking for your first projects.

You also want an **awl**, which is just a metal point set into a handle. It's often handy to make a little dimple in the wood to guide a drill bit or the tip of a nail. Woodworkers typically use a "scratch awl," which makes little holes and scratches layout lines into the wood. (Sometimes, it's better not to get pencil lead on your work, and a scratched line is surprisingly easy to see.) You can spend a few dollars on a traditional scratch awl or use any pointy piece of metal you have laying around. Even an old icepick works pretty well.

Once you have a tape, a square, a pencil and an awl, you have all the tools you need to do accurate work.

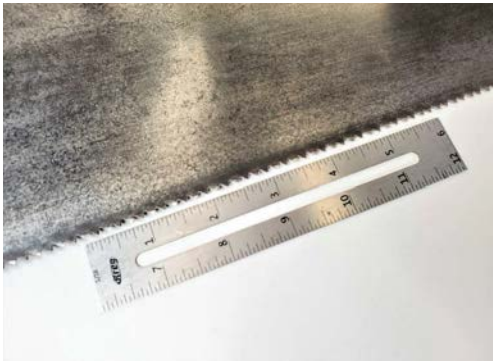
Chapter 7
Saws and Sawing

Your hatchet is a great tool for splitting and rough trimming, but if you need to chop a long piece of wood in half, you'll find it slow going. This is why people invented saws.

Instead of using a blade to chop *into* wood fibers, the teeth of the saw rake *across* those fibers, cutting them cleanly and leaving sawdust behind. Even an inexpensive saw can make a smooth, straight cut, and sawing wastes very little wood.

A saw is a flat sheet of steel with teeth cut into the edge. As you push the saw forward, the teeth slice through the wood fibers. As you pull back, the teeth rake out the sawdust, leaving you a clear space to continue sawing. With some saws, this action is reversed and the saw cuts on the pull stroke.

I chopped into this log for over a minute and I've barely dented it. Axes are bad at cutting across the grain.



Saw teeth close up. At six teeth per inch, this saw is a fast, coarse tool.

Your saw cuts a channel called the "kerf" that's as wide as your saw blade. The wood from the kerf is turned into sawdust. Every time you saw, you lose some wood.

This large saw is great for cutting across the grain. The gap that it leaves behind is called the "kerf."

When you saw a piece of wood, you turn some of it into sawdust. I sawed this board in half, but the left-hand piece is a little bit longer because of the kerf.

I've drawn two lines on this piece of wood to guide my sawing. As I cut, I'm careful to stay in the waste side, to the right of my line.

If you cut a piece of wood in half and put the two halves back together, the total length will be a little shorter than what you started with. This might seem like a tiny detail, but if you need to make a piece of wood exactly 6" long, then you have to think about your kerf.

When woodworkers saw a piece of wood, they generally draw a line. The wood they want to keep is to the left of the line. To the right of the line is the "waste side." If you're cutting wood to length, don't saw down the middle of your line. Instead, place your saw just to the *right* of your line so that the kerf stays in the waste. (If you're left-handed, then all of this is just flipped, and the waste side is to the *left* of your line.)

Ripping and Crosscutting

There are two ways to saw a piece of wood. If you're cutting *across* the grain to make a long piece shorter, that's called **crosscutting**. If you're sawing *along* the grain to make a wide piece narrower, then you're **ripping**.

Crosscutting makes wood shorter and you'll probably do a lot of it. Crosscuts are pretty easy because the saw is generally traveling a short distance and it's not hard to stay on your line.

On the left, I'm crosscutting a board to make it shorter. On the right, I'm ripping a board to make it narrower. I'm using a different saw for each cut and these saws are each designed for one kind of cutting.

Ripping is more difficult than crosscutting, because rip-cuts are often long, and it can be hard to stay on your line. Instead of ripping, you will sometimes split wood with the hatchet,

I'd like to split this piece of wood in half, but the grain is not cooperating, and my split is crooked. If I rip the same piece of wood with the saw, my cuts stay straight no matter what the grain does.

but splitting is a risky move. The split will always go with the grain, and it might not be straight. When you rip with a saw, you can mostly ignore the grain and cut a straight line, even if the wood is not cooperating. Long rip-cuts can be slow, but the results are predictable.

Picking Saws

When you're buying a saw, pay attention to the number of teeth. If a saw has five **teeth per inch** (or 5 **TPI**), then every inch of that saw has five teeth. (It's also called **"points per inch"** or **PPI**, just to confuse you).

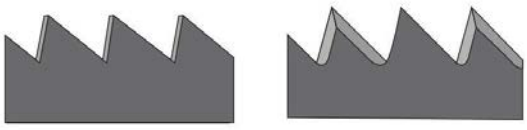
If there are five teeth per inch, then those teeth will be large, and the saw will be coarse. A five-TPI saw will leave a wide kerf and the surface it leaves will be rough. The tradeoff is that a saw with big, coarse teeth also cuts very fast. This kind of saw is great for breaking your stock down into smaller parts.

A small, fine saw cuts a narrow kerf and leaves a smooth surface. This saw has 13 teeth per inch. It's great for detail work, but it's too slow to use for cutting up big boards.

A shorter, finer saw might have 8–20 teeth per inch. This fine saw will have a narrow kerf and leave a smooth surface, but it will also cut slowly. Finer saws are used for small, precise cuts and making joints.

Rip-cut or Crosscut?

We're almost done learning about saws, but we need to know one more thing. Saws are advertised as either **rip-cut** or **crosscut**. Here's what you need to know: Ripsaw teeth are shaped like flat triangles. They are very good at cutting with the grain, and most ripsaws cut across grain very well.



Left: a closeup of rip teeth. They're flat on top and they're good a chipping out wood while cutting with the grain. Right: a closeup of crosscut teeth. The diamond shape of these teeth helps them slice the fibers when cutting across the grain.

A crosscut saw has diamond-shaped teeth that come to sharp points. These saws are really good at crosscutting (across the grain), but they rip very poorly. In this book, we'll use both rip and crosscut saws.

You will also see some saws advertised as "hybrid" saws and they are supposed to be good at both ripping and crosscutting. Some of these hybrid saws work pretty well, so it's okay to buy one and try it out.

Two Simple Saws

This book is about getting started right now, so we're going to go to the hardware store, buy whatever saw they have, and make it work. Any place that sells tools will have a general-purpose "contractor's saw." These saws usually have around 8 teeth per inch and they're shaped for crosscutting. A saw like this will get you started.

I also recommend a Japanese Ryoba saw. These saws are popular and easy to find. You can order them online and even find them at many big-box retailers. A Ryoba has a broad blade with different teeth on either side and a long handle that you can grip with both hands. Like all Japanese tools, these saws cut on the pull stroke, so they take a bit of getting used to. The blade is very thin and bends easily. The saw relies on pulling force to keep the blade straight, like a piece of string that's being pulled taut. The Ryoba has fine crosscut teeth along one edge and big rip-cut teeth along the other edge. Unlike our contractor's saw, this tool will rip and crosscut equally well because it's actually two saws in one. The Ryoba's thin blade

This contractor's saw is fast and aggressive but leaves a rough surface.

Two Ryoba saws that I have in my shop. The saw with the gray handle is made by the Vaughan company. The saw with the natural wood handle is made by Gyokucho. It costs a little more, but it's a better tool.

leaves a narrow kerf with little waste, and the saw's flexibility means it will handle specialty tasks like flush-cutting.

If the Ryoba is so good, why should we even bother owning another saw? The Ryoba is great for smaller work and precise cuts but it's too slow for big cuts or breaking down large boards. I recommend the contractor's saw for fast, rough cuts and the Ryoba for everything else. Soon enough, you will want more specialized saws, but just these two will handle lots of projects.

Sharpening

Knives and hatchets are easy to sharpen, but saws are different. Both of the saws I recommend are "disposable." Their teeth have been treated to be ultra-hard and they cannot be sharpened by the user. These saws are used until they get dull and then thrown away. (The Ryoba has a reusable handle, and you can buy replacement blades, which saves some money.)

Throwing away a tool might seem like a waste of money, but learning to sharpen saws takes time, equipment, and practice. When you're first starting out, it's great to buy a sharp saw and get straight to work. Both the saws I recommend will take a long time to get dull, and you'll have done many projects by the time they're used up. By then, you can invest in higher-quality saws and learn how to sharpen them yourself. It's not that difficult.

Learning the Contractor's Saw

Sawing takes a bit of practice. Start with your contractor's saw. You'll also need your pencil and speed square. These can be purchased at any big-box store and they're very cheap. While you're at the store, buy a couple of the cheapest 2×4s they carry. You're going to use these up for practice, so grab whatever costs the least.

Use your square to draw a line across the face of the wood and to carry that line down the edge of the board. Make sure the two lines meet at the corner. The wood to the left of the line is what you're keeping. The wood to the right is the waste.

A clear cutting line goes over the face and down the edge of your board. 2×4 stock is sold with the corners rounded off, so your line might not meet in the corner.

Starting the cut is the hardest part, but your left hand is going to help. Put your left thumb right next to the line and place your saw on the wood, just to the right of your line. Push your left thumb against the saw blade and tilt the handle up so the teeth are only touching the wood at the corner.

Left: Grip your saw with your index finger pointed. This hand position will help you cut a straight line. Right: Press the knuckle of your left hand against the blade of the saw to keep you on track as you begin your cut.

Grip the saw handle with your index finger pointing forward (this will help you saw straight). Pull the saw back toward you, letting it ride against your thumb to stay on the line. Lift the saw up, place the teeth back where you started, and pull it back two or three more times. These pull-cuts will establish a little groove to get your saw started.

Pulling back several times with the saw will make a little groove that will guide the cut. As you saw through the board, concentrate on pushing gently forward and keeping your saw straight up and down.

Tip: Sometimes sawing is slow work, and you might think you're not getting anywhere. Always watch for sawdust coming out of the cut. If you're making dust, you're making progress.

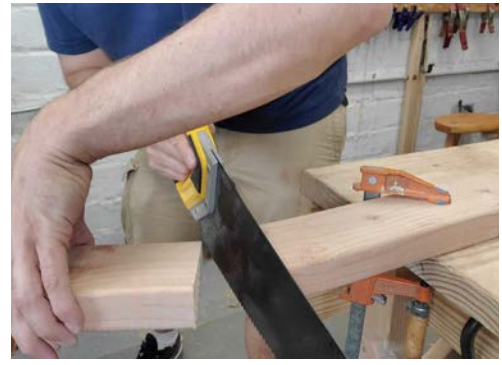
Once you have a little groove across the corner of your wood, put the tip of the saw in your groove and push forward. Don't push down. Keep your grip loose. The saw might skip or jump a little as you're starting out. Use gentle pressure and feel free to use the pull stroke a few more times to deepen that starting groove. Try angling the saw up or down until you can push forward and get a smooth stroke. Once your saw starts, it should be easy to keep going. Don't rush, and be sure to keep your arm loose. Draw the saw back gently after each stroke and put the force into your push strokes. For your first cut, just try to keep your saw on the waste side of the cut. Keep sawing until your waste falls off.

If your first cut stays on the waste side, then be proud. That's a good beginning. My cut is a bit crooked, but I stayed off the line so I can trim a little bit and get the edge perfect.

Now, draw another line just like the first. Carry it across the edge and use your pull strokes to get the saw started. This time, you're going to concentrate on making your cut square. Start out on the corner and cut along both your lines at the same time. Use the whole saw: start your cut at the tip and push forward until you reach the handle. Keep the saw at about a 45° angle. Once you get started, it should be easy to stay on your lines and make a square cut, but you might not get it the first time. Sawing is an essential woodworking skill, so give yourself permission to destroy some wood until you get it right.

After a little practice, your saw cuts might look more like this one. I stayed on the waste-side of my line and I kept the cut straight.

One last thing: as you get to the end of your cut, reach over your saw with your other hand and loosely grab the waste wood. Support the waste as you make your last few strokes with the saw. Don't pull up on the waste; you'll pinch the saw and make it hard to cut. Don't power through the end of your cut; slow down and feel the fibers separate as the saw nibbles through the last bit of wood. When your waste comes free, don't drop it. Stop and look at the cut. Is it straight? Is the surface even? What can you work on the next time? Keep cutting off 6" (15 cm) chunks, refining your sawing technique as you go.



Supporting the waste with your other hand is better than just letting it fall. You get a cleaner cut with less splintering at the end. Since you're already holding the waste, you might as well throw it somewhere out of the way.

You can let your waste fall to the ground where it will trip you, or you can toss it into a pile away from your work area. Get into the habit of keeping your waste wood in one place where it won't get in your way. Not only is it safer, keeping your waste in one place makes it easy to grab a scrap when you need to make a small part.

Your scrap bin can just be a cardboard box. With all your scraps in one place, it's easy to find an offcut when you need one.

Learning the Ryoba

The finer, slower Ryoba saw will handle all kinds of precise cuts, but it takes a little more practice to learn. Your contractor's saw has a thick blade that keeps itself straight while you're cutting. The Ryoba is much thinner and it uses pulling force to stay straight. This saw also cuts on the pull-stroke instead of the push.

We'll start with a crosscut, just like we did with the contractor's saw. Grab a piece of wood and draw your line across the face and down the edge. Make a few lines a little distance apart. The Ryoba is good for detail cuts, so we're going to practice cutting into the board and stopping, not cutting all the way through.

Lines drawn across the corner of your piece will guide your cuts.

Grip the Ryoba toward the top of the handle with your index finger pointing up at the blade. Place the blade on your line with the fine, crosscutting teeth against the wood. Pull the saw back in one, smooth stroke. The fine teeth should start easily and give you a clean beginning to your cut. If your cut starts straight, set the saw back on the wood and keep sawing. In the pictures, I'm cutting wood clamped to a workbench to make things easier to photograph, but you can put your wood on a five-gallon bucket and kneel on it to hold it steady.

With this saw, you're going to keep firm pressure on your backstroke to keep the blade in tension. Be very gentle on your push stroke to keep the blade from bending. No matter how careful you are, the blade will still bend sometimes, and you might get frustrated with this weird, floppy saw. Keep at it. The Ryoba is worth the time it takes to master.

Move along your board, cutting at each line. We're practicing the detail cut here, so there's no need to saw all the way through. Cut into the wood about an inch and stop. Each cut should be straight and square across both lines, but this skill might take you a while to master.

As you practice, you'll probably notice that the Ryoba cuts a very fine line; it might not be any wider than your pencil line. As you learn to cut straight, you can stop cutting to the right of your line and begin cutting directly *on* your line. The Ryoba will split a pencil line in half, and this level of accuracy will be useful when we start building things. Now's a good time to start splitting pencil lines with your saw. See if you can make a cut that erases the pencil line completely or leaves a little bit of pencil on both sides of the kerf. Once you can do that consistently, you'll be ready for all kinds of projects.

My left thumb holds the saw blade right on the line to start my cut. My right hand grips the handle toward the top and my index finger is pointed. (You can reverse all this if you're left-handed.)

If your blade bends on the push stroke, you're probably sawing too hard or twisting the handle. Try to relax and keep the blade straight up and down.

Practice a bunch of short cuts with the Ryoba. As you get a feel for the tool, your cuts will get straighter. At the left end of the board, my cuts are ragged and way off the line. As I move to the right, my cuts improve.

Advanced Ryoba Technique

Now that you can handle crosscuts with your Ryoba, we're ready to learn rip-cuts and practice some basic joints. Just cutting a notch in the end of a board is useful. We'll start with the layout.

Draw a crosscut line about 1" (25 mm) from the end of a board. Carry it across the edge and onto the opposite face. Then, measure in an inch from the edge and draw a perpendicular line down from the end of the board to where it meets your crosscut line. Carry this line across the end of the board and down the opposite face. You've now marked out a little square on the corner of the board and we're going to cut it out.

I've laid out 1" (25 mm) notches on all four corners of this board and drawn Xs to mark the waste.

Put your board on a plastic bucket, kneel on it, and use your crosscut technique to cut your first line.

(Left) I'm starting my crosscut while kneeling on my work. I've left my other hand out of the shot so you can see what I'm doing, but I'm still going to use my left thumb to steady the blade. (Right) At the end of my crosscut, my saw is square to the board so I can get right down to my line on both sides of the wood.

Now we're going to rip down to our crosscut. Rip-cuts take a lot of power, so it's helpful to use a two-handed grip and get a little farther away from your work. Set a scrap board on the floor, up on edge. We'll use this scrap like a little sawhorse. Set your piece of wood so one end is on the floor and the other end rests on your scrap. Step on your board with your left foot. Standing on your work might seem weird, but it's a traditional method, and you'll find you can hold your work firmly and see it clearly. Grip your saw with both hands, left hand on top and right hand toward the end of the handle.

Using a scrap of wood as a sawhorse lets me stand on the wood and still see it clearly. I start my cut with the fine crosscut teeth, and then switch to the big rip teeth and a powerful, two-handed grip. With this stance, ripping is easier.

The ripping teeth on your Ryoba are big and difficult to get started, so begin with the fine crosscut teeth. Saw down a little way, being careful to stay on your line. When you have a good groove established, switch to your big ripping teeth.

I only sawed the lines I could see, so now I need to flip this board over and finish the rip from the other side. Once I rip down the other side, there will still be a little "triangle" of wood at the base of the cut. I lift my arms so the saw is perpendicular to the wood and finish the cut square.

When ripping with a Ryoba, it's useful to saw "triangles" of wood and only saw what you can see, so set your rip teeth into your groove and saw down until you reach your crosscut line. You're sawing at an angle and you won't cut much on the far side of the board. Now flip the board and do the same thing on the other side. You've now cut away a triangle of wood on each side and all that's left is a small triangle of wood *inside* the cut.

If your waste doesn't fall right out, give it a whack.

Lift your handle so your saw is square to the wood and saw down until you meet your crosscut line. Your waste should just fall out, but if there are a few stubborn fibers holding it in, take the butt of your saw handle and give the waste one sharp tap to knock it out.

After some practice, you should be able to saw neat and square notches in boards. If your notches don't look good, grab another board and try again. At this point, you should have plenty of scrap laying around!

Take a look at your notch. Is it square? Are the cuts smooth? Don't worry if your first attempt is a little rough. We cut lots of pieces when we were crosscutting and each one has four corners you can notch. Repeat this practice until you can confidently cut a square notch in any board. As you get better, make your notches longer. Then try to rip a board down its whole length. After a few hours' practice, you should have a big pile of scrap and some new sawing skills.

Chapter 8
Japanese Sawhorses

Materials:

- 2×4 and 2×6 construction lumber

Tools:

- Ryoba
- Hatchet
- Knife
- Square
- Pencil
- Sandpaper
- Drill
- Screws (optional)

Now you have a couple of useful tools, but tools are no good without a way to hold your work. Maybe your garage has an old workbench in the corner, but maybe you live in an apartment or you don't have a work space. That's no problem. This book is filled with simple, portable work-holding solutions. We'll even build a small workbench later in the book. For now, we'll start with a pair of Japanese sawhorses.

These low horses my look unfamiliar, but they're easy to build and give us a stable platform for sawing.

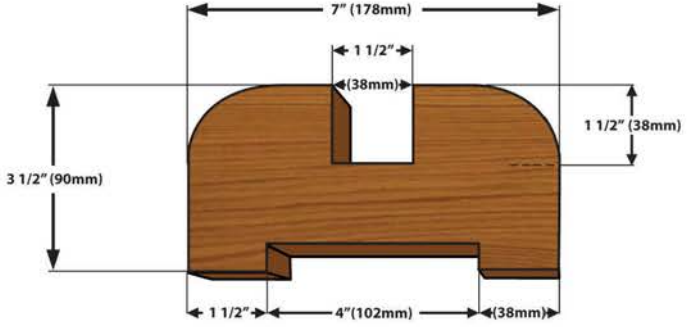
These horses look like miniature versions of the Western carpenter's sawhorse. The Japanese version is small because your Ryoba saw is so long. With these horses, you can hold your work steady with one foot and stand comfortably while you sight down the sawblade and use your whole body to pull the saw through the cut. For crosscuts and detail work, you can kneel on top of your wood, and the horses will elevate everything far enough off the ground to let you work comfortably and even use both hands to guide the saw.

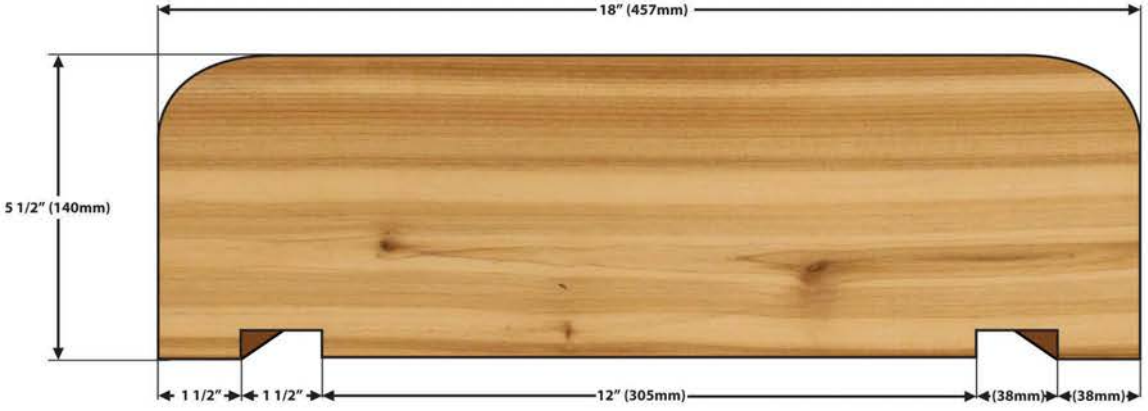
These horses are made from scraps of construction lumber. All you need is 30" (76 cm) of 2×4 and 40" (100 cm) of 2×6. In the United States, these are common sizes, and most construction sites will give you a few scraps if you just ask. If you live somewhere else, you'll have to hunt down some similar-size wood.

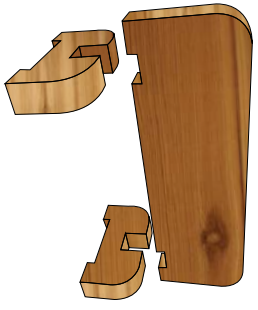
The tools and materials for this build are very basic. Not pictured: a tape measure and a pencil.

For tools, you'll just need your hatchet, your knife, and a sanding stick for the main work. For measuring and layout, you'll need your square, your tape measure, and a pencil.

Many beginners don't even have a corner of the basement to work in. No problem. I'm going to do this project out on my driveway, with no bench or work-holding to help me out.


7" (178mm)
1 1/2"
(38mm)
1 1/2" (38mm)
3 1/2" (90mm)
1 1/2"
4"(102mm)
(38mm)


18" (457mm)
5 1/2" (140mm)
1 1/2"
1 1/2"
12" (305mm)
(38mm)
(38mm)



To make some jobs easier, I've rolled an old log out of the firewood pile. Any old chunk of wood will give you a good platform for hatchet work and a convenient place to sit while you work with the knife and sanding stick. I've included basic plans for your sawhorses. Feel free to adapt these plans to whatever wood you can find. You can also make your horses a little bit longer or taller if you like. Keep in mind that I'm just over six feet tall and I find these horses totally comfortable. You probably don't need to make them much higher.

Begin by measuring and crosscutting your stock. Use your tape measure to mark off your lengths and be sure to carry the line across one edge. Use the fine, crosscutting teeth on your Ryoba to make these cuts. Put the wood on your log and kneel on it to free up both hands for sawing. Remember to use the thumb of your left hand to start the cut and saw down *both* your lines at once to keep the cut square. This is rough work, so don't worry about the saw kerf. The little bit of lost length won't make any difference.

The trickiest part of this build is the small "feet," so we'll make these first. Begin by using your square to lay out all the cuts as shown in the plans. To make things simple, most of the measurements are 1½" (38 mm). The notch in the middle is 1½ inches square, and the big notch in the bottom begins 1½" from each edge. That middle notch should be a tight fit on your two large beams, so you might want to pencil in one side of the notch, and then

Once I've started my cut, I hold the wood with one foot and grip the saw with two hands for long, powerful strokes. Notice how I'm sawing both the face and edge of the board at once. With my saw following both lines, I'm much more likely to get a square edge.

To get my center notch dead on, I mark one side and then lay a piece of 2×6 along my line and trace the other side. By marking the exact width of my stock, I'm guaranteed a tight fit when I attach the feet to the beam.

lay your beam across the foot and trace the other side. By tracing your stock directly onto your foot piece, you'll be sure to cut a slot of exactly the right thickness.

The curves on each corner have a radius of 1½" and you can lay these out using any round object 3" (76 mm) wide. I used a roll of masking tape. Once you have all the layout lines drawn, carry them across the edge of the piece. You might even want to do the layout on both sides. It takes a little extra time but makes cutting very easy. Finally, color in all your waste with a scribble of pencil so you know exactly what you're removing.

My foot is totally laid out and it only took the three tools pictured here.

While your piece is still whole and easy to grip, we're going to cut those round corners. Use the hatchet techniques we learned in Chapter 2. Use short chops to weaken the fibers, and then chop down to remove waste. This is a short piece of stock, so be sure to keep your other hand far back on the end of the work. Don't let your fingers curl over the top edge and never raise the hatchet higher than the hand holding the work. Taking many small chops is safer and more

The corners can be quickly shaped with the hatchet and knife. When I use the hatchet, the hand holding the work is far away from the cut. When I refine the curve with the knife, I work off the side of my lap where a slip of the blade can't cut me.

effective than one big swing. As your curve begins to take shape, slowly rotate the piece back and work on all the way down to the end of the board.

Once your corner is chopped, you can smooth out the ragged surface with your knife. Look at the picture and notice how I'm sitting with my knees together and the work held off the side of my lap. If the knife slips out of the cut, it swings through empty air and not some part of my body. Try for long slicing cuts that follow the curve made with the hatchet. The knife by itself might leave a good surface, but you can follow up with a sanding stick to really smooth things out. Smooth and shapely sawhorses are much more pleasant to use. (See Chapter 14 if you need help making a sanding stick.)

With your curves done, you can move on to the notches. The bottom notch is the hardest. Saw down the vertical lines with your crosscut teeth. Then you just need to remove the waste between those cuts. This work would typically be done with a chisel, and we're going to use our hatchet just like a chisel. Grip the head of your hatchet and use the edge to score your horizontal line. Put the corner of the hatchet against the end of the line and firmly roll the hatchet backward. With soft construction lumber, it should be easy to score deeply all along that line. Do it on both sides. Now put the top corner of your hatchet into your score-line and give it a firm whack with a scrap of wood. Work down your line, using the corner to get started and then rolling the hatchet parallel to the ground to take a wide cut in the middle of the notch. We're working *in between* the long fibers where wood is weakest, and you might be surprised how easily your hatchet penetrates the work.

To chop out the long notch at the bottom of the foot, I start by sawing the vertical lines and scoring the horizontal line with the edge of my hatchet. A nice, deep score-line will give me a straight split in the next step.

Once you've chopped your line all across one side, flip the work over and do the same thing to the other side. After a few sharp taps, your waste wood should pop right out. If the waste is stubborn and doesn't want to come free, take a second and saw down your vertical lines one more time. A few uncut fibers is enough to hold the waste in place no matter how hard you hit. If the underside of your notch is ragged, use your knife to clean and square it up.

To split out the waste, I start with the upper corner of my hatchet and strike firmly with a scrap of wood. This construction lumber is soft, so the edge should plunge right in. After I've worked along both sides of my line, the waste comes right out.

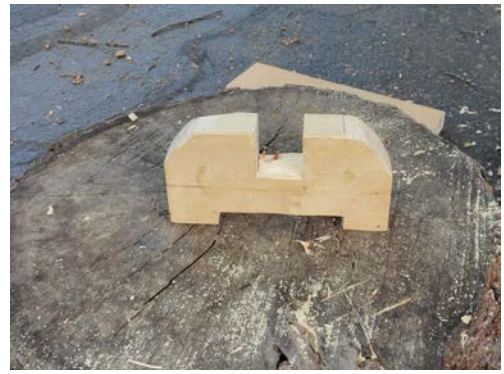
With that center waste removed, we now have two little feet on the bottom. Just like the four legs of a table, these little contact points are unlikely to rock, even on an uneven surface.

The last detail is the narrow, deep notch at the top of the foot. This one is much easier. Saw down the vertical lines, being sure that the cuts go all the way down on both sides. Then put your work up on some waste blocks and use the back of your hatchet head to knock the waste out. If you're using straight-grained stock, the waste should come out cleanly and leave a fairly square bottom that you can easily adjust with your knife.

One hard strike with the back of the hatchet should knock out your waste with no trouble, although you may need to use the knife to square up the bottom of the notch.

Now, try to slide your beam into your notch. If you're lucky, it will be a tight fit. If the beam won't go in at all, that's just as good. Use your knife and sanding stick to slowly trim the walls of the notch until the beam just slides on. A tight fit will make a much better tool, so take your time here.

Compared to the feet, the two long beams are easy. Chop the round corner details and smooth them out with your knife and sanding stick. Saw down the sides of the little notches and knock out the waste with the back of your hatchet.



My foot is roughed out, but the top notch has a splintery bottom and the walls need to be widened to fit the beam. The knife and sanding stick can handle these tasks.

Once all your parts are made, assemble them as shown in the plans. Put the completed horses on a flat surface like a kitchen table and sight across the tops of the beams. They should look dead parallel. You can also take a flat piece of wood, put it on the beams, and see if it rocks. If the tops of your beams are uneven, then one of your notches just needs to be a little deeper to take down a high spot. Disassemble your horses and use your knife to take a little material off the bottom of the notch. Reassemble the horses and test them again. Once you're satisfied, you can leave them as they are, or put a little glue between the parts and leave them

For crosscuts, you can kneel on the work and have both hands to start the saw right on the line. Once your cut is established, stand with one foot on the work and use two hands on the saw.

assembled with something heavy on top. I like to disassemble my horses from time to time, so I can adjust them or easily replace a broken piece. Instead of gluing, I run one screw up through the bottom of the foot and into the beam. Since my notches fit tightly, one fastener gives all the holding power I need. If you're new to screws, take a look at Chapter 10.

Tip: Once your sawhorses are done, you can throw a board across them and make a little workbench. Kneel on a mat, and you'll be amazed at how useful a low bench can be.

For many projects, these small horses are all the workbench you need. Place a board across your horses and put one knee on the work. Both hands will be free for sawing. Most of your small crosscuts and detail work can be done this way. If you need more power for thick, wide board, start your cut kneeling and then stand with your foot on the work. Now both your arms are free to grip your Ryoba and give you power for a long cut.

For rip-cuts, you can use a single horse with your work laying across one beam. Start your cut with your fine crosscut teeth, and then stand up with one foot on the work and both hands on your saw handle. At first, the work might seem far away, but your Ryoba is long and specifically made for this kind of work. You can sight down the blade and easily see your line while using the muscles in your arms, shoulders, and back to confidently pull those big rip teeth through the cut. This kind of sawing takes practice, but it's a fast and effective way to cut wood by hand. Just your Ryoba and your little pair of horses will help you do a huge amount of work.

For ripping, use one horse to angle the board up. Start the cut with your crosscut teeth and a thumb to steady the saw but stand up for the long rip-cut.

Add a board to your low sawhorses and you'll have the perfect bench for quick little project.

Chapter 9
The Bootjack

Materials:

- Scrap board (hardwood or softwood)

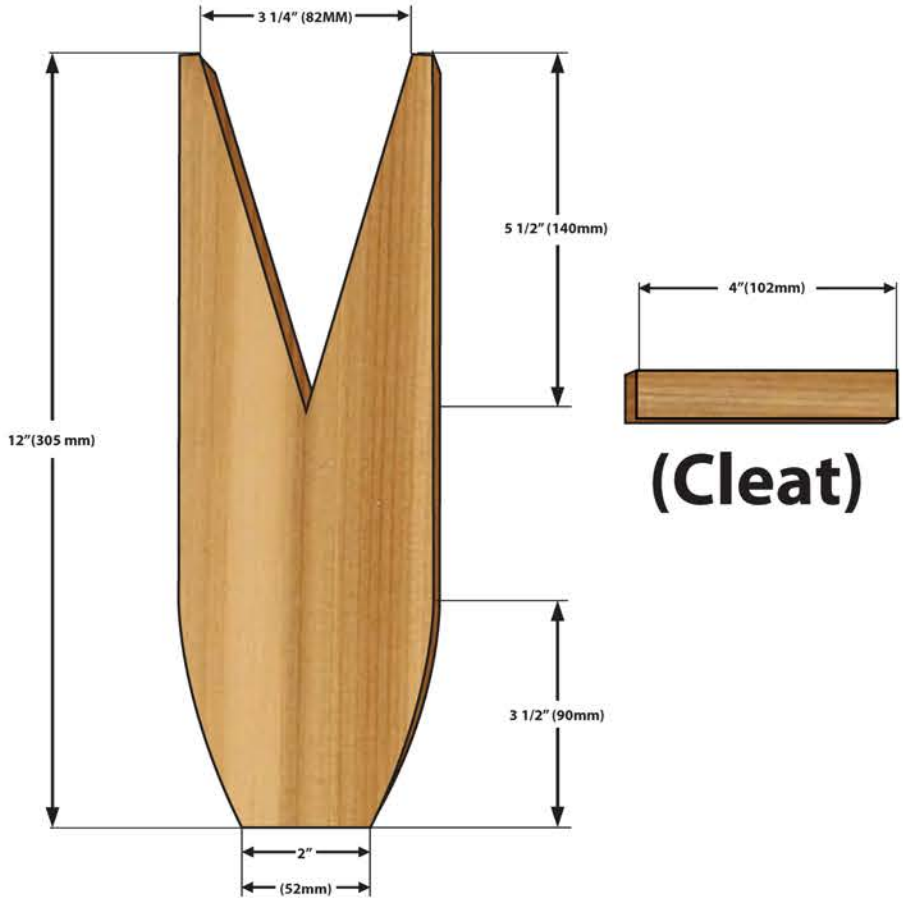
Tools:

- Ryoba
- Hatchet
- Pencil
- Square
- Sandpaper
- Drill and screws (optional)

Have you ever come into your house on a rainy day with your arms full of groceries? Most of us want to leave our wet shoes at the door, but how can you take them off without putting down your bags?

Our ancestors solved this problem with the bootjack. This simple, V-shaped board will grip the heel of your shoe and let you pull it off without using your hands or bending down. Once you've used one, you'll wonder how you ever lived without it.

The project gives us a chance to practice our sawing skills and use our new sawhorses. Your horses can make a fine little workbench if you just throw scrap board across them. I often work kneeling on the grass, but you can also do this project indoors and put a mat under your knees. For the short time this project takes, it's not uncomfortable.



For the stock, you'll need at least a foot (30 cm) of scrap board. It's easier if you start with a longer piece, but use what you have. A bootjack made from hardwood will last longer, but even pine will work.

Use the plans to lay out your cuts. None of the dimensions is critical. Just make sure the opening of your V-notch is big enough to fit your shoes. I have big feet, and my notch opens wide to fit heavy winter boots. Feel free to make your notch wider or narrower but be careful that the ends of the V don't get too thin and fragile. Mine are ⅜" (10 cm) wide, which is good for hardwood. If you're working with a softwood, leave them wider.

Use the rip teeth on your Ryoba to cut out the V-notch. Stand on your work to hold it steady. This is where using a long piece of stock comes in handy. After the notch is done, crosscut to final length.

Cut your V-notch with two long rip-cuts from the Ryoba. If your board is long, you can just stand on it to make the cut. Then mark the finished length of the bootjack and crosscut it, kneeling on the board to hold it steady.

Tip: This long, diagonal cut is halfway between a rip and a crosscut. You might want to try both sets of teeth and see which works better.

Your bootjack will look much more graceful with curved lower corners. You can draw these curves in freehand and cut down to your lines with your hatchet. Smooth out any tool marks with a bit of sandpaper glued to a scrap of board. While you're sanding, take a few minutes to round over all the sharp edges and work down inside the V to take off the saw marks.

The only other piece you need is a little **cleat** to hold the end of your bootjack off the ground. You can use the bootjack itself to find the width of your cleat and draw the saw lines. Before you saw the cleat out, take an extra minute and drill clearance holes for your two screws.

Sketch in some curves to make the lower part of the piece a little lighter. Trust your eye and do what looks good. By now, you should be pretty good at trimming curves with your hatchet.

Use the bootjack itself to mark the length and width of your cleat. The cleat should be around ¾" (19 mm) wide.

(See Chapter 12 for more on screw holes.) It's always easier to hold larger pieces of wood, so try to drill holes and cut details *before* you cut a small piece off a larger one.

Before you screw your cleat on, make sure you're putting it in the right spot. Balance the bootjack on your outstretched finger and make sure the cleat goes on *in front of* the balance point. This way, the back will always be heavier than the front and the V will always point up. Screw the cleat on with a pair of plated or coated screws to resist rust. Since the bootjack is guaranteed to get wet, you probably want to apply a hard finish like polyurethane. (See Chapter 22 for finishes and how to apply them.)

Drill your clearance holes before you saw the cleat free. Large pieces are always easier to hold.

Finish up by screwing on the cleat. The finished bootjack will let you pull off your shoes; no hands and no need to untie them!

Your new bootjack can sit on the floor near the door. It will get kicked around, get wet, and generally be abused. In a few years you'll want to make a new one, but it's such a quick project that you probably won't mind.

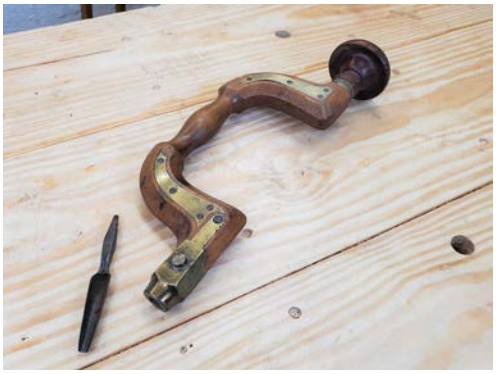
Chapter 10
Drilling and Boring

Drilling holes used to be hard. Some old time chairmakers even heated pieces of stone in a fire and *burned* holes through the seats of their chairs before installing the legs.

Compared to those guys, the modern woodworker has it easy.

Making Holes

All the cuts we've made so far have been either with the grain (splitting, ripping) or across the grain (chopping, crosscutting). Drilling goes both *along* and *across* the grain. The drilling tool must also clear away the chips it makes to keep cutting. That's a lot of work for a single tool.



This wooden "brace" and its hand-forged "bit" used to be standard equipment for drilling holes. For the drilling in this book, we'll use some updated tools.

For years, woodworkers drilled holes with simple tools like the **shell bit**, which doesn't even look like a drill bit. Since the 1850s, woodworkers have had **auger bits**. These corkscrew-style tools look familiar and they are excellent for drilling holes.

The words **drilling** and **boring** mostly mean the same thing, but boring often refers to larger holes or making an existing hole bigger. If I drill a ½" (13 mm) hole and I need it to be 1" (25 mm), I might "bore it out" to the correct size with a larger bit.

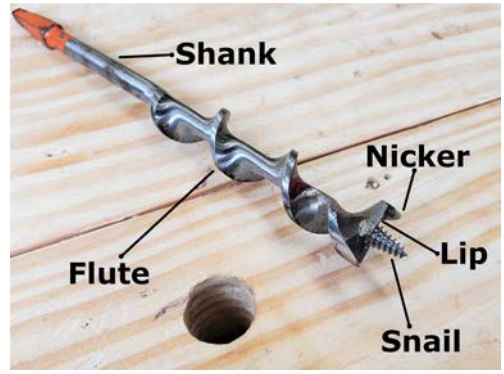
Anatomy of an Auger Bit

Drills are more complicated than you think. Let's look at an auger bit to see how they work.

The tip of an auger has a threaded point called **the snail**. This part pierces the surface of the wood and threads itself in as you turn the bit, keeping the auger on center. Once the snail is totally buried in the wood, the **nickers** come in like tiny blades and neatly score a circle in the wood, giving you a clean edge to your hole. After the nickers come the **lips**, which are straight blades that cut away the wood inside the circle made by the nickers.

All of these parts work together to get your hole started, but any drilling tool would get clogged if it didn't lift and remove the chips it makes. This is why auger bits have spiral-shaped **flutes** that travel far up the tool. You probably thought that this spiral shape did the actual drilling. (I thought so for years.) But those flutes don't do any cutting, they just lift the chips up and dump them out.

A set of good auger bits will get us through every project and this book, and you should keep your eyes open for them. Of course, many of us can't find vintage tools, so we'll talk about some modern alternatives.



The parts of an auger bit. Some drill bits have fewer parts, but they all work in a similar way. Understand this bit and you'll understand all of them.

If we look inside the wood, we can see the auger bit working. The snail pierces the wood and guides the bit. The lips break up the wood. The flutes carry the chips out of the hole.

Twist Bits

These are the most common drill bits and they're made for metal, but they'll drill through almost anything. The tip of a twist bit a comes to a dull point, which makes it hard to start

in wood. Since twist bits are designed for metal, they sometimes tear the wood fibers and leave a ragged edge. But these problems only happen with large bits—⅜" (10 mm) or more. Smaller sizes are easy to start and leave a clean hole. Twist bits are the best way to drill small holes in wood. Since they're so common, you can find a set of twist bits inexpensively, and even a cheap set will work fine for wood.

Twist bits are simple, cheap and effective, but they're not designed for wood. Larger bits might tear the fibers a little. Notice the ragged edges on this hole.

Tip: Garage sales are especially good places to find a deal on drill bits. I've bought brand-new sets for a dollar and you can find single bits for pennies.

Brad Point Bits

These bits are like twist bits, but their tips are more complex. In the center, they have a sharp spur like a nail (a small nail is called a **brad**). The outer edge has a pair of nickers like an auger bit. Brad point bits are designed for wood. They are easy to start, and the tip geometry makes a clean hole. Unfortunately, cheap brad point bits don't work well, and good ones can be quite expensive. Like all tools, they get dull, and they are difficult to sharpen. In my own woodwork, I've rarely used them.

Brad point bits are designed for wood. Like an auger, they have a sharp point and nickers that slice the wood.

Spade Bits

These bits look like a flat shovel. They have very simple geometry and no flutes. Spade bits are specifically designed for drilling larger holes in wood. They are easy to start because of their

long, sharp spur, and they remove wood fast. Spade bits are designed to be used in a power drill, and this is how they work best, but you can use them in a hand-powered drill, especially in sizes under 1". Because of their simple design, spade bits are not quite as neat as other bits, but even good ones are inexpensive, and a small set might cost less than $10. Spade bits are also easy to sharpen, and they can be resized for special applications. Grind away a little material on each edge of a spade bit, and you can make it a little smaller. For general boring of large holes, spade bits are a good choice, especially if you own an electric drill. If you need clean holes with very crisp edges, you'll need something better.

Spade bits are the cheapest way to bore big holes.

Forstner Bits

These bits look like a hockey puck on the end of a stick. They have a tiny, sharp spur and long, serrated nickers that go most of the way around the bit. Forstner bits drill very clean holes with crisp edges and flat bottoms. They are easy to start and rarely tear the fibers. If you're drilling a hole part-way through a board, a Forstner bit is a good choice because its short spur won't poke through the far side. These bits are designed for power drilling, but they also work in any hand drill that will grip them (they also come in hex-shank, which fit pretty well in traditional braces).

Forstner bits are complex and expensive, but they drill very clean holes.

The Forstner bit's one flaw is that it doesn't have long flutes to carry chips up out of the hole. When drilling deep holes with a Forstner, it's easy to let chips build up in the hole and jam the bit when you try to pull it out. When this happens, there's usually a lot of swearing and pulling.

Instead of letting the bit get stuck, pull it out occasionally and clear the chips while you're drilling. Like spade bits, Forstner bits work best in an electric drill. The short, unthreaded spur won't pull the bit into the work, so they aren't great for manual drilling.

Bits to Buy

If you plan on using a brace, it's best to find auger bits to go with it. These bits are common in many parts of the world, and once you know what you're looking for, you'll see them at garage sales, flea markets, and thrift shops. Try to find a full set, even if a couple sizes are missing. You can also build up your set slowly by buying single bits as you find them. Single bits should be cheap, but check the tips closely. Make sure the snail is in good condition and has clean threads. Look for sharp knickers and lips with minimal rust. If the bit has light surface rust, you can clean this off by drilling through a piece of scrap wood.

Modern auger bits are somewhat like vintage bits and some work well. (The one in the picture is okay, but not great). To use modern auger bits with a brace, you'll probably want an adapter like the one shown.

But if you have trouble finding vintage auger bits look for modern auger or **ship auger** bits. These bits are designed for power drills, but they're very similar to old-fashioned auger bits. These bits usually have a hex shank which may work in your brace. Many manufacturers also make an adaptor specifically for braces. Finding and using new bits is a big topic and I can't cover everything here. You can find more information about it at woodworkforhumans.com.

If you can't find auger bits at all, Forster bits may be the best choice for all-around boring, especially in larger sizes. These bits can be too expensive for some beginners. Keep your eye out for used sets and be careful of cheap imports. Many of them don't work well.

No matter which bits you get, I also recommend a small set of **twist bits** for drilling little holes. Almost any set will work fine for general drilling in wood. If you're planning on using these in the brace, buy a set of bits with a **hex shank**. The flat sides on the hex shank work pretty well even old-style drill-chucks and they won't slip while you're using them. With twist bits, you can also drill holes in metal, even with a hand drill.

Buying a Drill

There are lots of machines that will spin a drill bit. The one you choose depends on your budget and what you can find. Here's a quick list of the options:

Bit-Brace

This tool is my top choice for hand tool woodworking. It's just a big crank with a chuck at one end. The tool looks primitive and old fashioned, but until the cordless drill was invented in the 1970s, the brace was the only way to drill holes when electricity wasn't available. These tools were still in use by utility workers a few decades ago.

This bit-brace might look like a silly old tool, but a good brace is a cheap way to drill most holes.

Braces were made in huge numbers, so you can find good ones cheap, especially at garage sales. When you're buying one, look for a tool with minimal rust and damage. You also need to check the chuck, which holds the bits. Most chucks have two simple jaws with an internal spring that forces them apart as you unscrew the chuck. Look for jaws with a clean, sharp edges. They should come together smoothly as you tighten the chuck and separate on their own as you loosen it. Many braces just need a bit of rust-removal and oil to work well, so you can buy a brace that's a bit stiff, as long as it moves. Buy a decent bit-brace for a few dollars, fix it up, and it will handle 90 percent of your drilling and boring needs.

The jaws on this brace are a bit worn, but the edges are still fairly crisp. If the jaws look very rounded, don't buy the tool. There are many used braces in the world.

Bit-braces are really good at gripping bits with a square shank and okay at holding hex-shanks, but they're not great at holding round

bits. Luckily, most bits are available with a hex shank. There's also a slightly fancier type of brace with a "universal" chuck. These are harder to find, but they will grip a wider range of bits.

Hand Drills

The bit-brace will drill holes of all different sizes, but you'll find it clumsy for drilling little holes, especially with fragile little twist bits. For drilling small holes, you might want a hand drill. People also call these "egg-beater drills" because there used to be a common kitchen tool that looked exactly the same, except it had an eggbeater instead of a drill-chuck at the business end. Both tools work the same: grab the handle in your left hand, point the tool at the work and turn the crank with your right hand. Simple.

A hand drill is good for small holes.

Hand drills are slightly harder to find than bit-braces but they're still common, especially at antique shops, where they can usually be found for a few dollars. A hand drill has a little three-jaw chuck that's made for gripping twist bits. Just like a bit-brace, you want a chuck that opens and closes smoothly and jaws that look crisp.

Once you have a working tool, all you need to do is insert a bit, tighten down the chuck, put the tip of the bit against your work and turn the crank. The only thing to worry about is keeping the drill straight as you crank. If you own both a bit-brace and a hand drill, you can drill every size hole quietly, cleanly, and without electricity. For what they cost, these two tools offer good value.

Cordless Drill

For power and convenience, nothing beats a good cordless drill. These tools have the torque to drill large holes and they're light enough to handle skinny twist bits without snapping them. When I'm building furniture, this is the tool I reach for the most.

These tools can have a bit of a learning curve. Most of them feature a "key-less" chuck that takes a few minutes to learn, and for such small tools, they pack surprising power. If you're not used to using a cordless drill, you might drill too deeply or have a large drill bit suddenly jam and wrench your arm. You'll have none of these problems with a bit-brace or hand drill.

Cordless drills are also expensive, although even cheaper models are good enough for basic woodworking. The cordless drill is the most expensive tool in this book, but even if you don't stick with woodworking, it has lots of uses around the house.

This electric drill is pretty expensive, but it's powerful and dependable. Before this one, I owned two cheaper drills and they also worked well.

Corded Drill

Most manufacturers don't even make plug-in drills anymore, but older models can still be found at garage sales, usually at very low prices. Power tools with cords are less convenient, but they still work well. For the projects in this book, an old corded drill is more than enough.

Drilling Good Holes

Little holes are easy to drill. Bigger ones require a bit of practice, and you should drill a few holes in scrap wood before you do a project.

Mark your hole locations with an awl (or anything pointy). You'll get the location right and your bit will start easily.

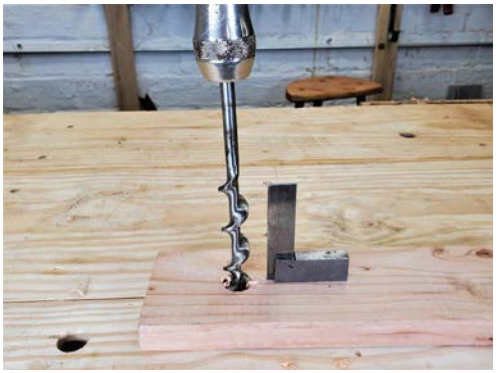
Starting the hole is the hardest part. Big drill bits have a spur that pokes right into the wood, but little twist bits are blunt at the tip and they can wander before they bite down. Before you start a hole, it's useful to pierce the wood with an awl. Piercing the wood before you start drilling will help your bit cut and keep you on target. You might know exactly where you plan to drill, but by the time you've found the correct size bit, you might have lost that your place. Mark your hole *before* you go hunting for tools.

Once you start drilling, your biggest problem is keeping the drill straight. Right at the start, you can change your drilling angle, but once your hole is established, you're stuck with it. If

you're drilling a large, deep hole, it's useful to start the hole and then stop and line up your drill bit with a square or a piece of scrap wood before you finish the job. A little visual reference is usually enough to keep your drill right on target.

Many of your holes won't go all the way through the wood. These are called "blind holes" and the biggest problem is getting them to the right depth. A little bit of tape wrapped around the drill bit will give you the right depth every time. "Through holes" go all the way through your piece and they often **blow out** the far side, splintering the wood and tearing the surface.

Blowout is easy to avoid with the bit-brace. This tool gives you surprisingly good feedback, and you can feel when the snail pokes through the far side of the wood because the brace suddenly gets easier to turn. When that happens, stop and pull out the bit. Flip the wood over, stick the snail into the little hole on the far side and finish the cut. You'll have a neat hole with clean edges on both sides.



A cheap little square like this one will help you drill straight. A square scrap of wood is almost as good.

The tape on this bit tells me exactly when to stop drilling.

You can do the same thing with an electric drill, but it's much harder to feel when you're about to break through. When I'm drilling a hole with an electric drill, I stop frequently and check the far side. When I just poke through, I flip my piece and drill in from the other side.

Another technique for avoiding blowout is clamping a piece of scrap wood to the far side of the work. When your bit breaks through, the fibers are supported by the scrap and they don't tear or splinter. Of course, you need clamps and scrap wood for this technique, so it's better to learn your tools and practice stopping *before* you break through.

Once you've mastered drilling, you can use it in lots of projects.

To prevent blowing out the far side of your hole, drill until the point of your bit pokes through, then flip the board around, put the bit into the hole, and finish drilling. The finished hole will be clean on both sides.

Chapter 11
Desk Organizer

Materials:

- Block of wood (hardwood preferred)

Tools:

- Ryoba
- Drill and bits
- Square
- Pencil
- Knife
- Sandpaper

It's nice to have something you made sitting on your desk. A little organizer is a quick project and it will remind you of all the fun you can have when you're *not* at work.

Most desktop organizers are just a combination of holes and slots and these are both easy to make with a drill and a fine saw. There are no plans for this project because I want you to design your own. I'll show you the techniques, and you make something that fits your needs.

For my wood, I've picked a thick scrap of oak. It's a durable wood that's also tough to work, so I'll need to be careful. You can use any hardwood for this project. These heavy, dense woods are more stable and look nicer, but even a thick chunk of pine would make a nice organizer.

Tip: Anytime you need a thick block of wood, you can always glue several thinner pieces together. This technique is called "laminating" and you can alternate different species of wood in your lamination to get an attractive striped pattern.

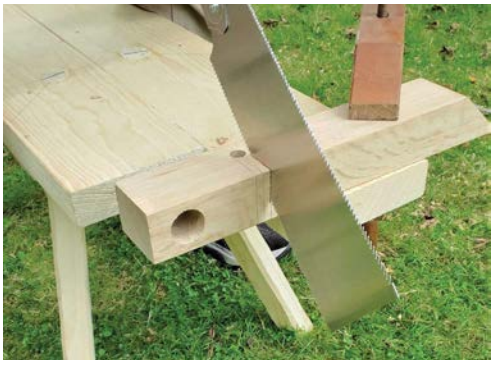
Everyone needs a spot to store pens and pencils. For my pencil holder I'm just drilling a single large hole using a 1⅛" (28 mm) spade bit. You can drill big holes like this with spade bits in a brace, but it's tough going and you might not love the result. This is a great time to use an electric drill that can spin the bit much faster and make a cleaner hole. If you can't drill large holes like this, just make smaller holes for individual pens and pencils. That works just as well.

An electric drill and a big spade bit make this hole easy to bore. For this project, I'm using the workbench from Chapter 19, but you can use a board on the low sawhorses, just like we did for the bootjack.

Most desktop organizers hold business cards, envelopes, and sticky notes. All these items can sit in slots and it's easy to make a slot by combining a hole with two saw cuts. I've designed my organizer to hold sticky notes in the middle, so I'll need a deep slot.

To make a slot, start by drilling a hole. Then use your square to strike lines from the edges of the hole and carry them around the side and onto the opposite face.

You can see in the picture that I'm drilling through the center of my block. I've drawn a line and carried it around the edge and onto the opposite face. This way, I can drill from both sides. When you drill a deep hole by hand, it's likely to go off course a little bit. Drilling in from both sides cuts down on error and usually gives you a straighter hole.



To saw out my notch, I remember the "triangles" rule from Chapter 7. I saw the lines I can see, flip the piece, and saw the lines on the other side. I finish up by bringing the saw perpendicular and sawing the final triangle hidden inside.

Once the hole is bored, I use my square to strike lines from the edges of the hole up and around the block. When I saw down these lines, I'll turn my hole into a slot with a smoothly curved bottom. To make the cuts, I'll use the fine, crosscut teeth on my Ryoba, and I remember the "triangles" rule. I saw down the two lines I can see, and then flip the piece to saw from the other side. When my waste falls out, I might need to clean up the walls of my slot. I can slice through ragged fibers with my knife or make a thin sanding stick to take off saw-marks on the inside walls.

Leave your stock full length as long as possible. When you've cut most of your details, saw the organizer free.

I am also designing my organizer as a phone holder, since I use my phone as a clock when I'm in my office. All I need is a shallow slot in the end of my organizer and this is just like the slot I already made. I drill a vertical hole close to the edge of my block and saw in from the end. This is a rip-cut using rip teeth, but nothing else is different.

After you've made all the cuts, sand your piece and break any sharp edges or corners. The final piece should feel pleasant in the hand. You can leave the wood unfinished or look ahead to Chapter 20 for ideas on adding a finish.

The finished organizer holds everything I need, and I could easily make another one if I want something different. These also make nice gifts for coworkers. No one needs to know how quickly you made it!

The phone notch is on the end of the organizer. Drill a hole and rip down from the end. You're done.

The completed organizer.


ZINSSER
Bulls Eye
Shellac
Traditional Finish & Seale
CLEAR

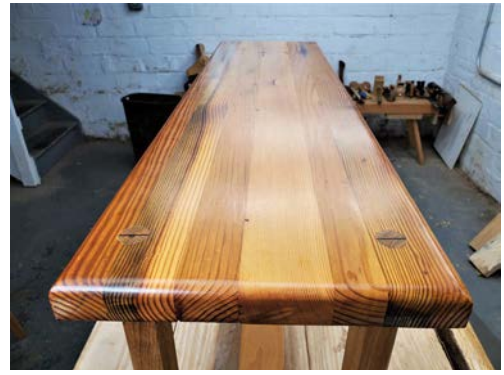

SUPER GLUE
WARNING: EYE IRRITANT. SEE LABEL
Net Wt 0.1 oz (3g)

Chapter 12
Glue, Screws, and Nails

A big part of woodwork is sticking two pieces of wood together. Chair legs have to be attached to the seat. Shelves must be attached to a bookcase. To connect two pieces of week, you need a joint, a fastener, or glue.

Two joints. On the left mallet with the head and handle joined in ***mortise-and-tenon*** *with a wedge for added holding power. On the right is a simple* ***dovetail****. The angled sides of this joint help hold it in place, but it still needs a bit of glue.*

The strongest woodworking connection is a **joint** where two pieces fit together and lock in place. In the picture, you can see a traditional mallet. The handle goes all the way through the head in a square hole. This is called a "mortise and tenon." The pieces fit snugly and there's a wedge in the middle of the tenon that locks everything together. We'll learn more about joints in Chapter 16.



This benchtop is made with many thin boards laminated together. The wide glue surfaces and long-grain connections make these joints strong and durable.

You can also join two pieces of wood by gluing them together. Modern wood glue is strong and waterproof, but it won't work for everything. Wood glue is great for **laminating** wood; gluing several pieces together to make a thicker or wider piece. In the picture, I show a bench where I made the seat by gluing up several narrow boards. This is a great way to make the larger pieces you need. The long joints between each board have lots of surface area and you're gluing long-grain to long-grain, where the surface of the wood is flat and solid.

These two pieces can be connected with a "butt joint." A little glue and clamping pressure will make them stick together.

But imagine gluing one piece of wood to another piece at a right angle. This type of connection is called a **butt joint**, and, while it's used occasionally, it's weak. This joint has a small surface area and connects long-grain to end grain. Remember from Chapter 1 that end grain is like the tips of drinking straws; it's mostly empty space with little glue surface. Almost any pressure applied to a simple butt joint will break it, so you only see this joint in low-stress settings. For most joints, glue by itself won't do the job.

Butt joints are fast and easy, but they're very weak. Even after letting it dry overnight, I popped this joint apart with my bare hands. You can't build very much with this joint.

In addition to glue, woodworkers often use **fasteners**, a big family of hardware that includes screws, nails, tacks, and staples. Nails used to rule in carpentry and furniture shops, but the rise of low-cost screws meant that nails have become more of a specialty item and they aren't used as often.

Screws

A screw is a threaded post with a pointed tip and a head. As you turn the head, the threads draw the screw deeper into the wood. Screws are designed to do specific jobs, and any home center will stock dozens of varieties. It's easy to get confused, so let's focus on the screws you'll see most often.

Wood screws. These fasteners are specifically made for woodwork. They feature a thick, durable shank, a wide thread, and a flat head that will sit flush with the surface of your work. You can tell wood screws at a glance because they usually aren't threaded the whole way up to the head. These screws are usually plated to resist rust, but you can also buy them in brass or stainless steel. Traditionally, wood screws had a simple **slot head**, but now they're more commonly found with a cross-shaped **Phillips head**. For furniture and indoor use, real wood screws should be your first choice.

Deck screws. These are like wood screws, but they're threaded all the way to the head and are coated to fight corrosion. Deck screws are designed for outdoor construction using softwoods.

These fasteners are strong, inexpensive, and long-lasting. They're ugly, but they work in most places where you would use a regular wood screw. If you need a lot of screws and appearance doesn't matter, deck screws are a good choice.

Left to right: wood screw, deck screw, drywall screw, sheet metal screw. Note the "bugle head" on the drywall screw and the round head on the sheet metal screw.

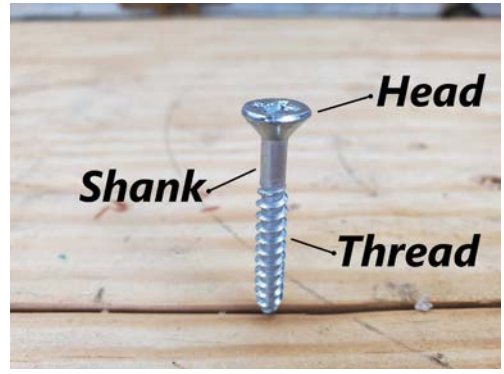
Drywall screws. These screws look a lot like deck screws. They're usually dark-colored and a bit thinner. Viewed from the side, a drywall screw has a "bugle-head" instead of the triangular profile of a standard wood screw. Some people use drywall screws for woodworking because they are inexpensive and easy to drive, but they're also much more brittle than wood screws or deck screws. Drywall screws break easily and offer no benefits. Avoid them.

Sheet metal Screws. If you have a jar of old screws in your basement, some of them will be sheet metal screws. These fasteners usually have a rounded head and a fully threaded shank. They look a bit like wood screws, and they will hold pieces of wood together. (I've used them many times when there was nothing else around.) These screws won't sit flush with a surface of the project and they don't look great, but they work in a pinch.

How to Drive a Screw

Screws must be simple, right? You drill a hole through two pieces of wood and drive in the screw. Unfortunately, it's not that easy.

Screws work by pulling two pieces of wood together. The screw's threads should only engage with the *bottom* piece. The



Anatomy of a wood screw. Each part of a screw plays a role in connecting pieces of wood.

screwhead pulls the top piece down to meet the bottom piece and the threads must *not* engage with the top piece. If you drill the same size hole through both pieces of wood, the threads can force the top piece up as you tighten the screw. This common problem is called a **jacked screw** and it will hold your boards apart instead of pulling them together.

Tip: If you own a big set of drill bits, you'll often find two different sizes that will both work to drill the pilot hole for a screw. If I'm working in hardwoods, I choose a larger bit for my pilot hole. A larger pilot hole prevents splitting. If I'm working in softwoods, I pick the smaller bit for a tighter hold.

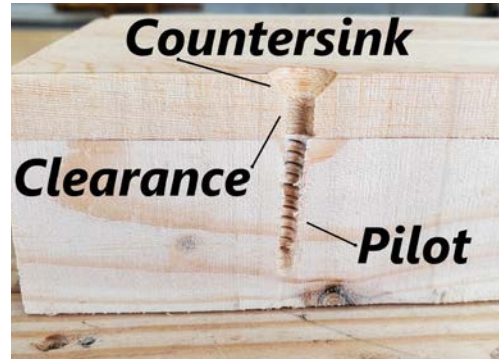
A correctly drilled screw hole is actually three holes. In the bottom piece of wood, you drill a narrow hole that will let the screw pass while the threads grip the wood. This is called the **pilot hole**. In the upper piece of wood, you drill a larger hole, so the threads and shank won't grab the wood at all. This is called the **clearance hole**.

Your screwhead is flat on top, but the underside is triangular, and you need a hole for the triangle to slide into. This last hole is made with a **countersink** (which is the name for both the tool and the hole it makes.) These tools cost only a few dollars and they work in any kind of drill or brace.

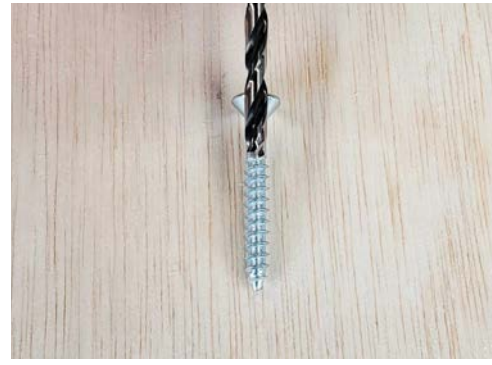
The countersink is a simple tool that works in a drill or a brace. Cut your countersink before you drill your holes and you're guaranteed to get a smoother result.

Here's how you drill: clamp your two pieces of wood together, find your screw location and prick it deeply with an awl. Next, use your countersink to make a shallow space for the screwhead. Now take your screw and find the correct pilot-hole bit. When you hold the correct bit up to the screw, it will be the same size as the screw shank, but the threads will stick out to either side. Drill this pilot hole through *both* pieces of wood. Now unclamp your pieces

Finally, find your clearance hole bit. It should be slightly larger than the screw-threads, but much smaller than the screwhead. Drill your clearance hole all the way through your top piece of wood. Drop a screw into your clearance hole and use the point of the screw to catch the top



I installed this screw and then cut the wood in half to show what happens inside. Note how the three holes each work differently. The threads bite deeply into the ***pilot hole****. The* ***clearance hole*** *doesn't even touch the screw shank. The* ***countersink*** *cradles the screwhead and allows it to pull against the threads.*



Finding your drill bits is easy. The pilot-hole bit should let the screw threads show on both sides. The clearance-hole bit should be slightly larger than the screw-shank.

of your pilot hole. Using the fastener to line your holes up is much easier than doing it by eye. Use a screwdriver to tighten the screw until the head seats firmly into the countersink.

You can run into lots of problems with screws, so here are a few tips to make things easier.

- Drive your screws with firm downward pressure. You want the driver to stay engaged with the head at all times. Screws should never be very difficult to drive. If you're having a hard time, stop and double-check your holes. Make sure they're deep enough and the correct diameter. Never force a screw; you'll just strip the head.
- If you're using screws with deep holes or very hard woods, you can lubricate threads with wax or bar soap. A little bit of lubrication keeps heat from building up while you're

Drop your screw into the clearance hole and then use the point to find the pilot hole. When you use the screw to line up your holes, you save a lot of fumbling around.

Rub a little bar soap into the threads of a screw and it will drive much more easily.

driving the screw and cuts down on snapped fasteners without affecting holding power.

- Hardwoods are more difficult to use with screws and much more likely to split. Be careful to drill your holes deeply enough and don't forget the countersink.
- Softwoods are very forgiving with screws. You can often skip the pilot hole and the countersink. Just drill the clearance hole and drive the screw straight in. The screw will make its own pilot hole as you drive it and the screwhead will compress the wood and effectively countersink it.

A driver bit in your brace is a powerful tool for driving fasteners. You'll be amazed at how quickly you can sink screws with this setup.

- Phillips-head screws are generally much easier to drive than slot-head, but there are three different size Phillips-head drivers. Most screws take a #2 driver, but you always want to use the *largest* driver that will fit the fastener. The correct driver often looks too big, but it will help keep the head from stripping.

- Cordless drills and impact drivers are excellent for driving screws quickly, but they're often too powerful for furniture work and will leave you with stripped heads and split wood. Drive screws by hand whenever possible. If you need extra power, put a screw bit into your brace. This setup gives you nearly effortless driving while still allowing enough feedback so you don't break anything.

Problems with Screws

The first time you drive a screw correctly, you'll be shocked at the tight connection. Quality screws driven into solid wood are incredibly strong. The only problem is that solid hold rarely lasts.

Wood and metal expand and contract differently. While wood shrinks and swells with changes in humidity, metal doesn't. Over time, all that wood movement causes the fastener to loosen. As pressure is applied to a screw, the wood around its threads slowly weakens, allowing the screw to shift back and forth. Over time, the screw will fail completely and pull out of the wood. Find an old piece of furniture made with screws and it's guaranteed to be loose and wobbly. Screws can be tightened a few times, but eventually their holes will strip out and the whole piece will fall apart. Screwheads can also be ugly, so they're often driven beneath the surface of the wood and then filled with wood plugs or putty. Personally I find this approach just as ugly as bare hardware and I prefer to avoid screws anyplace that will show.

I used screws and construction adhesive for this joint in my workbench. Screws work well for shop furniture like benches, especially with a good design that won't let them loosen over time.

Of course, screws have lots of good uses in the shop. They're perfect for building shop furniture and storage and they allow projects to be disassembled. Screws are also great for applications where they won't be under a lot of stress. If you need to attach a back to a bookcase, screws are a good choice. If you need to install a table leg, you're going to need something better.

Nails

Most people associate nails with rough carpentry, but nails have a long history in fine woodwork. Traditional nails were forged by a blacksmith or cut by machine. Old-style nails are square in cross-section and this shape makes them hold very tightly in wood. Many pieces of nailed furniture are still strong, even hundreds of years after they were made, so don't dismiss nails for your work.

Left: Square-cut nails are expensive but useful. Right: Round wire nails are cheaper, but don't hold as well.

In the 1800s, square nails were slowly replaced by **wire nails**, which are round and don't grip wood nearly as well. As a result, nails quickly got a bad reputation among furniture builders. Large wire nails are mostly used in carpentry and aren't much good for woodwork, but smaller finishing nails (as well as **tacks** and **brads**) are perfect for attaching small pieces like decorative trim. These little nails don't have much holding power, but they're fast and perfect for light-duty uses. The picture shows a little wall box I made quickly without glue. The only thing holding it together is small finishing nails, but the completed box is surprisingly strong, and my family just uses it to hold winter gloves, so the nailed construction is perfect.

This wall box is held together with nothing but little wire nails. It's more than strong enough for holding light objects.

Traditional, **square-cut nails** are still produced by at least one factory and I encourage you to try them out as you get deeper into woodworking. They have to be special ordered, but nails are both fast and effective for woodworking.

For the projects in this book, we will use some screws, but we'll focus on simple joints and glue.

Glue

Even perfectly cut joints are usually reinforced with a dab of glue. The combination of joinery and glue offers the strongest and best-looking connection.

For centuries, woodworkers used **hide glue**, which was made from animal skins. This traditional glue worked well, but it had to be kept hot and it couldn't fill gaps, so it only worked with tight-fitting joints.

While traditionalists and instrument makers still use hide glue, most woodworkers now use **PVA glue** (also known as **yellow glue** or **wood glue**). PVA stands for polyvinyl acetate, a synthetic polymer mixed with water. This glue is nontoxic if you don't ingest it, produces no fumes, and can be used at room temperature. Excess glue can be cleaned up with a moist rag while it's still wet. Once dry, PVA glue is stronger than wood. PVA glue can fill small gaps, so it works even when your joints aren't perfect.

PVA is the only glue you need for the projects in this book, but you'll hear about many other kinds of glue, and some of them are very useful.

Three common glues. Yellow PVA is sold as wood glue and it's the most common for woodworking. Two-part epoxy comes in two bottles and forms a clear, strong bond. CA glue comes in little tubes. It's great for fast, small jobs.

Superglue. Also called CA glue, superglue is another synthetic adhesive. This glue is clear, extremely strong, and dries very fast, but it's also toxic and produces strong fumes. CA glue is great for small pieces, repairs, and filling small cracks, but it dries so quickly that it's very easy to glue your fingers together or glue yourself to your project. This sounds funny, but it can be serious and painful. Wear gloves and work with good ventilation.

Epoxy. This is a two-part resin. The user mixes the two parts together. Epoxy is clear, thick and very good at filling gaps. It can also be tinted with dye or mixed with various powders and fillers. In addition to being a good glue, epoxy can add color or visual interest when it's used to fill cracks or voids in wood.

Contact cement. This thin, milky glue is made for attaching thin layers of wood, plastic, or leather to a foundation. Thin sheets of fancy wood called **veneers** are often glued to plywood to dress it up. Contact cement is a common choice for veneering. It's also great for bonding cloth or leather to wood. Contact cement comes in both toxic and nontoxic formulas, and I've had good luck with both. It's more complicated to apply than other glues, so read the directions carefully.

Choosing the Best Connection

When you're just starting out, it's hard to know if you should use glue, fasteners, or a joint. Joints usually offer the strongest connection, but they take the most time and skill. Screws are especially good for projects that need to be done quickly or disassembled later.

Don't forget that you can combine connections in a single joint. Sometimes, it's useful to glue two pieces together and use screws for added hold. The screws will take the place of clamps and hold the wood together while the glue dries. After it's cured, the glue will help keep the fasteners from loosening.

For all the projects in this book, I'll tell you which connection to use and why we're using it. Once you've done these projects, you'll have a much better idea of how to join wood together.

Chapter 13
Chopping Block

Materials:

- Fresh-cut log
- 2×6 construction lumber
- Lag screws
- Washers

Tools:

- Contractor's saw
- Ryoba
- Square
- Bar clamp
- Pencil
- Drill and bits
- Adjustable (crescent) wrench

Your Japanese sawhorses will give you a great platform for sawing, but every woodworker needs a solid surface they can pound on. For the projects in this book, you must chop, split, saw and carve. These tasks will all be easier once you've built the chopping block.

The chopping block was common in seventeenth- and eighteenth-century wood shops. A furniture maker would often take wood to the block to quickly split a board or chop away waste. The solid weight and tough end grain of a block will stand up to hits from the hatchet and won't get chewed up like the surface of your workbench would.

In historical shops, the block was often a single log, very wide and roughly waist high. A log like that can weigh several hundred pounds. We need something easier to move, but we can't

sacrifice strength or stability, so we will use a smaller piece of wood and make a tripod stand out of construction lumber. Our block will be solid enough to pound on and its wide base will keep it from tipping over, but we'll also be able to take it apart for easy moving.

Once we've attached our legs with heavy-duty **lag screws**, we'll add some simple work-holding to make our chopping block function like a small workbench. With just an afternoon of work, we can make a compact and useful addition to our shop.

A log, a knife, a hatchet and some construction lumber will get us going for this project.

Wood Selection

As you're reading this book, watch out for freshly cut logs. In many parts of the world, green logs are left by the side of the road to be collected on trash day or picked up for firewood. You can also keep your ear open for the sound of chain saws. Many times, I've heard that whine off in the distance and followed it to a pile of fresh wood. If someone is cutting up a big tree, they will probably give you a chunk. Another good source of logs is a firewood dealer. Show up on a day where they are splitting wood and just buy an unsplit section for a few dollars. Firewood dealers, tree cutters, and arborists are especially good sources for logs because they usually know the species of tree they are cutting up.

Your block should come from a tough hardwood like oak, ash, hickory, or maple. Sticky softwoods like pine are tough to deal with when green and won't hold up to chopping. Even if the tree cutter doesn't know the exact species, they'll know if it's hard or if it's filled with gummy sap.

For this project, get a piece of green wood straight from the tree. Fresh logs that sit on the ground quickly pick up insects that you don't want in your house. Do not use a piece of wood that was dead before it fell or has obvious rot or holes. As for size, find the biggest piece you can comfortably move. My log is 14" (35 cm) in diameter and 12" (30 cm) long. Coming straight from the tree, my log was heavy and difficult to lift, but it will only get lighter as it dries out.

A round log will often split as it dries, and this is fine for a chopping block. If you're not going to use your log right away, store it outside, off the ground and under cover. A porch is an excellent place to store wood before you use it.

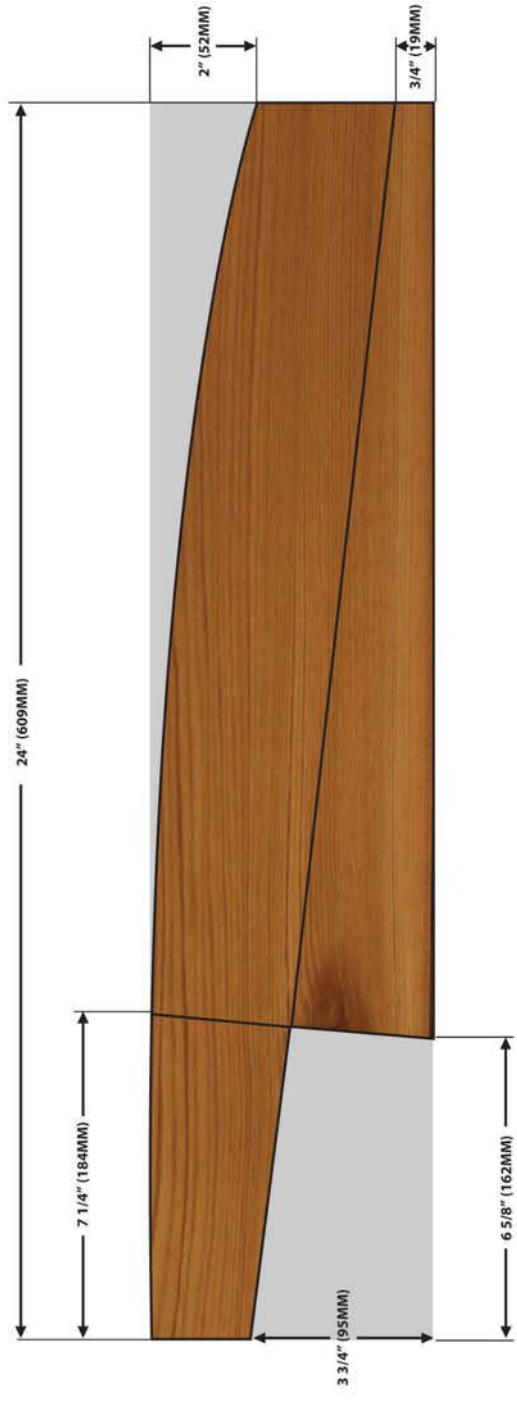
The log for my block came from a Siberian elm (which is not an elm and not from Siberia). It's a tough, oak-like wood that's common where I live. You might notice that the surface of my log is shiny. While I was storing it on the porch, I coated the ends with a thick layer of yellow wood glue. Wood gains and loses most of its moisture through the end grain, so sealing the ends of a log will make it dry more slowly and reduce splitting. Glue makes a good sealer, but even house paint will do if that's what you have.

For the legs of your block, you'll need about 6' of construction-grade 2×6. For hardware, you'll need six lag screws—heavy-duty wood fasteners meant to be driven with a wrench. I chose ⅜" x 6" screws and washers that fit them. (If you're buying metric hardware, get 8- or 10-mm screws around 150 mm long.) Longer is fine, but they'll be harder to drive. This is common hardware that you'll be able to find at any big-box store. While you're there, pick up an inexpensive adjustable wrench to turn the screws.

Construction

Use your low sawhorses to cut your lumber into three 2' (60 cm) sections. You can also use your sawhorses as a platform while you measure and lay out your next cuts. The diagram shows how to lay out your cuts to turn a plank of wood into a leg. By cutting out the notch on the left side, you'll give the log a place to sit and an angle that will make it stand firmly. The curve on the right-hand side removes material that might stick out and trip you as you walk around your chopping block. You might have to adjust the measurements to suit your particular piece of wood. My log has angled sides and I had to trim my legs to fit.

Once you've measured all the distances, you can use a piece of wood as a ruler to draw the long diagonal line. Use your square for the other lines, and to carry your cut lines across the edge of the board. The long curve can be drawn freehand.

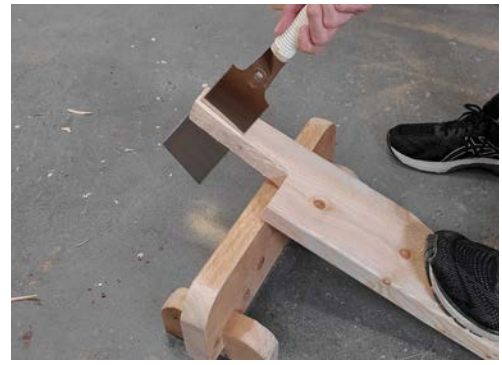

2" (52MM)
3/4" (19MM)
24" (609MM)
7 1/4" (184MM)
6 5/8" (162MM)
3 3/4" (95MM)

Your small sawhorses make a good platform for laying out your cuts. Remember to use your square for perpendicular lines, and any of the legs will make a good straightedge.

Remember to use your Ryoba's rip teeth for the long cut and the finer teeth for the short crosscut. Once you've taken out the waste, you'll need to chop out that curve. Luckily, your log makes an excellent chopping block, even sitting on the ground. I just kneeled next to mine and went to work with the hatchet. After the curve is roughed out, sit on your log and use your carving knife to even out the surface. This long curve goes with the grain and is easy to cut with a knife. Practice taking long strokes and try for a smooth surface.

A single sawhorse is handy for ripping the long side of the notch, and your hatchet will chop off the curve. Your finished leg should look something like mine.

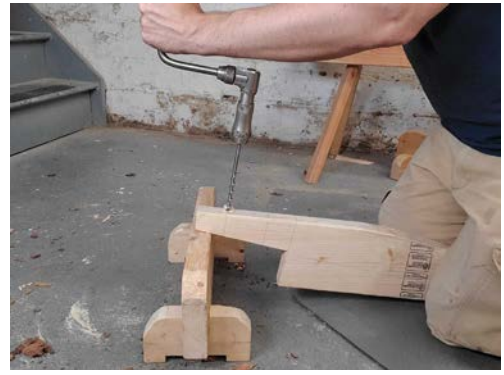
Your completed leg should look something like mine, but this project has a lot of room for variation. The most important thing is getting a good angle on your leg so that your chopping block will sit steady. Fit the notch of your leg into one side of your log.



My leg doesn't fit my log very well. It's too straight and there's a big gap at the bottom. I saw away a little wood to get a better angle and a tighter fit.

Your log probably won't have straight sides, and you'll need to either trim the angle of your leg or chop a little wood off the side of your log to get a good fit. The important thing is the angle. Your legs must angle *out* from the log to create a sturdy work surface.

Now we're ready to attach the legs to our log. Use your square to strike two lines across the face of your leg and use these lines to keep your drill straight as you bore **clearance holes**. Remember that these holes must let your hardware slide freely through. (Go back to Chapter 12 for a refresher on using screws). It can

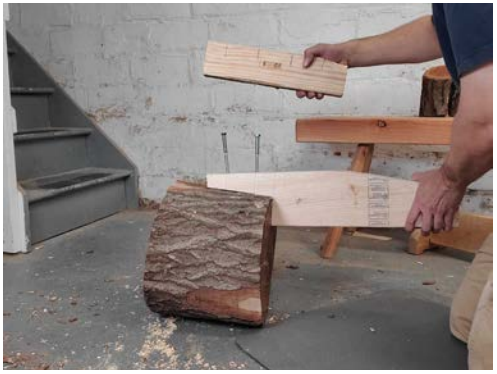


The lines I've drawn on my leg make it easy to keep the brace straight as I bore my clearance holes. My knees make a good vise for this handful of holes.

be difficult to hold wood while drilling deep holes, but you can clamp the wood between your legs with one end up on a sawhorse. As you drill, check your lines and make sure your bit is lined up.

Now place your leg against the log, drop in two lag screws, and give them a firm tap with a piece of scrap wood. The points of the screws will leave deep dents in the log and tell you exactly where to drill. Remember to change drill bits to a smaller size before you drill **pilot holes** in the log. These holes should match the shank of your screw but allow the threads to bite in. Don't worry about drilling into this huge piece of wood; green wood is soft and easy to work.

Once your holes are drilled, add washers to your lag screws, and tighten everything down. You can rub a little wax or bar soap on the threads of your lag screws, and they'll tighten more easily. Repeat this process for your other two legs and stand the chopping block up. Don't worry if the block is a little wobbly at first. We're going to fix that right now.



Put the screws in the holes and give them a whack. Now you'll have clear locations for drilling your pilot holes.

Run your screws in with an adjustable wrench (or a socket wrench if you have one). Get them good and tight. If you try to tighten them later, the screws are likely to snap.

Tip: Many woodworkers work outside, but if you leave your chopping block out on the lawn, the legs will quickly rot. If your block will mostly be outside, use pressure-treated lumber rated "ground contact" for the legs.

The feet of your legs will not sit flush with the ground right away, so glue a pencil to a little piece of scrap wood and use it to draw a line around the bottom of each leg. This line will be exactly parallel to the floor, and when you cut off the waste below the line, your legs will sit steady. Once your block is standing up, you might find that the position of the legs isn't perfect. My log was far from round and even though I spaced the legs evenly, the block still wanted to tip in one direction. I pulled off one leg and reinstalled it a few inches over. You should expect to adjust your block to get it really stable.

A pencil and a scrap of wood will make a marking tool that scribes the plane of the floor onto your legs. Crosscut this line and your leg will sit steady on the floor.

At this point, the block is already a useful work surface. It's at a comfortable height for hatchet work, and you can easily set it up in a corner of your garage or even outside. But we can make the block into a versatile workstation by adding just a little work-holding. We're going to take an inexpensive F-clamp and install it in the side of our log.

Drill holes up the side of your log and knock out the waste between them with your hatchet.

Start by drilling a 1" (25 mm) hole a few inches from the top. This hole will hold the lower jaw of the clamp. Then drill a series of smaller holes to hold the narrow bar of the clamp. Use your hatchet to knock out the waste in between the holes and follow up with your knife to get the last few bits. When you first insert your clamp, it probably won't go in all the way or be straight. You'll probably need to drill out some more waste in your big hole, and you might need to drill in at an angle. It all depends on the shape of your clamp. Hopefully, removing a little waste will let your clamp slide in most of the way and then you can tap it home for a tight fit inside the block.

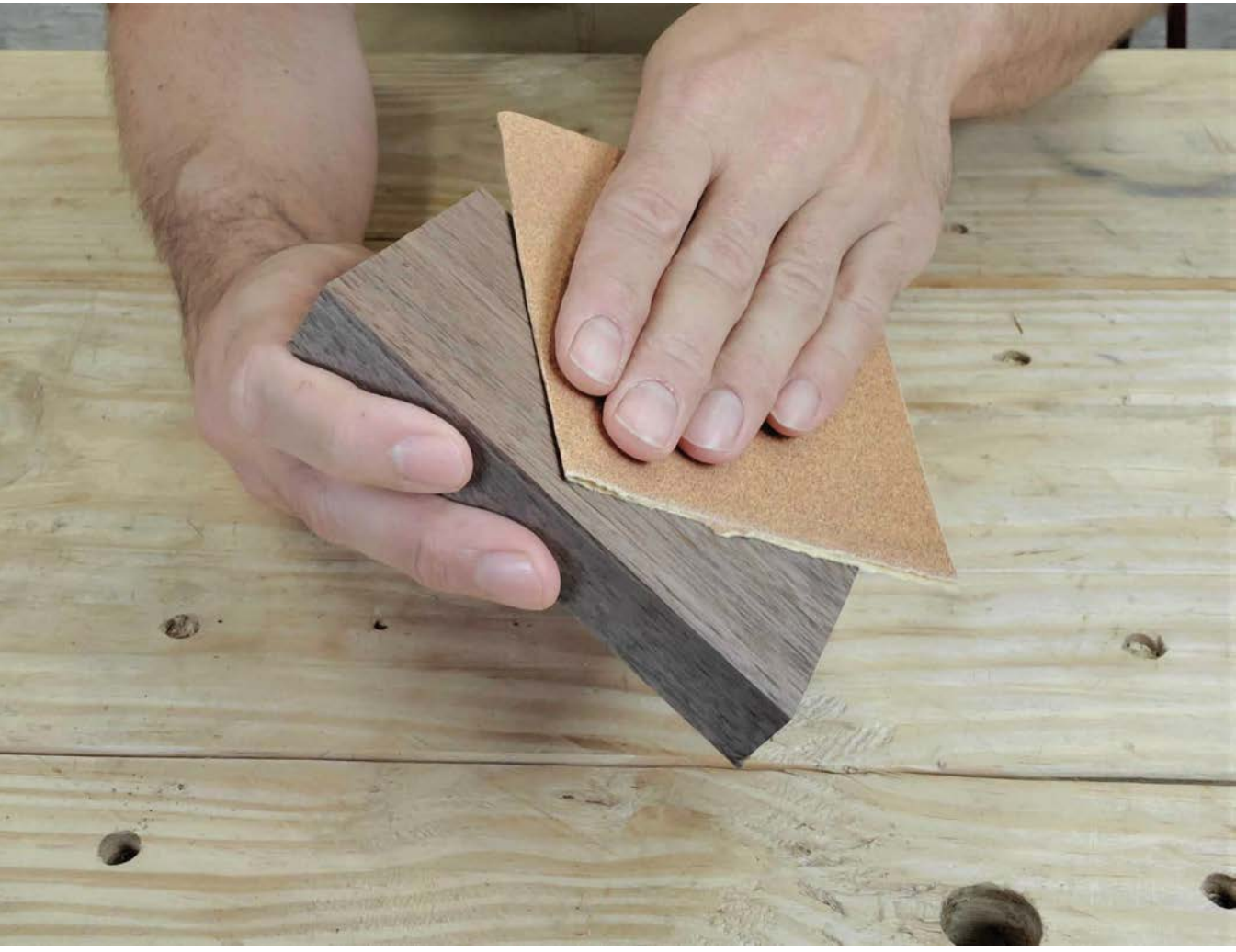
After adjusting your hole, you clamp should slide in and stay in place with friction. Once it's done, drill a hole (or two) in the top of your log to accept a peg. The clamp will hold work down and the peg will keep it from rotating.

With the clamp installed, you'll be able to hold work securely to the top of your block. This setup will allow you to drill, trim, and saw boards without having to hold them. The only problem is that work held with a single clamp might rotate, no matter how hard you tighten the clamp. An easy fix for this problem is to just add a peg to the surface of your log. Find a piece

With a clamp and a peg you can hold wood still for sawing or chopping.

of hardwood dowel (an old broom handle works well) and drill a hole slightly wider than the diameter of the dowel. Now, you can hold a piece of wood with the clamp and brace one side against your peg. The clamp will hold it down, and the peg will keep it from rotating.

Now you have a solid and portable work space for our other projects. We'll use this block to learn our first joint, build a mallet, and make some real furniture.



Chapter 14
Sanding Tools

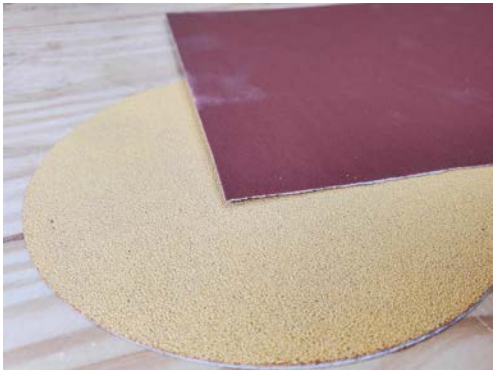
I think everyone has used sandpaper. It's idiot-proof: you rub it back and forth over wood and the surface gets smoother. Even preindustrial woodworkers had sandpaper (made from ground glass).

Modern abrasive papers are very high tech and combine ultra-hard particles like aluminum oxide with high-strength adhesives and durable paper. Modern sandpaper is expensive, but it also lasts a long time.

Picking Your Paper

Sandpaper is sold in different grits, and the numbering system is a little confusing. The higher the number, the *smaller* the abrasive particles. So, 80-grit paper is very coarse, and 2000 grit is extremely fine. The coarse (low) grits are used for shaping and leveling and the fine (high) grits produce the final surface.

Each grit leaves scratches in the wood. If you use 80-grit sandpaper on a project, the surface will be deeply scratched. If you go directly to a fine grit like 220, those deep scratches will *never* come out. To get



Two different grits of sandpaper. The yellow paper is 80 grit and is coarse enough that you can see the individual abrasive particles. The red paper is 220 grit and is so fine that it appears smooth in the picture. If you touched it, you would easily feel the abrasive.

from the rough surface of 80 grit to a final surface, you would need to use 100, 120, 150, and 180 grit. Each grit removes the scratches left by the last one and by the time you get to 220-grit paper, your wood will be smooth and ready to finish.

If all that sounds like a lot of work, it is, especially if you're working by hand. All that sanding is also dusty, boring work. It's much better to pick your paper carefully and do less sanding. Learn to use your hatchet and knife to make a smooth surface and you can do a lot less sanding.

I keep 80-grit paper around, but I mostly use it for shaping wood; I never use it for surfaces. To get a surface smooth, I usually start sanding with 100 or 120 grit. I use lots of 150 grit, and it's often the only grit I use. I once worked with a professional furniture finisher, and he never used anything finer than 150 grit. He told me that anything beyond 150 was a waste of time. I do keep 180 and 220 grit around, but I don't use them a lot.

For the projects in this book, I suggest you have 100- and 150-grit paper. As you work, you'll learn if you like coarser or finer grits.

Shaping and Finishing

Sanding has two basic uses: it can remove wood to shape a piece or smooth out a surface before the final finish. When you use sandpaper for shaping, the sandpaper is working like a file or rasp. It's removing material quickly and usually leaving a rough surface behind. Traditional woodworkers rarely use sandpaper for shaping, but it's a cheap and effective method for some projects. Glue a piece of coarse sandpaper to a stick of wood, and you have a useful shaping tool, especially for making curves.

Sandpaper is more commonly used to smooth out a surface and make it ready for finishing. By the end of a project, the surface of your piece is likely to be scratched and a little bit dirty. Fine sandpaper will remove light scratches, pencil marks, and dry glue, leaving you with a surface that's ready to finish.

Basic Technique

Bad sanding can ruin a project and waste time, so let's get it right. Sandpaper works by scratching the wood. If these scratches go *across* the grain, then they're very easy to see. If you sand *with* the grain, the scratches blend in and disappear.

To avoid problems, test your sanding on a piece of scrap. You want to start with the coarsest grit you need. Lots of beginners think they should go directly to their final grit, but fine paper is slow and wastes time. Test out your 100 or 150 grit on a scrap of wood and you'll get a feel for what you need.

Lots of sanding is done with the paper just held in your hand, but a full-size sheet of sandpaper is too big to work with. I tear my sheets into quarters. You can't cut sandpaper because the hard particles will ruin any blade that touches them. Instead, fold your paper where you want to cut it, then turn it and fold in the other direction. You can run the edge of a pencil along the fold line to speed things up. When you have a nice crease, put the paper over the edge of a table and pull down to tear off your piece. Fold and tear your sheet again until you have four quarters.

I sanded both of these pieces with coarse, 80-grit sandpaper. Both pieces are deeply scratched, but for the left-hand piece, I sanded with the grain and the scratches blend in. For the right-hand piece I sanded across the grain and the scratches are very obvious.

Sandpaper is difficult to cut but it's easy to tear. Fold it over and use a pencil to make a sharp crease, then use the edge of a table to support the fold while you tear. You'll quickly learn how to get a clean and straight line.

I fold each quarter-sheet in half and grip one corner between my thumb and the side of my hand. The paper rests on my fingers so they can follow the shape of whatever I'm sanding.

Advanced Sanding

The handheld approach works for some projects, but if you're working on something flat, you might want to put a dry sponge or a chalkboard eraser behind the sandpaper. This soft backing will help support the paper and press it evenly on your surface while also allowing a little give so your paper can follow curves or dips in the project.

For basic sanding, hold the paper in your hand and let your fingers support the paper as it moves across the work.

This commercial rubber sanding block grips the paper securely and makes it easy to sand large surfaces with the paper held flat.

Tip: Even fine sandpaper is just abrading the surface of the wood. Sanding can make grain look blurry. As you move into finer woodwork, you might want to investigate planes and scrapers, which slice the surface and leave the grain looking crisp and shimmery.

For very flat surfaces like box lids or tabletops, you'll need something hard and flat behind your paper. You can buy a rubber sanding block at any home improvement store. These commercial sanding blocks have little flaps on the ends with metal points that grip your sandpaper. I used one of these handy little blocks for years . . . and then I figured out that I could wrap sandpaper around any scrap of wood and get the same result without having to fiddle around fitting the paper to the block. Now I just use whatever is laying around for my sanding blocks.

Most of the time, I just wrap my sandpaper around a piece of scrap and use that as my sanding block. You have to hold the paper on with finger pressure, but it's very easy to change your paper when it gets worn out.

Sanding Sticks

Lots of projects need a detail like a rounded edge. Professional woodworkers often use expensive rasps for this work. You can buy cheap rasps, but they're usually rough tools and will tear up your wood.

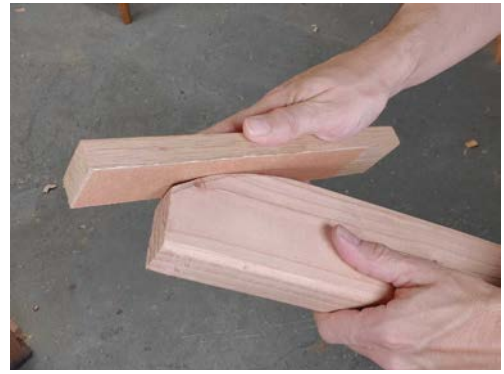
Luckily, you can make inexpensive shaping tools by gluing sandpaper to pieces of wood. You can make these sanding sticks any size or shape you need and pick whatever kind of paper you like. I prefer a couple of sticks about 2" (50 mm) wide and I keep a coarse and a fine one around. I like to fold the paper over the edge of one stick so that I have a narrow sanding surface. You can also glue your paper to a piece of old broom handle to make a curved sanding stick.

Most of my sanding sticks look like this. I usually fold the paper over one edge so that I have a wide and narrow surface to work with.

I use 3M Super-77 spray adhesive to make my sanding sticks. You only need a very light coat on the paper, and it will stick to the wood and be ready to use in a few minutes. You can replace

worn sticks by pouring some mineral spirits on the paper and peeling it off . . . or you can just throw your old sanding sticks away and make new ones.

Remember that spray adhesive and mineral spirits both produce hazardous fumes and are flammable. Use them outside or in a space with good ventilation.



This sanding stick will smooth out the rough surface my hatchet left on this curved piece of wood.

Once your sticks are done, you can use them for a bunch of shop tasks. Sanding sticks are especially good for taking a rough curve and making it smooth or rounding over a sharp edge. A curved sanding stick will fit into tight spots and shape tool handles to fit your hand exactly.

Chapter 15
Finding Wood

I get a lot of questions from new woodworkers, but the most common one is: "Where do I find wood for my projects?"

I can't give a simple answer because wood supply depends on where you live, your budget, what you can transport, and what you can store. Aside from all that, sourcing wood is a skill, just like all the other skills in this book. At first, finding wood for your projects will seem impossible and you won't know where to start. After a few years, you'll probably have a good stock of wood on hand and a whole list of sources. I've been doing serious woodwork for over a decade and I never worry about finding the wood I need. In time, you'll get to this point, too.

I can share some good techniques for finding wood no matter where you live, but first, let's figure out what we're looking for.

Hardwood vs. Softwood

Beginners get confused about the difference between hardwood and softwood. Here's the technical definition: **softwoods** come from **coniferous** trees. These trees are generally evergreen. They have needles instead of leaves. Common softwoods are pine, spruce, fir, and hemlock. **Hardwoods** come from **deciduous** trees.

A selection of common North American hardwoods. Top to bottom: walnut, maple, cherry, oak.

These are trees with broad leaves that usually fall off in the winter. Common hardwoods are oak, maple, ash, and walnut.

If these definitions sound weird to you, you're not alone. It's hard to understand what leaves and needles have to do with the hardness of wood.

Here's a better definition: softwoods are soft and hardwoods are hard.

Some softwoods are pretty dense, but even a common hardwood like maple is *a lot* harder than any softwood. In general, hardwoods are heavy, durable, expensive, and attractive. Softwoods are light and easy to dent, but also strong relative to their weight. Softwoods are generally cheap, and they're not often prized for their looks, although many species can be lovely.

These days, we associate softwoods with carpentry and construction because these timbers are inexpensive, lightweight, and able to support heavy loads. We usually associate hardwoods with furniture-building because these more expensive timbers resist denting, stand up to hard use, and often have attractive grain.

I made this little pine box for my daughter. Even though it's softwood, it looks nice and it's held up well.

As a new woodworker, you shouldn't get too hung up on hardwoods. People in North America and Europe have long made chests, tables, and chairs out of whatever softwood was available. Softwood furniture was less expensive and easier to produce, especially for people like farmers, who often made their own furniture. You would think that a table made of white pine wouldn't last very long, but we have many pieces of softwood furniture that have survived for hundreds of years.

Start your woodworking with softwoods. You'll make progress faster and spend less money while still making quality pieces that will last a long time.

Sources

If we're starting with softwoods, a good source is your local home center. These stores usually sell construction lumber in a variety of sizes. You can build many of the projects in this book from 2×4s.

Construction lumber comes in a variety of species, but it's usually marked, so you know what you're getting. My top choice in softwood lumber is southern yellow pine (SYP), which is surprisingly hard and durable. SYP isn't available everywhere, but another good choice is Douglas fir, which is also relatively hard and has an attractive pinkish color. You might see wood labeled "SPF," which stands for spruce/pine/fir. SPF can be any of these three species, but all three are useful. The only construction wood to avoid is "whitewood," a mystery softwood imported from Asia. Whitewood is shockingly soft, and it should be your last choice.

All these softwoods come as construction lumber. Top to bottom: Douglas fir, SPF (white pine), and southern yellow pine.

Most of the wood in the home center will be kiln-dried, which is important. Don't buy green (un-dried) wood or anything labeled **treated**. Treated woods have been soaked in chemicals that resist rot and are also toxic.

Home centers generally sell pine boards in a variety of sizes. These boards are typically ¾" (19 mm) thick and have crisp corners instead of the rounded-over edges of construction lumber. These boards are sold as generic material for home projects and they're great for making inexpensive furniture. Look ahead to Chapter 20 for a project made from inexpensive pine board.

Pine from a home center is never top-quality wood, but it's kiln-dried and usually planed flat and smooth. You can find good lumber in the stacks if you're willing to do a little digging. Look for pieces that are flat and straight (close one eye and look down the edge of a board to test it for straightness). Avoid wood with lots of knots or obvious pockets of sap. Sort through the stock to find the best wood for your project, and then carefully restack the lumber you didn't choose. Be courteous to the people who work at the home center. Their jobs are hard enough.

The Lumberyard/Hardwood Dealer

There are many businesses that specialize in high-quality woods. These operations usually stock a wide variety of kiln-dried woods, including imported exotic woods.

Good hardwood dealers will have the species you want in a variety of sizes and thicknesses. The downside is that these places are generally pricey and intimidating to the beginner. Finding,

cutting, and drying hardwood lumber is an expensive process and the finished product is always going to cost a lot.

> **Tip:** If you do have access to hardwoods, poplar is a great choice for the beginner. This inexpensive wood is relatively soft and easy to work. Poplar doesn't stain well, but you can paint it or just use a clear finish.

The first time you walk into a hardwood dealer, you might be surprised to see that there are no prices on any of the wood. Hardwood is sold by the **board foot**: 12 square inches of lumber 1" thick. (Metric-system countries use a similar system). Hardwood dealers charge a **price per board foot**. When you pick a piece of wood to buy, an employee will measure it and calculate the number of board feet it contains and then multiply that by the price per board foot. These prices fluctuate frequently, and you have to ask for a price sheet when you arrive. With a little practice, you'll be able to measure your own wood and calculate the board feet so that you know how much money you're spending before you check out. If this all sounds like a lot of work, don't worry. You can do all the projects in this book without ever setting foot in a hardwood dealer. Those stores will be waiting for you when you're a little more experienced.

Reclaimed Wood

"Reclaimed" is a trendy word for "pulled out of the trash." As the world's old-growth forests have been depleted, governments have moved in to protect our remaining big trees. The result of this necessary conservation is that good wood is scarcer and more expensive than it was half a century ago. But the beautiful timber of the past hasn't disappeared; it was used in buildings that still exist. Many of these buildings are old and being demolished and the wood that comes out of these structures is simply amazing.

I made this vase from a chunk of the wood it's sitting on. This is ipe, which is now sold as an exotic. This piece was being used as a support beam in a salt mine.

I live in Cleveland, Ohio, an old industrial city filled with crumbling factories. Many of

these structures were built when old-growth hardwoods and imported exotics were cheap and plentiful. The old factories in my town often have white oak floors 3" thick and support beams made from imported Ipe (a Central American wood that's one of the hardest in the world). As these old buildings are torn down, some of the wood goes to specialty dealers who process it and resell it to furniture builders like me. But some of this wood just goes in the dumpster, where anyone can pull it out.

Be aware that wood from demolition can contain bugs, nails, chemicals and other nasty surprises. Always use caution when moving, storing, and working with these woods. But, for the adventurous craftsperson these reclaimed timbers can be a goldmine.

While we're on the subject of dumpsters, don't forget about new construction sites. Many houses and other buildings are still framed with solid wood and carpenters throw away some surprisingly big chunks of construction-grade softwood. Always ask before you take something, but I've never met a carpenter who minded if I took some of his trash.

If you have any large cabinet or furniture shops in your area, have a look at what they're throwing out. Large-scale production uses a massive amount of wood and the pieces they call "scrap" can be perfect for the hobby woodworker. I've made entire pieces of furniture from dumpster-wood.

These thick chunks of maple and walnut came from a dumpster. To the shop that threw them out, they're trash. To the home woodworker, they're valuable wood.

You can also call or visit cabinet shops and ask if they have any scrap they'd like to sell. Some places do sell their scrap wood; others just give it away. Many big shops regret throwing away good pieces of quality hardwood, but they don't have room to store it once a job is over. Many of these people are happy to see their leftovers get used by an enthusiastic woodworker. Take a little time to develop relationships with local professionals. Bring them a six-pack or a plate of cookies when you go to visit. Little touches like this make you more likely to get good wood for free. Some places will even call you when they have especially good scraps that they don't want to throw out.

Another source of good hardwoods is old furniture. I always take a quick look at whatever my neighbors are throwing away. A lot of modern furniture is made from particle board and plywood, materials that aren't very useful to hand-tool woodworkers, but older pieces might be made entirely from solid hardwoods. Legs from desks and tables are often thick and straight. Tabletops can yield many feet of good boards. It's hard to find pieces of thin wood for smaller projects, but the sides of old drawers are often made of thin stock that you can't find at the lumberyard.

Old bedrails can be a great source of wood. In this picture, the top piece is yellow pine and the bottom one is maple.

It's also become very popular to salvage hardwood from shipping pallets, but I've never had great luck with this source. Pallets are often made of quality hardwoods, but the pieces are generally small and filled with nails. I've disassembled a few pallets for the wood, but I always find that it's more effort (and splinters) than it's worth. But, if pallets are the only source you have, then you can make it work. Lots of woodworkers have.

When you're salvaging wood, be cautious and use your judgment. If something is wet, heavily stained, or smells weird, don't take it home. Be on the lookout for insect holes. Sometimes, things get thrown away for a very good reason, and you don't want to bring someone else's problem home with you.

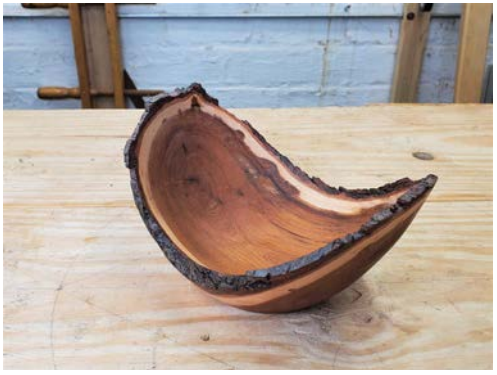
Green Wood

Fresh logs can be a great source of wood, especially for small projects like the butter knife in Chapter 5. Some hobby woodworkers even saw their own trees into boards and do their own drying, but that's always seemed like a lot of work to me.

The advantage of green wood is that it's soft and easy to shape. Lots of green wood projects can be finished fast and given as gifts. Green wood is also usually free. You just need to know where to look for it.

Many times, you can find fresh logs stacked by the side of the road, free for the taking. It's also useful to get to know your local firewood dealer or people who cut trees for the local utilities. Sometimes it costs a few dollars to get a nice log from one of these sources, but it's often worth a little bit of money to work with fresh, local wood.

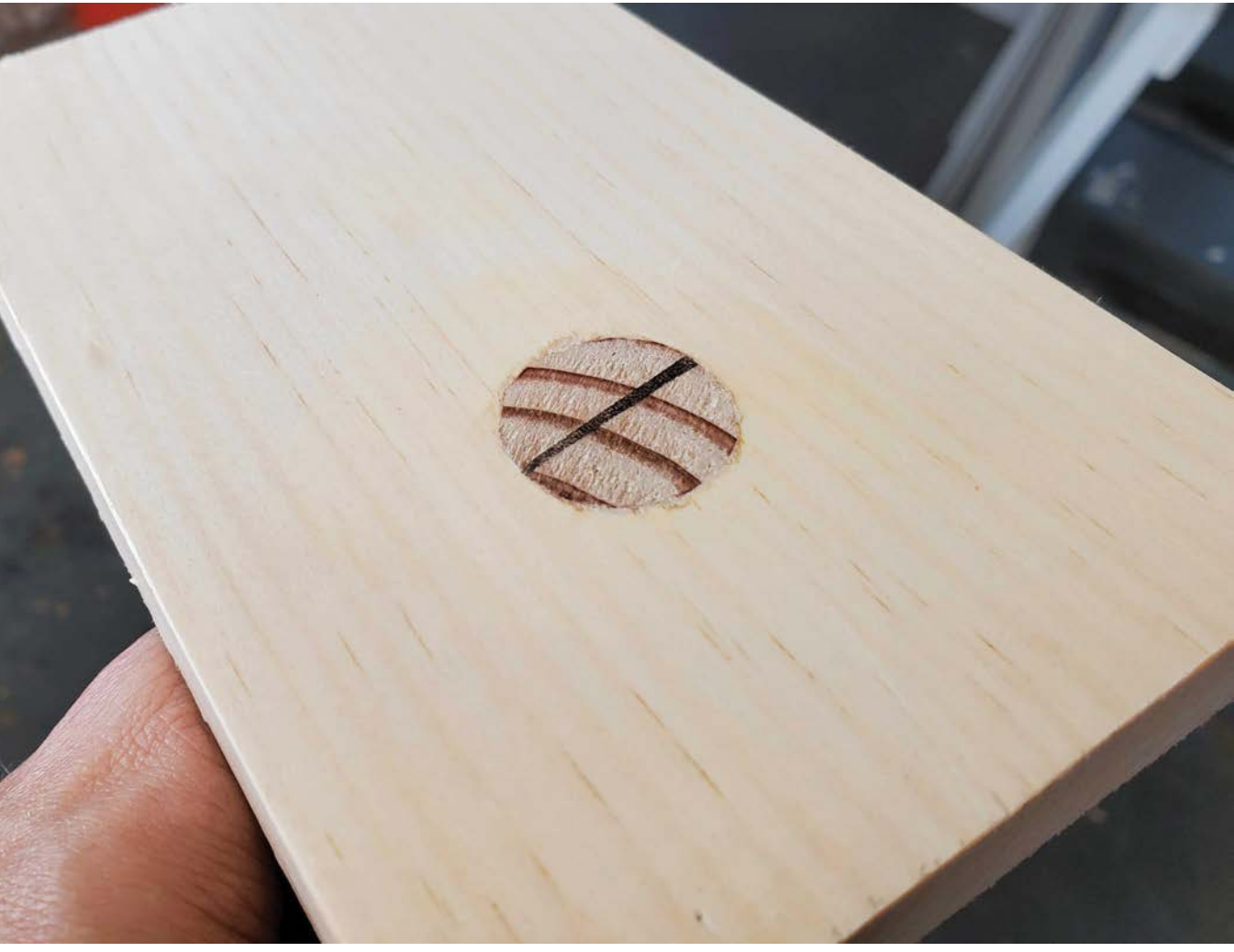
My favorite source of green wood is arborists, or professional tree-trimmers. Not only do they have access to lots of free logs, they really know their wood. My local firewood dealer is happy to sell me a few chunks of wood, but he rarely knows what anything is. A professional arborist knows every species in the area. If you tell an arborist you need Silver Birch for a special project, he or she will know exactly where to find it.



I made this cherry bowl from a green log. If you'd like to learn more about making this kind of work, check out my book One Week to Woodturning.

Green wood is only useful for some projects, but it's fun and satisfying to make something straight from the tree.

Now you should have a good idea where to look for wood. Let's build something.



Chapter 16
Your First Joint

Materials:

- Softwood lumber (2×4 or similar, plus a scrap of thinner board)
- Hardwood scraps

Tools:

- Brace or drill
- 1" (25mm) drill bit
- Pencil
- Square
- Ryoba
- Hatchet
- Knife

Open any woodworking magazine and look for "joinery" and you'll see pictures of fancy and complicated joints like the dovetail and the pinned bridle joint. Looking at these perfectly interlocked pieces of wood can leave a beginner intimidated.

Don't worry. These fancy joints are advanced work and some of them are made for looks more than strength. You can build strong, durable furniture with simple techniques.

Here's what you need to know: A joint makes two pieces of wood lock together. Some woodwork uses glue or screws to connect parts, but glue can fail, and fasteners will loosen over time. A good joint can stay together even with *no* glue (although we'll throw some glue in, too).

A joint is just one piece of wood that fits *inside* another piece. You make an opening in one piece and then fit another piece into it. That's all.

What's the easiest opening you can make? A hole.

Our first joint will start with a hole drilled in a piece of wood. Call it a **mortise** if you want to get fancy. Then we'll shape another piece into a cylinder that slides into that mortise. Our cylinder is called a **tenon**. If we just added glue to this mortise and tenon, we would have a pretty good joint, but we're going to make it even better by splitting our tenon and driving in a wedge. The wedge forces the tenon into the sides of the mortise and locks everything together.

This style of joinery is sometimes called **staked** or **socketed** construction. It's centuries old and it has been holding furniture together since the Romans. Once you know about it, you'll see this style everywhere.

We find this style most often on chairs and other seats. But we can also use this joint to keep a handle on a mallet, the legs on a workbench, or hold together a wooden toolbox.

Fancy joints like these make woodwork seem impossible, but there are plenty of simple joints that are strong and useful.

This milking stool uses the round mortise and tenon. I made it years ago, and it still gets used every day.

Before we build a project, lets practice this joint. Sharpen your hatchet and put a 1" (25 mm) bit in your brace.

Let's imagine we're making a seat for a chair or a stool. You'll need a board for the seat. Something around an inch thick will do fine. You can use pine or some other inexpensive construction wood. Drill a hole through your board and practice stopping as soon as the snail or spur comes out the far side. Flip the board over, stick the snail into the hole and slowly finish your hole. You want clean edges on both sides.


I drilled this hole from both sides, but I also clamped a piece of scrap underneath during drilling. The scrap supports the fibers to minimize damage if you break through by accident.

Next, you'll need a stick of wood for the "leg." One easy way to get good leg stock is to rip a piece of 2×4 in half. Practice with a short length: 18" is good.

Tip: Always use a harder wood for your legs since they're under the most stress. If you have spruce and southern yellow pine, put the softer spruce into the seat and use the tougher pine for the legs.

Now we're going to lay out our tenon and get ready to cut it. Measure down about 2" (52 mm) from one end of your leg and use your square to carry a line all the way around. Next, saw down the corners around your line. And then connect the corners with shallow cuts across the four faces of the leg. Don't cut too deep. You're just severing the fibers so they don't split in the next step.

Clamp your stock to a leg of your chopping block so that you have easy access to the end. Draw an X by connecting the corners and you'll have the center. Put the snail of your drill bit into the center and drill slowly until the lips of your bit just nick the surface and leave a clean circle. This mark gives you the exact size of your bit so we can make a tenon that fits. We're going to start the tenon with our hatchet.

First, knock off the corners. Place the edge of your hatchet on a corner a little bit away from your circle and whack the back of the head with a scrap of wood. A little piece of wood will pop off. The split should stop at the corner where you sawed. If it doesn't, stop and saw those cuts

*I've drawn a **shoulder line** on the end of my leg and now I'm sawing that line all around the leg. This creates a stop-cut like we used in Chapter 5.*

You can screw-clamp the leg to your chopping block and have free access to the end. Once you've found the center of your stock, drill down to score a circle in the end.

a little deeper. Once you've knocked off all the corners, you'll have an octagon with 8 corners. Knock off those corners and your tenon will be roughly round.

We'll finish with a technique I call **pop and pare**. Find a spot where you want to remove wood, set your hatchet's edge and give the back a little *pop* with the heel of your hand. You're being gentle this time to take off a small piece of waste. When you're very close to your line, it's time to pare. Use the edge of your hatchet to take a light slicing cut down to your saw line. When most of the waste is removed, switch to your knife.

When your tenon is close to size, you'll want to test it in the mortise. Don't use the hole we just drilled. Pushing the tenon in and out will only distort the hole and make a loose fit. Instead, drill a test hole in a little scrap of wood. Hardwood or plywood work well for this test piece because they can take a lot of friction without changing shape. Your tenon will probably be a tight fit in your test hole, so rotate the piece back and forth as you work it down to the shoulder. When you pull the test piece off and look closely at your tenon, you'll see some shiny spots where the wood fibers got crushed or *burnished*. These are the high spots. Carefully trim these away with light, controlled strokes.

You can use your hatchet to split most of the waste off your tenon. A piece of 2×4 makes a good mallet. Notice how the stop-cuts keep the splits from traveling too far down the leg.

Drill a hole in a scrap of hardwood and use it to test your tenon. At first, the tenon won't fit at all. Trim a little with your knife and try again. Once your test board slides on a little bit, you'll be able to see crushed, shiny fibers and a little ridge where the test-board stopped. These signs will tell you where to trim.

Your test piece might not go all the way to the shoulder on the first try. The burnished spots will tell you where to trim. Once the test piece slides on with a snug fit, your tenon is done. Don't worry if you have to twist it a bit; a tight fit makes a strong joint.

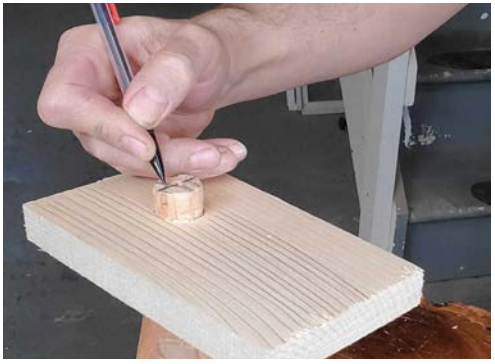
Trim carefully with your knife, taking very thin shavings. At this stage, little changes make a big difference. After several rounds of trimming and fitting, your test-board should slide all the way to the shoulder.

Now you can insert the tenon in your real mortise. It should fit snugly. You might even need to tap the end of your leg with your hatchet to get it seated. If the joint is very loose, stop and cut a new tenon. We're practicing, so let's get it right.

Our joint is now fitted, but that square shoulder beneath the tenon is a problem. If we use this joint to make a stool or a chair, the weight of someone sitting on the seat will drive the tenon into the mortise until it sits on that shoulder. Further pressure might loosen the joint. To finish our leg, we'll chop that shoulder away and make a smooth taper beneath our tenon. As pressure is applied to our seat and the tenon is forced deeper into the mortise, the taper will enter our mortise and tighten the fit. As people sit on the seat over the years, the joints will only tighten as those tapers are pushed deeper into the mortises. Making the taper is easy. Chop most of the waste away with the hatchet and then smooth the surface with the knife. There are no measurements here; just use your eye and your judgment.

The hatchet and the knife will quickly turn your shoulder into a taper. A little sandpaper helps smooth the transition between the taper and the tenon.

With the tenon in the mortise, look at the grain of your board. In the picture, I've drawn in the grain lines with a pencil to make them easier to see. Go to the top of your tenon and mark a line *perpendicular* to the grain of the board. This detail matters a lot. We're going to saw down this line and drive a wedge into the tenon. If the wedge is *parallel* to the fibers of the board, then the wedge will split the board and ruin the project.



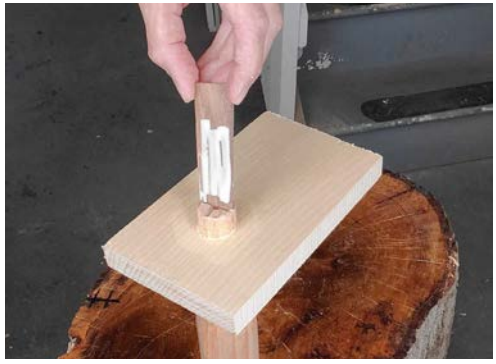
Mark your tenon perpendicular to the grain of your seat-board and then saw down that line.

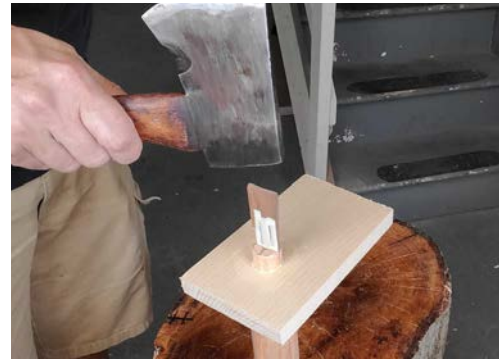
Pull the tenon out of the mortise and saw down the line we just marked with your Ryoba saw. Start with the fine crosscut teeth and then switch to the aggressive rip teeth to finish. This slit might be too tight to get the wedge into, so I often slide a piece of sandpaper into the cut and widen it slightly.

I sawed this wedge from a scrap of walnut. It tapers to a featheredge and is much longer than I need. I'll be able to drive this wedge deeply into the joint.

Next, make a wedge from hardwood. You just need a tiny piece, so you can often salvage wedges from junk furniture. Start with a piece of wood 1" thick (the same width as your tenon). Put your saw about ⅛" (3 mm) from the edge and saw down at a slight outward angle. As the cut deepens, use your left hand to press the wedge in toward the saw and keep it from splintering. At the bottom of the cut, your saw will break through, and you'll be left holding a little wedge of wood. Your wedge might be a bit ragged, so smooth it out with a sanding stick. It might take a few tries to get a good wedge. Keep at it; it's not difficult.

Now we'll assemble our test joint. Brush wood glue all around your tenon and inside your mortise. Fit them together and rotate the slit in your tenon so that it's perpendicular to the grain of the board. Now brush a little bit of glue onto your wedge, slide the edge into the tenon, and





I put glue around my tenon before inserting it in the mortise. Now, I've got glue on my wedge and I'm inserting it into the slit and tapping it home with the back of my hatchet.

carefully tap it home with the back of your hatchet. As the wedge penetrates the joint and gets tighter, you can hit it harder. Sometimes, my wedges break at the very end. This is no problem. The part inside the joint is all that matters.

Give your joint an hour to dry and saw the tenon flush with your Ryoba's fine teeth. The final joint should feel rock solid, like the two pieces of wood are now a single piece.

Your Ryoba makes a great flush-cut saw and you can follow up with a sanding block to make your joint really smooth. Once it's done, this joint can be surprisingly attractive.

Troubleshooting

Of course, this is your first joint, and everything might not be perfect. Here's a quick guide to troubleshooting this joint:

Problem: The joint is loose and wiggles or twists even after the glue is dry.

Solution: The fit between the mortise and tenon wasn't tight enough. You probably trimmed the tenon too much or tested it in the mortise too many times. Cut the joint again and aim for a tighter fit. Your wedge also might be too thin. Try cutting a thicker wedge for the next one.

Problem: The joint is tight, but there are gaps visible between the edge of the tenon and the mortise.

Solution: Your tenon isn't round enough. As you trim the next tenon, concentrate on taking smaller shavings and working your way all around the tenon.

Problem: The wedge went all the way in, but the joint still isn't tight.

Solution: Your wedge needs to be thicker. Cut a few new ones and aim for a wedge that's fatter on the thick end. Your wedge should stick out when it's driven home. When you're driving the wedge, you want it to stop because it's very tight in the joint, not because it's hitting the bottom of the slit. It can take a few tries to get the wedge angle just right.

Problem: The wedge won't go into the tenon, or it bounces out when I hit it.

Solution: Your wedge is too fat or doesn't taper to a fine enough edge. Cut a few thinner wedges and tune up their shape with a sanding stick. Your wedge should taper to a featheredge at the thin end. You also might need to widen the slit in your tenon a bit. Fold a piece of sandpaper in half and slide it in and out of the slit a few times. You just want the slit a little wider, especially at the top where you'll be inserting the wedge.

You might have to practice this joint a few times before you master it. It's worth the effort. Once you've got it down, you'll be able to cut this joint fast and use it on a lot of projects.

Chapter 17
The Mallet

Materials:

- Chunks of firewood

Tools:

- Ryoba
- Chopping Block
- Bar Clamp
- Drill
- Hatchet
- Knife
- Pencil
- Tape
- Glue

Woodworkers need to hit things. A metal carpenter's hammer is fine for pounding nails, but it will mash up your tool handles and dent your wood. You could use a rubber mallet from the hardware store, but that bouncy head will waste most of the energy from each strike. Believe it or not, an old-fashioned wooden mallet is the best tool for hitting things.

I keep hammers and rubber mallets around the shop, but I reach for a wooden mallet the most.

Finding wood

To make this mallet, I pulled everything I need out of the firewood pile. I picked a chunky log of Osage orange, a super-tough hardwood that's also used for making archery bows. You can use anything that feels heavy, hard, and mostly dry. Don't use a whole, or round section of log. Remember that any piece of wood containing the central pith is guaranteed to split. Use a *section* of the round. Split firewood is a perfect source for this material.

For my handle, I found a stick of Black Cyprus in the kindling bin. This is a springy hardwood that will absorb shock and reduce the strain on my hand. Other good handle woods include oak, ash, and hickory, but any tough hardwood will get the job done.

My stock is just pieces of firewood. In the second picture, you can see the end of the log that will make the head. Notice that this piece is just a section of a larger round log. My piece doesn't contain the pith and is unlikely to split as it dries.

Shaping

You can see from the pictures that my log is already pretty square, and that's going to save me a lot of effort. I'll start by chopping away all the wood I don't need. This log is short, and that makes chopping more dangerous. Remember that you should never hold the top of your log and then also chop at the top. In the pictures, you can see that I'm not holding the log as I chop

To trim the stock for the head, I'm putting the edge of my hatchet where I want a split and hitting the back with another piece of firewood. This approach gives me both control and power, and the log is quickly trimmed.

away that ragged corner. I placed the edge of my hatchet where I wanted to remove waste and then gave the back of the hatchet a few taps with another small log. This is a controlled method of waste removal that keeps both of my hands safe. Once my split is started, I can pick up both the hatchet and the log and bring them *both* down on the block to continue the split. Another good technique is to hold the log on the top, begin chopping halfway down one side, and then flip the log over and chop away the other half of the waste. This way, you're always striking far away from the hand holding the wood. My log is also a little bit too thick, so I'm splitting off a slice from one side. I've chosen a pretty straight-grained piece, so the split is clean and straight.

Once my blank is squared up, I'm going to carefully pare away all the dirty, dry wood on the outside. This step is partially for looks, but it will also reveal any rotten wood or insect holes that could make my mallet fall apart. Take light strokes with the hatchet and keep the blade parallel to the wood. You're trying to peel off a thin layer and create a smooth surface. Of course, we're just making a tool here, so don't worry if things end up a bit rough.

To trim off the ugly surface of my log, I'm gently chopping down half of one side and then flipping the log over and chopping off the rest. Note that my other hand is holding the log by the top of the far side and my fingers are never close to the cut.

My log is too long for a mallet head, but I left the extra length to make it safer to chop. Now that I've turned my log into a square billet of wood, I'm going to saw it down. Five to seven inches long (13–18 cm) is plenty for a mallet. The delicate teeth on my Ryoba won't handle such a thick slab of wood, so I use my big crosscut saw. I also use my chopping block with its built-in clamp to hold the work while I make the cut. As I remove the waste, I'm cutting at a slight angle. The faces of my mallet can be perfectly square, but if they angle *out* a little bit at the top, then I won't have to extend my wrist as far when I swing the tool. You can just eyeball an angle of a few degrees. Once I've taken off the bulk of the waste, I make another slightly angled cut on the other face.

I can use my chopping block with the clamp to hold my log while I saw it to length. In the finished piece, you can see the slight angle on the end. Both the striking faces should be angled this way.

Now the head is mostly done and just needs a little detail work. I use the hatchet to take off all the sharp corners along the sides of the head, and then I use a sanding stick to round over the edges of the striking faces, especially on the top. A sharp edge might splinter when struck, but a curved edge is durable. Finally, I sand the whole thing using 100 grit. The completed head should feel smooth and comfortable in the hand. Your tools should not give you splinters.

I'm not going to leave any sharp edges on my mallet head. I'll use the hatchet to trim the edges and then a sanding stick around the faces. The final tool needs to be comfortable and resist splintering.

With the head complete, we can prepare the handle. My stock is too long, so I cut it down to about 14" (35 cm). My final handle will be even shorter, but it's always good to leave your stock big while you're working with it. My Ryoba is perfect for this smaller crosscut, and you can see that I've set up my chopping block with the clamp and a peg to hold the wood down and resist the pulling action of the saw. This setup is great for small crosscuts that would be awkward on the sawhorses. The handle stock is also too thick, but this is a piece of split wood with straight grain, so I know I can split off a bit of thickness without ruining the piece. I just stand my handle up on the chopping block, place my hatchet where I want to split, and use my mallet head to drive it down. If you're using a piece of sawn board or you don't trust the grain, just clamp the handle to the leg of your block and rip it to thickness with the Ryoba. My handle is about ¾" (19 mm) thick and 1⅜" (35 mm) wide, but it just needs to be comfortable in your hand. The exact measurements don't matter.

My chopping block is a good surface for small cuts like sawing away extra length. My handle is also too thick, so I split it to width using my mallet head to drive the hatchet. Even without a handle, my mallet is already useful.

When your handle stock is trimmed to size, use your knife to slice off all the corners and work the wood into a rounded and comfortable shape. Just like the hatchet, you don't want your knife too close to the hand holding the work, so work from the halfway point down, and then flip the wood to finish the cut. Take the longest shavings you can. This will give you a smooth surface. Once you've whittled the handle to shape, wrap a piece of sandpaper around it and sand everything smooth. Take extra time getting the shape of the handle right. Sharp edges cause blisters.

My knife quickly takes the corners off my handle. Because this is split wood, the grain runs the whole length of the piece and I can easily take long shavings.

Joinery

The toughest part of most mallets is fitting the handle to the head. Traditional mallets have the handle extending all the way through the head. This construction gives the tool strength and durability, but it's challenging to make. Instead of cutting all the way through our head to install the handle, we'll use the joint we just learned. It's easy to install and very strong.

First, use a straightedge to connect the corners on the bottom of your mallet. This will give you a rough center point. Now clamp the head to your chopping block and drill a hole with a 1" (25 mm) bit. Keep the bit straight up and down as you bore and go at least 1½" (38 mm) deep.

To make the joint that holds everything together, you'll need to know the depth of that hole. In the pictures, I'm using a coffee-stirrer and a black marker to make a little depth-gauge.

Both of these traditional mallets have handles that extend all the way through the head. While this construction is very sturdy, it's also difficult to make.

Now we're going to use our round mortise and tenon to join the head and the handle. Clamp the handle to the leg of your chopping block and carve the round tenon we learned in the last chapter. Use your depth-gauge to find the length of the tenon; you want it to be *shorter* than the depth of the mortise by about ¼" (6 mm). Test the fit in your mortise. Compared to a furniture joint, you want this one to be a *tiny* bit easier to slide in. The joint should still be snug, but it should go in with light pressure.

After I drill a hole in the bottom of my mallet, I can clamp the handle-stock to the chopping block and carve the tenon on the end.

Use your Ryoba to slit the tenon. Your slit should be *perpendicular* to the head of your mallet; if you make it parallel to the sides of the head, you might split the head right in half.

Cut a hardwood wedge. I'm using a scrap of walnut board, but you can also find good wedge material right in your firewood pile. Give your wedge a nice gradual taper and make sure it's a little bit *shorter* than your tenon.

Any stick of wood will make a depth gauge for finding the length of your tenon and your wedge. Both of these must be ***less*** *than the depth of your mortise.*

Assembly

Here's how to assemble: Put glue around the tenon and on the wedge. Insert the wedge into the tenon and stick the whole thing into the mallet head. Grip the mallet head and start tapping the handle straight down against your chopping block. The tenon will slide in easily until the wedge bottoms out in the mortise. Then, as you drive the handle further into the head, the wedge will be driven further into the tenon, where it will force the sides of the tenon apart and tighten the joint. As you tap the handle into the head, you should feel resistance increasing, and it should be hard to get the handle all the way seated. If you get it right, the handle will feel rock solid right away and you'll be able to use it even before the glue dries. If the handle feels even a tiny bit loose, don't let the glue set. Pull it out immediately, clean the glue off with a wet rag, cut a fatter wedge, and try it again. I've made this style of mallet many times and sometimes you don't get it right on the first try. No problem. It's easy to try again.

Before I assemble the mallet, I coat all the surfaces with glue and insert my wedge. Then I put the handle in the head, make sure it's turned the right way, and start taping it against my block. As I drive the handle in, it tightens.

When I made the mallet for this chapter, I made the tenon fit too tightly, and I cut the wedge a little too thick. When I went to install the handle, I had to hit it really hard, and I ended up snapping the tenon right off. It was frustrating, but I just drilled the broken tenon out of the mortise and cut a new tenon on the end of my handle. This is why we left the handle long; mistakes aren't a big deal if you have extra stock. The second time, I trimmed the tenon for a slightly easier fit and made the wedge a bit slimmer. This time, the handle seated in the head with three or four solid taps against the block and once it was in, I couldn't move or twist the handle no matter how hard I tried.

There's one more detail to understand about this project. My mallet head was still a little bit wet in the middle; most logs are. On the other hand, my handle stock was thin and completely dry. You might think this difference in water content is a problem, but it will help this project stay together. When I knock the dry handle into the moist head, they will trade a little bit of water. As the head dries, my handle hole will shrink, further locking the tenon in place. My tenon might also swell a little bit, making it tighter. Woodworkers have been exploiting these moisture differences for centuries. A traditional chairmaker will drive bone-dry rungs into a slightly wet leg. As the legs dry out, they clamp down on the rungs, allowing the chair to stay solid for decades.

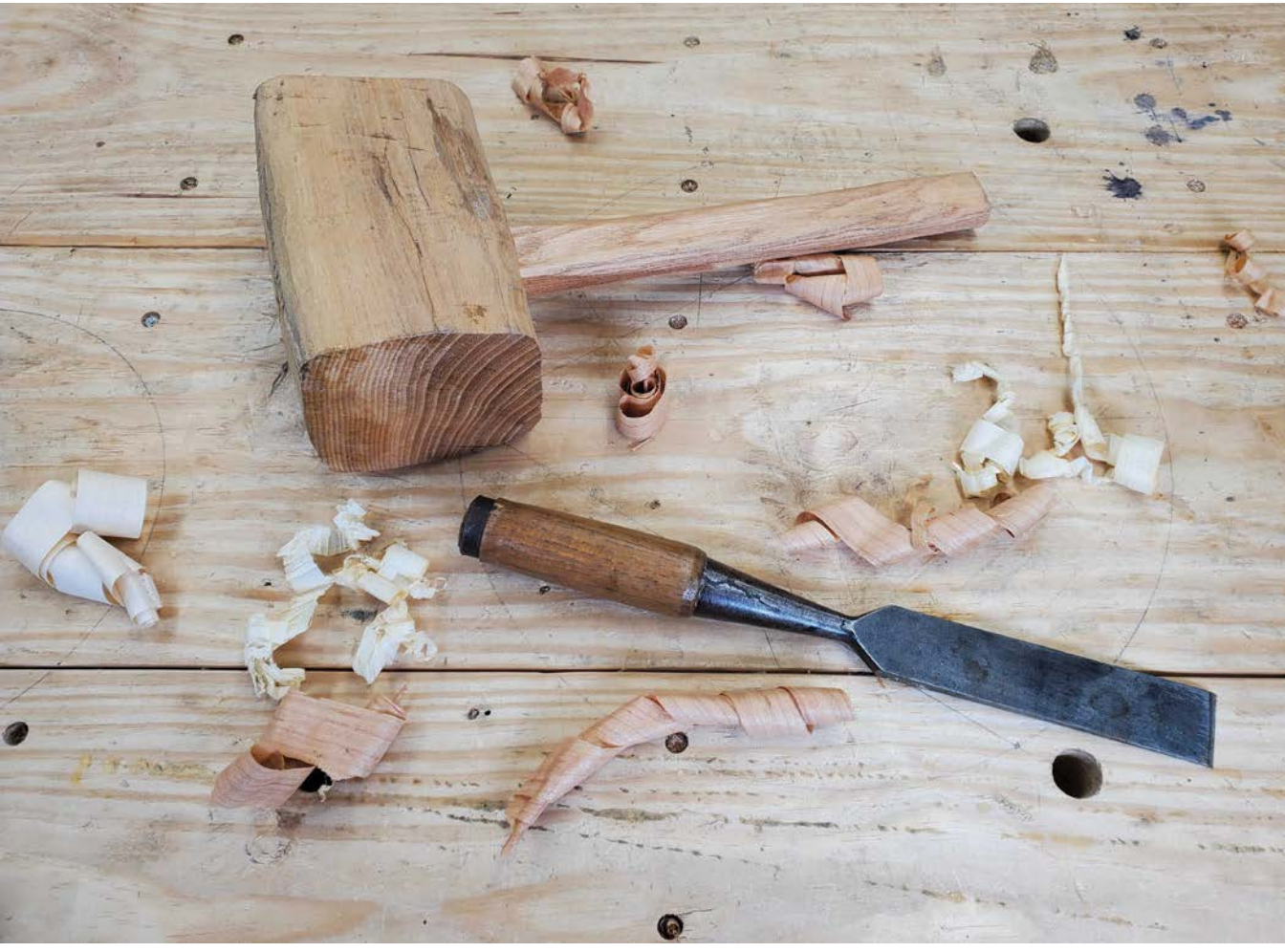
Tip: Leave your handle long until you've used the mallet for a little while and gotten a feel for where you like to grip it. You can always trim it shorter.

When you finish this project, you'll have a solid mallet for woodworking. A mallet allows you much greater control when you use your hatchet. Now, you can place your hatchet right where you want a split and then hit it with your mallet. You'll deliver a lot of force with precision and it won't damage the hatchet head at all. A mallet is also perfect for driving legs into chairs or seating stubborn joints. Light taps with a heavy mallet will get things moving without damaging the wood or your furniture.


A hatchet plus a mallet gives you both power and control for splitting. Instead of swinging the hatchet, you can place it anywhere on the work and then tap it with the mallet.

Eventually, you will probably want to own more than one mallet. The one we've made in this chapter is what I call a "general whacking mallet." It's good for hitting things hard and I don't expect it to last forever. I keep a smaller and lighter mallet for tapping chisel handles and doing delicate work. My smaller mallets last for years because I let the big ones take the abuse. The good news is that you can now make as many mallets as you want. Once you've mastered this simple joint, you can cut the head and handle to any shape or size you like, and this style of mallet can be made in a few hours.

Make a few in different sizes and see what you like!



Chapter 18
The Milking Stool

Materials:

- 2×12 SPF lumber
- Hardwood scraps

Tools:

- Ryoba
- Square
- Sawhorses
- Drill/brace
- Knife
- Mallet
- Awl
- String
- Sanding stick
- Pencil

Congratulations! You now have the tools and skills to build a real piece of furniture. In this chapter, we'll make the classic milking stool that's been used on farms for centuries. This short, lightweight seat can be quickly taken from cow to cow during milking and its tripod legs will sit steady on uneven ground. These stools often moved from the barn into the house where they gave convenient seating near the kitchen fire. Make this stool and it will quickly find a home in your house.

Materials

Farmers made milking stools from whatever wood was laying around. We'll continue that tradition by using cheap construction lumber from the big-box store. I grabbed a 2×12 piece of SPF from the home center. You might remember from Chapter 15 that SPF means "spruce/pine/fir" and can be any of the three woods. My wood happens to be spruce, which dents easily but is strong and light. It's a good choice.

Get a few tools and find a shady corner of the yard and you're ready to get started.

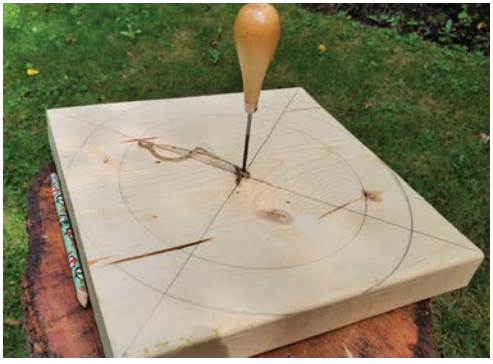
Gather your sawhorses, chopping block, and bucket of tools and pick a comfortable spot to work. This project will probably take you most of the day. I found a shady corner of my backyard and used my sawhorses to cut a square piece from a construction-grade 2×12. If you don't have access to construction wood, you just need a piece of board around 11" square (28 cm) and 1½" (38 mm) thick. Almost any species will do, but softwoods are light and easy to work with.

My seat comes from this SPF 2×12, but any solid wood will do the job. Your low sawhorses can easily support this big board for crosscutting. Use a straight scrap of wood to connect the corners of the square and you'll have the center.

Layout

This project requires a lot of layout, so be sure you're starting with a square piece of wood. Saw it carefully so that you have straight edges and 90° corners. Pick the worst-looking side of your board to be the bottom and do all your layout on that side. Begin by connecting the corners with a straightedge to find the center of the board. Mark it deeply with your awl. All your layout depends on the center point, so don't lose it.

First, lay out the round seat. Most woodworkers use a compass to draw circles, but we don't need one. Tie a loop in the end of a piece of string and tack it to the center of your board with the awl. Make another loop that just reaches the edge of the board and tie a tight knot. Stick a pencil through your outer loop and pull the string taut as you draw a circle around your center point. This line will give us the edge of our stool.



Your awl combined with a pencil and a piece of string makes an effective compass. Draw one circle as big as your board will allow and then another smaller circle to lay out the location of the legs.

Next, we need to find the locations for the legs. They can't be right at the edge of our seat because each leg tenon needs to be surrounded by wood. Shorten your string by about 1¾" (44 mm) and trace another circle inside your first one.

With these two circles drawn, we can cut off most of the waste from our seat. Make four saw cuts across the corners of your board to turn it into an octagon, then cut off each of those eight corners so that you have something roughly circular. Now you can use your carving knife to take off any remaining high spots and slowly work down to your line. Carving the rim of the

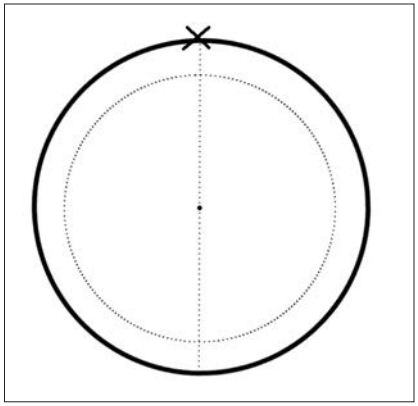
By making a series of straight cuts around the edge of your board, you can transform a square into something roughly round.

seat gives you a great opportunity to learn about how a blade interacts with wood. The long grain will slice smoothly and leave a nice surface. The end grain will be tough and ragged. If you cut against the grain, you might take off too much wood or splinter the surface. If you find your cut going wrong, try flipping the plank around and cutting from the other direction. To make an even smoother circle, use your sanding stick to work the edge, evening out the curve and taking out tool marks as you go.

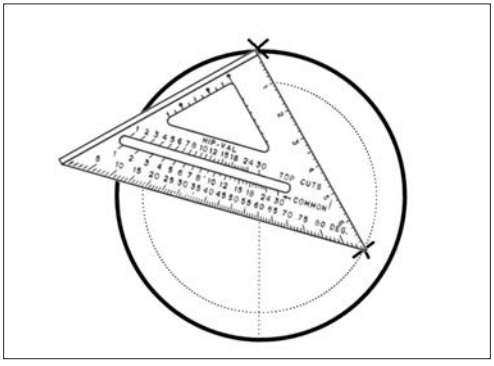
Your knife can smooth out your saw cuts. Follow up with a sanding stick to get the final shape of your seat. It doesn't need to be perfectly round. This is farm furniture, after all.

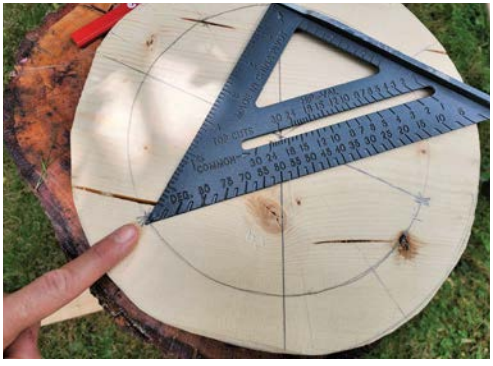
Now, we'll finish the layout. We need to divide our inner circle into three equal segments so that our legs will be evenly spaced. We can use our speed square for this job. First, erase one of the straight lines that you drew across the board so that you have one straight line dividing your circles in half. Make a heavy mark where that line crosses your inner circle. That point will be leg location. We just need to find the other two.

Place the corner of your speed square against your first leg location and pivot the square until it reads 60° against the center line. Make a mark where the point of your square crosses the circle. This is your second leg location. Flip the speed square over and do the same thing in the other direction to find your third leg location.



After you erase one line from your layout, your seat should look like this. Where your line crosses the inner circle is the location of your first leg. Mark it so you can see it easily.





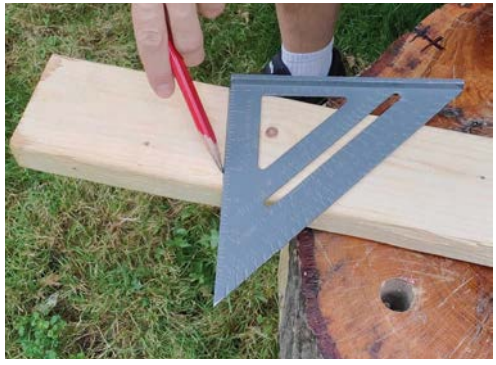
When your speed square reads 60° off your centerline, it will be pointing to your second leg location. Flip it over and repeat to find the third leg location.

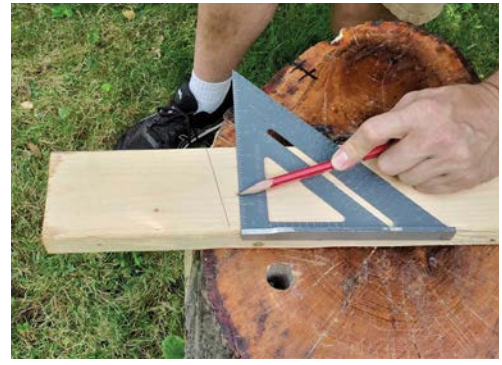
Now, take a straightedge and run a line from each leg location through the center of your circle. You'll know your layout is correct if your circle looks like a pie divided into six equal slices.

If you get confused about any part of the layout, you can watch a complete video of this stool being built at woodworkforhumans.com.

Your final layout should look like this. The (*) marks show where I'll drill for my legs.

We want our legs installed at a slight angle, so we're going to make a little angle guide out of scrap wood. Put your speed square against the edge of a piece of 2×4 and pivot it outward until the protractor reads 12° against the edge. Strike a line with your pencil. Now you have a line 12° off perpendicular, which is a perfect angle for our milking stool legs. Carry this line around the 2×4 with your square and carefully cut it with your Ryoba. Now you have an angle guide that will help you control your drilling.





You can use your speed square to easily lay out an angled line. Cut along this line and you have a 15° angle guide.

Installing the Legs

Clamp your seat to the chopping block and put a 1" (25 mm) bit in your drill. Mark the three leg locations with your awl to help your drill bit start. The three lines we drew across the bottom

of our seat are called **sight lines**, and you need to sight along them as you drill. Set up your seat so that one of the lines is pointing straight away from you. Put your drill on a leg location mark and start drilling straight up and down so that the nickers of your bit can slice the wood evenly and get a good start. Then put a couple loops of tape (or anything else sticky) on the bottom of your angle guide and lay it along your sight line. Your angle guide doesn't need to touch your drill bit; it's just a visual reference. Now, start drilling again, but to tilt the bit so it's in line with your guide and lined up with your slight line. This all sounds complicated when you read it, but it's easy when you do it. Start your drill and then bring in the guide to give you the angle.

Begin drilling along your sight line with your drill held straight up and down. When the hole is started, add your guide block to give you the correct angle.

Drill slowly through your seat and keep checking the far side with your fingers so you know when the snail pokes through. Remember to stop drilling, flip your seat over, and finish the hole from the top side so that you get clean edges and no breakout. As you begin the next hole, be sure to re-clamp the seat with your next sight line pointing straight away from you. Keep the underside of the seat open so that you can check for the snail as it pokes through. Drilling these holes correctly is important. Do it slowly.

If the drilling goes well, the seat is mostly done, and you can spend some time detailing it. Use your knife to bevel the top and bottom edges of the seat. Hold your knife at 45° and work all the way around the rim. Think about grain direction as you work. You might have to stop and change directions often. After your edges are beveled, use your sanding stick to shape those bevels into smooth roundovers. The completed seat should look smooth and inviting.

Tip: Your seat should be thick for strength, but you can make it appear thinner by beveling the bottom more than the top. Cut a ¾" (19 mm) bevel around the bottom edge, and it will make the whole stool look lighter.

My knife quickly slices a bevel around the edge of my seat. Notice that I've sketched a line about ½" (13 mm) inside the rim. I did this line by eye, but it will keep my bevel consistent. After I carve away the waste, I can round the bevel over with the sanding stick and some sandpaper held in my hand.

Once your holes are drilled and your edges are detailed, your seat is done, and you can lay it aside. Now we'll make the legs. I'm preparing my stock by ripping a couple of 18" (45 cm) lengths of 2×4 in half. This gives me leg blanks that are about 1¾" (44 mm) square. This is a good thickness for softwood, but if you have access to hardwood like oak, you can make your legs a bit slimmer and they'll still be strong.

Clamp your leg blanks to your chopping block and carve the tenons, just like we've done in other projects. Just make sure they're long enough to reach through your seat. Remember to use a test hole in a hardwood scrap to check your tenons; don't test them in the soft wood of your seat. Once your tenons are complete, carve away the flat shelf underneath each one and turn it into a smooth taper. Remember that this tapered section will wedge the leg more tightly in the seat every time someone sits on it.

I get my leg stock by ripping some 2×4s in half. The wood is the same SPF that my seat is made from, so I'll leave the legs thick for strength.

By now, you're probably getting good at carving these round tenons.

Now you can test-assemble the stool. Put the tenons into the seat holes, set the whole thing on the ground and look at it from a distance. Your legs might look a little bit crooked, but don't worry; this is a handmade piece, and nothing is perfectly straight. If you're unhappy with a leg, try rotating it in its hole or swapping it with another leg. I've made several of these stools and I've always been able to get pleasing angles by just fiddling with the legs for a few minutes. Once your legs look good, number them 1 through 3 on the end of the tenon and then write each number on the seat. Put the numbers right next to each other so that when you put the legs back in, you can instantly rotate them back to the correct position by just lining up the

numbers. Right now, this stool is mostly done but those blocky legs look crude and ugly. Let's do some shaping.

Detailing

Put the legs in the seat and rotate them until all the angles look even. Then number each tenon and put a matching number on the seat. You want to be able to line up those numbers and instantly get your leg back in the exact position where it looks best. In the photo, you can see two little numeral 1s on the leg and the seat.

Short legs look good if they taper in two directions: up toward the seat, and down to the foot. Make a mark about 6" (15 cm) from the foot of each leg. We'll leave the wood at that mark full thickness and taper everything on either end. For the short taper down to the foot, use your Ryoba at a slight angle to rip away some wood on all four sides, then grip your knife firmly and use a straight, planing cut to carve away the saw marks. Look back at Chapter 4 for a refresher on knife grips.

Ripping at a slight angle will start your taper. Follow up with the knife and you can "plane" off the saw marks and get a smooth surface.

Now, trim off the corners so that the lower part of your leg forms a tapered octagon. You can use your sanding stick to clean up any of the flats and get the surfaces smooth.

To taper the upper part of the leg, start by drawing a couple of tapered lines next to each corner. Carve away the wood between the lines to get an octagon that's narrow up by the tenon and fat down at the bottom. At this point, you must use your eye to judge each leg. Are the tapers smooth and even? Are the lines straight? Don't be afraid to use your knife to carve away any spots that look thick or chunky. This is a rustic piece, but your legs can still be slim and elegant.

After you've tapered the sides, rotate the leg and trim off the corners. Clean up the cuts with a sanding stick and you'll end up with a nice octagon. Down at the foot, the taper can be as narrow as 1" (25 mm). A narrow foot makes your stool look light.

Once you're happy with the shape of your legs and the way they sit in your seat, I recommend sanding the legs with 100-grit paper. The stool is much easier to sand before it's assembled. You can sand the underside of your seat but leave the top alone. Sanding will erase the numbers you penciled in and make assembly difficult.

To make tapering the upper leg easier, I've drawn some lines along each corner. Notice that my lines are wider at the top of the leg. I can easily remove the waste with my knife and follow up with a sanding stick.

Just like in our previous projects, slit your tenons *perpendicular* to the grain of the seat and prepare hardwood wedges. Coat your tenons in glue and insert them into the seat. Make sure the numbers line up and give the foot of each leg a few taps with the back of your hatchet to make sure it's firmly seated. When all three legs are in, put glue on the wedges and tap them gently into each tenon. I like to begin tapping the wedges with a piece of scrap wood to give them an easy start, and then switch to my hatchet to drive them home. Remember that this project is made of light softwood and you don't want to hit your wedges too hard. They should penetrate deeply into the tenons, but once they stop moving, leave them alone.

A well-seated wedge looks like this. Notice that there's a lot of wedge sticking out of the tenon. Cut your wedges long and give them a very gradual taper. You want to stop hitting the wedge when it stops moving, not when you run out of wedge to hit.

Let your stool dry for least an hour and then flush cut the tenons with the fine crosscut teeth of your Ryoba. To get the tenons really flush, you can use your sanding stick as a sanding block. Its flat surface will level the ends of your tenons without digging into the seat.

A little bit of blue painter's tape will keep your seat from being scratched by the Ryoba. Once you've trimmed and sanded your tenons, they'll have a neat and tidy look. A bit of dark walnut in the wedges adds contrast to the pale spruce of the seat.

Finally, put your stool on a flat surface and see if the seat looks level. If it's not, carefully trim one of the legs until the seat looks good to your eye. Then, lay a pencil flat on the floor and run a line around the foot of each leg. Crosscut these lines and then chamfer the ragged edges with your sanding stick. Your stool should now sit flat, and the feet will be flush with the ground.

A common pencil laid on the floor will let you scribe an even line on your feet. The completed stool is a real piece of furniture that you will have for years.

I've made several of these stools over the years, and they're all around my house. My whole family finds them comfortable and the small size makes them easy to move around the house.

Chapter 19
The Workbench

Materials:

- Two 2×6×8 pieces of construction lumber (see below for details)
- Deck screws
- Hardwood scraps

Tools:

- Contractor's saw
- Ryoba
- Square
- Sawhorses
- Drill/brace
- Knife
- Mallet
- Sanding stick
- Pencil

Now that you've done a few projects, it's time to build a workbench.

Don't panic.

Some woodworking benches are huge and intimidating, with complex joints and fancy vises for holding work. Our bench will be simpler. Modern workbenches look like big tables, but centuries ago, workbenches really *were* benches. They were long, low and narrow, like the bench from a picnic table. The woodworker sat straddling this bench with one leg on either side. Sitting

in the middle of the bench like this, you can put your work in front of you and there's room behind you for a few tools. Compared to modern benches, these low benches seem small and light, but they work because you're adding your own weight to the bench. Your body weight will turn a lightweight platform into a solid surface for chopping, trimming, and sawing.

These low benches to go back as far as ancient Rome, but they're still in use by modern chairmakers in America as well as woodworkers in China and Central and South America. Not only are these benches effective, they're also easy to store and they don't take a lot of materials, so they're perfect for our minimal approach.

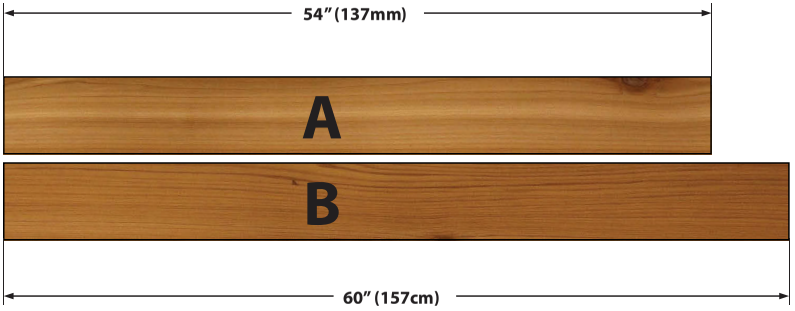
You can make the whole bench from a pair of 8' construction-grade 2×6s. (In America, a 2×6 is actually 5½" wide and 1½" thick. If you live in another country, you're looking for something about 140 mm wide, 38 mm thick, and 2.5 m long. Your local supplier of framing lumber should have something similar.) If you have a choice of woods, southern yellow pine is the best, but Douglas fir and SPF are also good choices. Don't buy "whitewood" or treated lumber. Your wood must be kiln dried. On the day I went to the store, they had white pine, which is a good choice.

You can make the whole bench from a pair of common 2×8s.

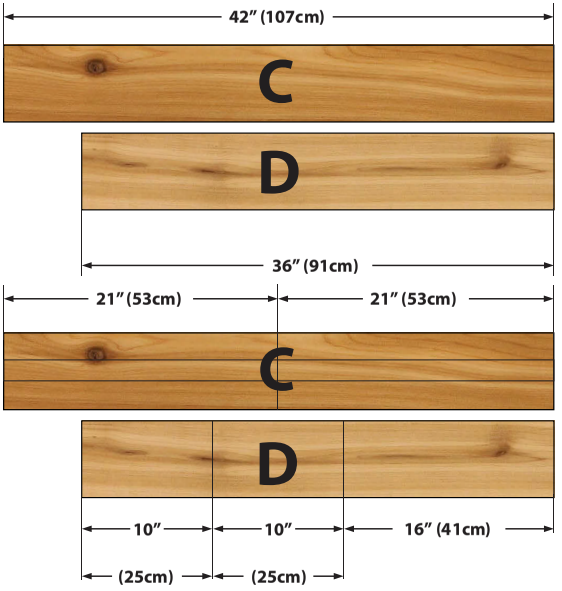
Make the Top

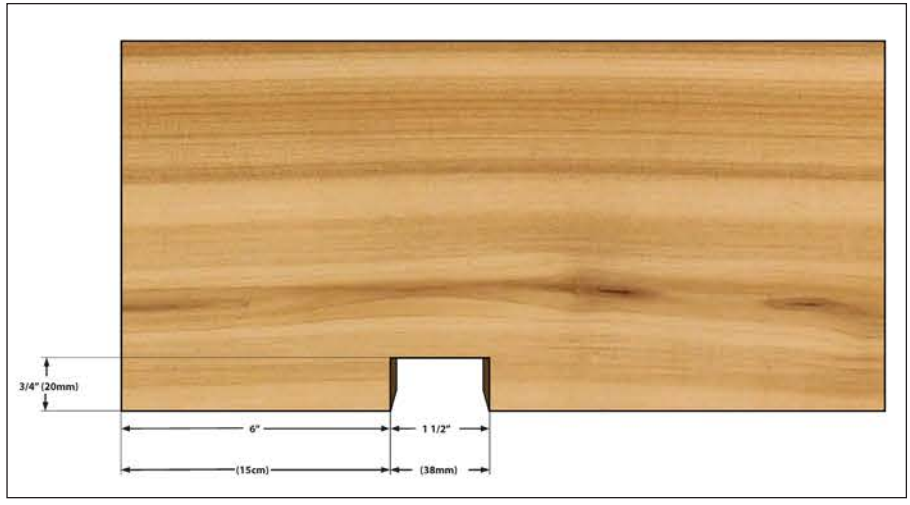
While you're buying your lumber, pick up a box of 2½" (65 mm) coated **deck screws**. As I discuss in Chapter 12, these fasteners are made for outdoor construction in softwood, so they're easy to drive and don't rust.

Start by crosscutting your lumber into the four lengths shown in the plans. Pieces A and B will be the top of your bench. They should be as flat as possible. Piece C will be ripped to form the leg stock, so choose straight-grained wood with no knots. Piece D will be cut up into battens and other support pieces. If your wood has any big knots or other defects, make sure they end up in Piece D.

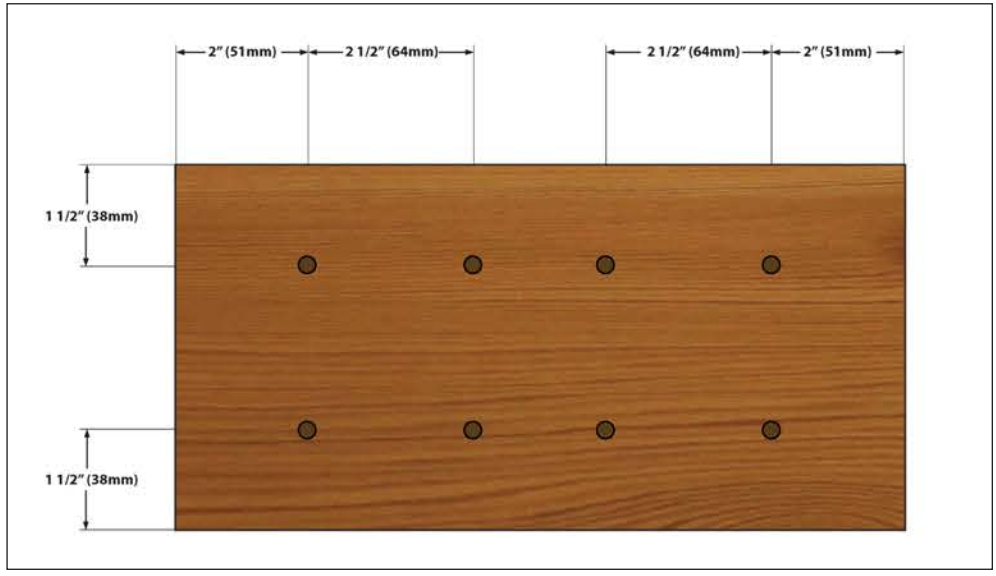

54″ (137mm)
A
B
60″ (157cm)


A
B


42″ (107cm)
C
D
36″ (91cm)
21″ (53cm)
21″ (53cm)
C
D
10″
10″
16″ (41cm)
(25cm)
(25cm)



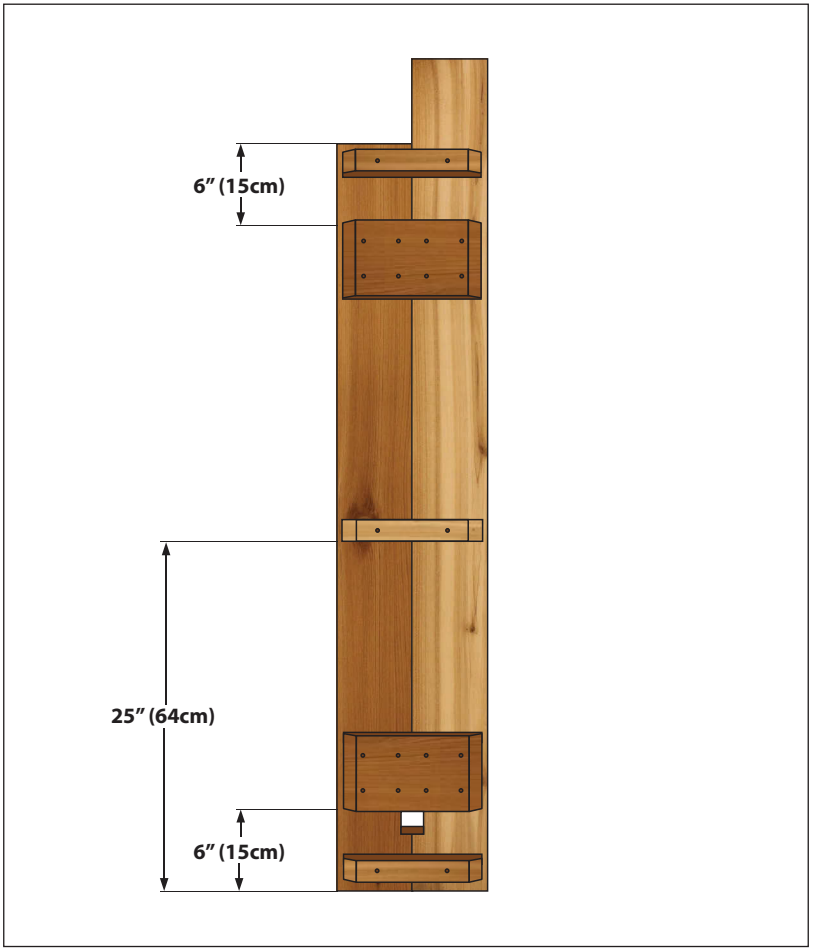
Lay out this pattern on your boards and then carefully saw the lines with your Ryoba. Once you've knocked out the waste and put the boards back together, you'll have a square mortise.



Drill clearance holes in your battens. I've given exact locations, but you don't need to be super precise. Space your screws evenly, and your batten will be strong.

Lay pieces **A** and **B** next to each other and use your square to lay out the two little notches shown in the plans. Crosscut the lines and knock the waste out with the back of your hatchet, just like we did for our Japanese sawhorses (Chapter 8). When you put your boards back together, these notches will form a square mortise, which is handy for holding all sorts of workbench accessories.

Now we'll join our boards together using battens and screws. Traditionally, this kind of bench was made with a single, thick slab of timber as the work surface. These slabs are expensive and hard to find, so we'll use battens to hold our boards together and create extra thickness where



My large battens are screwed to the bench 6" (15 cm) from either end. After the legs are installed, you can add the smaller battens in the middle of the bench and close to the bench ends.

the legs join the top. Cut your battens from piece **D** and bevel the edges with your hatchet. Getting rid of sharp corners will make your bench more durable and easier to handle.

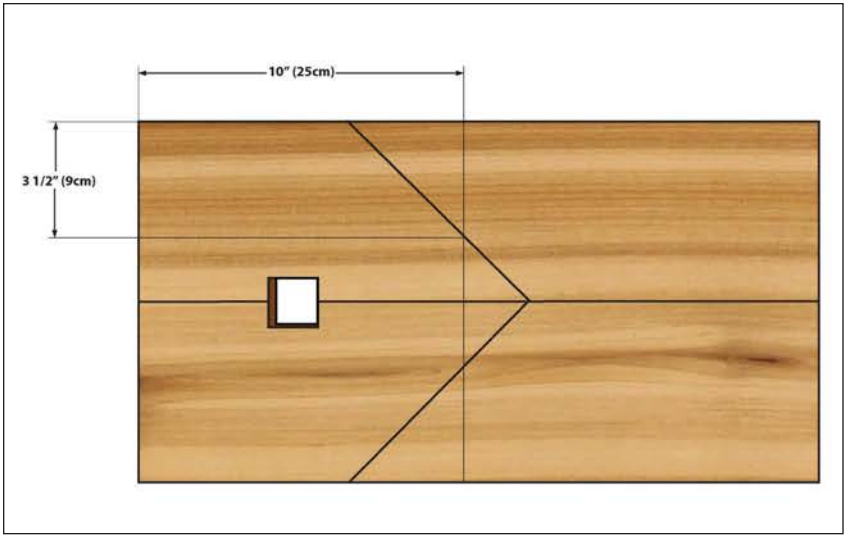
Your battens will be installed on the underside of your bench, 6" (15 cm) from either end. Drill clearance holes through the battens using the pattern shown above, then clamp the battens in place and run the first couple of screws in. You won't need to drill pilot holes in this soft wood, and you can run the screws in using a Phillips-head bit in your brace.

You might be surprised at how easy it is to drive the fasteners, so don't overdo it. Stop as soon as the screwheads sink beneath the surface. If you're using an electric drill to drive the screws, use the clutch to prevent over-torqueing the screws and splitting your wood. I also added some wood glue between my battens and bench, but this is optional.

Install your battens with screws and your brace. A little wood glue can't hurt. In the picture, I just put 4 screws in each batten. That way, I know my drill won't hit a screw on the way through. After the leg-holes are drilled, you can add the other screws.

Now we'll lay out our leg holes and make our legs. This workbench isn't very different from the Milking Stool, and most of the steps are the same. Our bench will need a wider stance, so the drilling angles will be a bit different.

Turn your bench right side up on your sawhorses, and use your square to strike a line 10" (25 cm) from one end. In furniture making, this line is called a "baseline" and it helps with layout. Measure in 3½" (90 mm) from each edge of the bench and mark those points on your baseline. These points are the location of the legs. Now we need to find the angles. Place your speed



Draw your baseline first, then measure in to find your leg locations. Run 45° lines from your leg locations to the edge of your bench and your layout is done.

square against the edge of the bench and move it down until the long edge of the square hits your leg location. Strike a line from the edge of the bench through your leg location point. This 45° line will help our legs splay out for a wide stance. Next, you'll need a 15° guide block. You can use the one from the Milking Stool (Chapter 18).

For added strength, we're going to drill 1¼" (32 mm) leg holes and carve leg tenons to match. For small furniture, 1" (25 mm) tenons are fine, but we need more for a workbench. The added

Whether you drill with the brace or an electric drill, line your bit up with our 45° lines and then bring in the angle-block.

width will make the finished legs much stronger. If you're using a brace, your bits probably won't go larger than 1" (25 mm) in diameter, but you can buy a 1¼" (32 mm) spade bit for a few dollars. These bits will work in a brace, and I've drilled deep holes with them, but it's a chore. For this one project, I recommend you borrow an electric drill.

To drill your leg holes, sit on the benchtop, put the point of your drill bit on your leg location, and align your drill with your 45° line. Start drilling straight up and down to establish the hole, then bring in your angle block and tilt your drill to match its 15° angle. This is a deep hole and spade bits aren't great at ejecting chips, so it's useful to occasionally pull the bit out of the hole while it's still spinning to kick out some waste. Your bit and drill might also get quite warm drilling these large holes, so pause between each one to let things cool down. When you finish each hole, your bit will probably break through and leave a ragged edge, but this is a workbench, so it doesn't matter.

To lay out your legs, use the edge of a board. I ripped piece C into six legs and then picked out the best four. The two legs I'm not using can be cut up to make three small battens.

Make the Legs

Once all the leg holes are drilled, you can rip the legs and carve the tenons. Piece **C** can be crosscut in half and then ripped to make up to six legs. You need strong, straight pieces for your legs, so we're going to cut extras and pick the best four. Your leg blanks should be square, so you can lay them out using the edge of one board. This will automatically give you the correct thickness.

Your leg tenons are just like the ones we cut for the Milking Stool. These are just 1¼" (32 mm) wide. Now you have a mallet to help cut them.

Clamp each leg blank to the Chopping Block, find the center, and use your spade bit to define the round tenon. Crosscut a shoulder at least 3" (75 mm) from the end and carve your tenons using the hatchet. Now you have a good mallet to strike it with, and the waste removal should go quickly. Once the tenon is mostly round, switch to your knife and begin testing the fit with a hole drilled in a scrap of hardwood. (Remember that the test-board you made for the last project is too small. You'll need a new one to test these larger tenons.)

Install your legs in your mortises and have a look at the bench. Now is a great time to rotate legs or switch them around to correct any crookedness.

After your tenons are made, chop away the shelf below each one and carve it into a smooth taper, just like we did for the Milking Stool. We're going to be driving these legs into our bench with the mallet and we want that taper to enter the leg holes easily and wedge the legs in place.

Now you can put your legs into your mortises and have a look at the angles. If something seems off, try rotating the legs or switching them around. The angles don't have to be perfect, but get them as even as you can. Once you like the locations of your legs, number them and draw cutting lines *perpendicular* to the grain of the benchtop, just like we did for the Milking Stool.

Assembly

With your leg holes drilled, you can add the final battens to the underside of the bench. These are just narrow strips of wood cut from the extra leg stock. You can quickly bevel the corners of each one and then install them with two screws. You'll want one batten in the center of the bench and one at either end. See the plans for batten locations.

Before I glue in the legs, I'm screwing on the small battens. These are made from the extra legs I didn't use. I put one batten in the middle of the bench and one at either end. The exact locations don't matter.

Installing the legs is simple. Slit your tenons along the line we just drew and widen the tops of the slits with a bit of sandpaper. Cut wedges from hardwood. This project is larger than the Milking Stool, so make the wedges longer and fatter at the thick end. My wedges were a full ⅛" (3 mm) or more at the top. We want these wedges to exert maximum pressure on the joint. Coat your tenons with glue and insert them into their mortises. Twist the legs so that the numbers line up and your slits are perpendicular to the grain.

Now we'll use the mallet to drive the legs deeply into their mortises. Tap each leg firmly at the foot and listen carefully to the sound it makes. As you drive the leg deeper into the benchtop, the sound of the mallet taps should change from a hollow *thunk* to a dull *thud*. That thudding sound tells you that the legs are completely seated. I drove my legs two at a time so I wouldn't have to worry about the glue setting up on the pair of legs I wasn't working on.

Well-made wedges can be driven firmly and will stop moving before the wedge is buried in the tenon. If your wedges are disappearing into the leg, try cutting thicker wedges with a steeper taper.

With the legs installed, flip the bench onto its legs, spread glue on your wedges, and drive them into your tenons. I tried to use my new mallet to drive my wedges, but

I found it too heavy to be useful and I went back to starting the wedges with a scrap of lumber and finishing them with the back of my hatchet. Give the glue an hour to dry and then flush cut your tenons with your Ryoba.

You can build your whole bench in your backyard like I did, but it's helpful to move it to a flat section of floor or sidewalk to level and trim the legs. I used the floor of my garage. My bench had one short leg, so I propped it up with scrap wood. Once the bench was sitting level and not rocking, I put a scrap of board next to each leg and scribed the floor line all around the leg with a pencil. After I cut along these lines, my bench sat steady on the floor.

Using the Low Bench

As soon as your bench is done, you can start doing bigger and more ambitious projects. Now you have a large, flat platform that will support larger pieces of wood. Sitting on the bench puts you close to your work and makes it easy to do delicate trimming with your knife or hatchet. Drilling holes and driving fasteners is much easier when you can put the work at knee-height and use your weight to push down on your drill or brace.

While I still recommend your Japanese sawhorses for rip-cuts and large stock, your low bench is unbeatable for all kinds of crosscutting, as well as smaller detail work. For any kind of crosscut, hang your work off the end of the bench, kneel on it with one leg, and then saw with either your Ryoba or your contractor's saw. Even woodworkers who have a large workbench often use a knee-high bench for sawing because it's so efficient and ergonomic. It's easy to center your body over the work and use the large muscles in your shoulders and back. Many big cuts will now be faster and less tiring.

Sawing on your low bench is easy. Your body weight holds the work and you can get right on top of the cut.

Drilling on this bench is a lot like sawing. Hold the work with your body weight and bear down on the drill.

I'm sure you're wondering about the uneven boards on one end of the bench. This feature makes the bench more flexible for holding work. If you're drilling or sawing thin stock, you can place the wood across the empty space between these boards. The 90° angle formed by those uneven boards will support your work on either side while giving your tool empty space to move. Now you can drill holes by placing the work across this gap and you won't have to worry about damaging your bench as the drill bit pokes through.

The little corner on the end of your bench makes a great place to clamp narrow stock. In this picture, I put a scrap under my stock to keep it from sinking into the ground as I hit it.

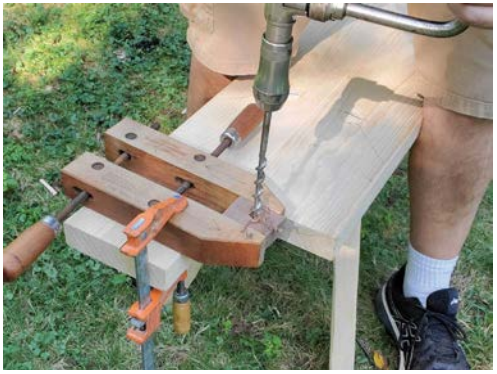
You can also use the uneven boards *with* your clamps to hold work in almost any position. If you want to work on the end of a narrow piece of stock, place it in the corner and clamp it with your F-clamp. You can rest long stock on the ground or support shorter stock with a few blocks of scrap wood and you'll have easy access to the end. Now, you can carve your leg tenons sitting down. Your stock will be held steady, and you can get your eyes closer to the work for trimming and other details.

Tip: Remember that your screw clamp works best if you set the distance between the jaws and then righten the rear screw. This delivers maximum pressure.

Many operations are easier with a vise, and your screw clamp makes a pretty decent vise now that you have a place to mount it. For holding little pieces of wood, just use your F-clamp to secure your screw clamp to the benchtop. With this setup, you can grip almost any small piece for drilling or sawing.

If you need to work on the end of a board, clamp your screw clamp at either end of the bench and then grab your board at any height that's convenient. Remember that your screw clamp works best when the jaws are parallel, so it can take a little bit of fiddling to get them lined up. These hardwood jaws might also dent softwoods like pine, so you might want to line them with something soft and grippy like leather or sticky-backed cork.

For gripping wider boards, it's handy to use the long edge of your bench to support your work. For really large stock, you might need to add another clamp across the bench to hold the whole board. You can grip wide panels on the far side of your bench and then kneel on it for sawing. This approach works especially well with Japanese pull-saws. If you want to use a push-saw, you can use the nearer side of your bench. In this setup, it's handy to have another place to sit facing your work. Luckily, we just built a very nice little stool that's just the right height.



Your two clamps can work together to hold small pieces for drilling and carving.

You can hold wide boards against the edge of your bench by adding one more long clamp. In the picture, I've clamped my work to the far side of the bench so that my pull-saw can work effectively.

You can also expand the capabilities of your bench by making your own accessories to fit into our square mortise. For my bench, I built a "palm," which is a simple device that dates back to mediaeval China. The palm is just a notched piece of wood on a square post. The scraps from my bench gave me all the stock I needed to make this device. After sawing the notch, I drilled a hole in the board and installed the post with a round, wedged tenon. Then I added a little cleat to the back of the board. This cleat grips the edge of the bench and helps keep the palm from rotating. This device is great for holding boards while I work on their edges, and it gives me an easy way to hold legs steady while I chop tapers and other details. Credit for this device, and for low benches in general, goes to Chris Schwarz and his book *Ingenious Mechanics: Early Workbenches and Workholding* (Lost Art Press; 2018).

If you stick with woodworking, you'll eventually want a bigger, heavier bench with a thick top and at least one traditional vise. In the meantime, don't underestimate your simple, low

The palm is just one of the handy devices you can make to fit your new bench. I haven't included plans for the palm because I want you to challenge yourself. Look at the picture and try to make it.

bench. I've used benches like these for just about every woodworking operation and made everything from stools to dovetailed boxes with just a low bench and a handful of clamps. And, if you stick with chairmaking, green woodwork, or outdoor crafts, you might find that the low bench is all you ever need.

Chapter 20
The Tool Tote

Materials:

- One pine board, 8' (2.5 m) long and 9" (23 cm) wide
- One hardwood dowel, 1" (25mm) in diameter
- Wood screws, 1¼" (32mm) long

Tools:

- Contractor's saw
- Ryoba
- Square
- Low bench
- Drill/brace
- Knife
- Mallet
- Sanding stick
- Pencil
- Screwdriver
- Masking tape
- Superglue

Are you keeping your tools in a plastic bucket?

I am, and it's time to stop. Our tools deserve better, and a traditional tool tote makes a great project. Craftsmen from shipwrights to plumbers have been using open-topped boxes to store and carry their tools for centuries. We can continue that tradition.

One pine board and one dowel will give you plenty of material for this project.

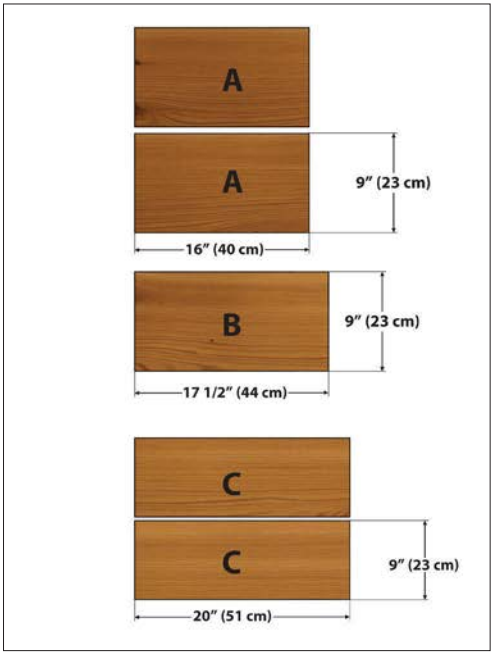
This project only costs a few dollars. You'll need a single, 8' (2.5 m) board of 9"-wide (23 cm) pine. You'll also need a 1" (25 mm) dowel. Spend a few extra cents for oak dowel if your store carries it (or cut up an old broom handle if that's what you've got.) For fasteners, buy a box of 1¼" (32 mm) wood screws.

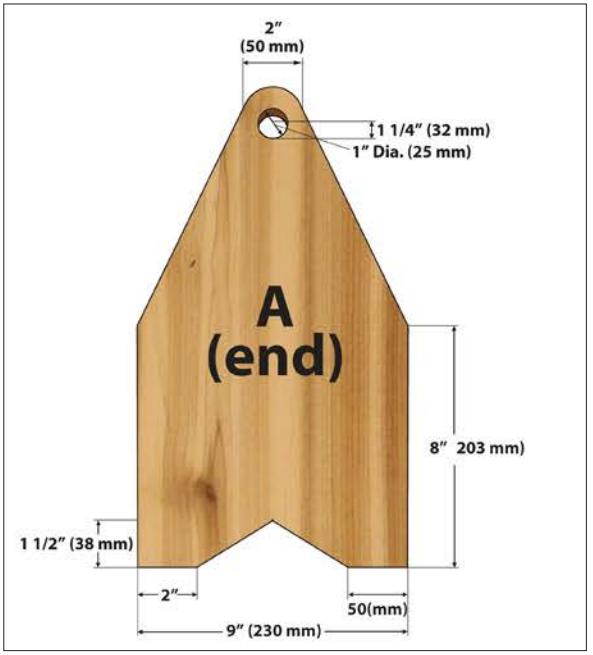
In my chapter about fasteners, I said that screws don't make a long-lasting connection in wood, and you might be surprised to see them in this project. Screws lose their hold with the repeated stress and leverage put on furniture pieces, but our tool tote will be under no such pressure. Even a heavy load of tools weighs much less than a person and the screws won't be stressed. We'll also use a smart design and wood glue to make everything stronger.

Make the Parts

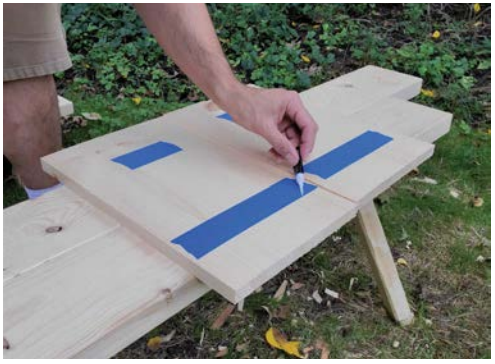
This project is made from five simple pieces, and two of them are duplicates. Start by crosscutting your board into the five lengths shown in the plans. Your end pieces need to match each other exactly, so I recommend cutting one end piece and then using it to mark the line for your second piece. Copying your measurements directly off components keeps them exactly the same. You can do the same thing with the sides. Once all five pieces are cut, you will have used up most of the board.

Crosscut all your components from the plans. The little piece sitting on top of the stack will be cut up to make some details later in the project.





Most of this project is cutting and shaping the ends (**A**), since they have most of the details. To end up with two identical pieces, it's helpful to fix them together and work on both at the same time. Stick a few pieces of masking tape or blue painter's tape to your ends, dab on a little superglue and press the ends together for 30 seconds. The glue will fix your pieces tightly together, but the tape will make it easy to get them apart without damaging the wood.



Put pieces of tape on both your ends and add a line of superglue on the tape. When you press the ends together, the glue will stick the boards together, but because it's only on the tape, you'll be able to separate the parts later.

Tip: You can buy superglue "accelerator" from many tool companies. Put glue on one piece of wood, spray a little accelerator on the other, and press them together. The accelerator will make the glue dry instantly and you can keep working.

Hopefully, your ends will have at least two edges that match up cleanly. Keep these edges together. Once the boards are glued together, you'll have a chance to trim off any unevenness on the other edge with the Ryoba. When your boards are square and even, you can start cutting the details shown in the plans. The top of the end-piece is a narrow triangle that will stay out of your way as you reach for tools. The tip of the triangle is rounded to prevent splintering. I laid out this radius by tracing the bottom of my glue bottle, and I shaped the curve with my knife. The wide, triangular cut in the bottom of the end

The layout for your ends is just a few lines, and your glue bottle makes a nice radius for the arc at the top. Put a little squiggle of pencil in the waste to remind you what you're cutting away.

With your two ends stuck together, it's easy to cut the details onto both pieces at once. When you're done, use the knife and the hatchet to slowly force the pieces apart.

divides the piece into two feet. We'll put the bottom board *above* these feet so that if you ever set your tote down on wet ground, the bottom (and your tools) will stay dry. If these feet ever rot or get damaged, you can saw them off and glue on new ones.

The last step to shaping your ends is drilling the handle hole at the top. Just like all our holes, we want this one clean and crisp looking, so drill it slowly from both sides. Test-fit your dowel and sand it a little if it won't fit. After all the details are cut, take a few minutes to clean and square the edges with your sanding stick. This work is easier with the boards stuck together.

Separate your ends by sliding the edge of your knife between them at the tip of the triangle. Once you've separated them a little, slide in your hatchet and use it to pop the two pieces apart. Peel off the tape.

Next, we need to secure our bottom (**B**). It would be easy to screw through the sides and into the bottom piece, but this would be a weak connection. Common pine boards are thin and screwing into end grain always makes a fragile joint. It's much better if the bottom rests on some **cleats**, small shelves that hold weight. Cut four little blocks and install them as shown on the picture above. Use glue and screws. Since we're screwing into soft pine, we'll drill clearance holes in each cleat, but no pilot hole or countersink. Drive the screws slowly by hand and they'll seat without splitting the wood.

Cut your handle from your oak dowel. Make it about an inch longer than your sides. It can be difficult to cut a round dowel evenly, but if you wrap a piece of tape around your dowel, it will give you

The cleats installed on the ends. Note that I've struck a pencil line at the point of the lower triangle and used it to align my cleats. This placement will also keep my cleats from being visible on the finished tote.

A piece of tape wrapped around a dowel makes it easy to get a square cut. Just follow the edge of the tape.

an easy line to follow. Time to dry-fit the pieces.

Insert the ends of your handle into the holes and lay your bottom on the cleats. The important thing now is getting everything square. Set your speed square on the bottom and check the ends. You can change the angle of the ends by moving the handle in and out in its holes. Once both the ends are square to the bottom, trace around your handle where it enters and exists each hole. These lines will make it easy to get everything square again as you glue up. Before you pull everything apart, draw a line on the end of your handle perpendicular to the grain. We're going to wedge the handle just like we did with the legs of the Milking Stool.

With the dowel in its holes and the bottom resting on the cleats, I can use my speed square to make sure the ends are square to the bottom.

When you have the sides square to the bottom, trace around the handle where it enters the sides. The lines on the handle will let you get it back in position fast during glue-up.

Assembly

Before you glue up, cut a couple of hardwood wedges and slit the ends of your handle. Put glue on the ends of your handle and put the handle into *one* of the end-pieces, using the pencil-lines to get the location exactly right. Rotate the handle so its slit is perpendicular to the grain of the end-piece, insert a wedge, and tap it home. We're installing the handle into the sides one at a time so you can rest one end of the handle against the bench for resistance while you're knocking the wedges in. It would be difficult to do both ends at once.

When one side is fitted and wedged, saw it flush and install the other end. Before you wedge the other end of the handle, lay the bottom-piece in place and make sure it lays flat and doesn't rock on its cleats. If you need to, rotate the handle in the end to get the bottom sitting square.

Then wedge the end and saw it flush. The bottom can just sit on its cleats, but it's even better to run a few screws through the bottom and into the cleats. There's no need for glue, and this construction will make it easy to replace the bottom if you ever need to.

With the bottom in place, your tote should feel surprisingly sturdy. The parts we've already assembled make up most of the structure. The sides are just screwed on to keep the tools in; they don't add much to the strength of the tote.

Screwing through the bottom and into the cleats will tighten up the structure. In the picture, you can see a small gap between the bottom and the end. As I tighten my screw, that gap will close.

To make the sides, just rip your two sidepieces (**C**) to the correct width. The top edge of each sidepiece needs extra attention because the sharp corner at the rim of the tool tote would quickly get splintered by tools coming in and out. To prevent this, we're going to **bevel** one edge of each board.

You can lay out your bevel by letting the nail and knuckle of your middle finger ride against the edge while you hold your pencil at the distance you want. This simple technique is surprisingly accurate. After most of your waste is chopped away, finish up with a planing cut from the carving knife.

Strike a line about ¾" (19 mm) in from the board's edge. There's no need to measure or use your square here. Just hold the knuckle and fingernail of your middle finger against the edge of the board and let them ride the edge as you run the pencil tip down the wood. With a bit of practice, you'll be able to strike lines exactly parallel to an edge with nothing but a pencil and your hand. Do the same thing across the top of the board, coming in about ½" (13 mm). Now we're just going to carve away the material between our two lines. Begin with the hatchet, holding it close to the head and taking short strokes to score the material before you come back and cut it away. Finish with a long, planing cut from your carving knife. Be careful of grain direction and take the longest, smoothest strokes you can. Touch up any rough spots with a sanding stick.

We cut the sidepieces a little bit long to make the final fitting easier. Chances are your sides won't line up perfectly with the ends of the tote. This is no problem. Let the ragged ends of your sidepieces stick out a little bit when you glue and screw them to the end-pieces. This way, you can use your Ryoba to flush cut the sides and get them perfectly square to your ends.

My sides aren't even with my ends, but I left them long on purpose. I can flush-cut the sides, referencing the Ryoba off the end-pieces to get a perfect edge. In this photo, you can also see the handle installed and wedged.

My finished tool tote holds all the tools from the book, even the sharpening stones. Even better, there's room left for your tool kit to grow.

When your tote is complete, load it up with all your tools. With this design, all twelve of your tools should fit comfortably and you'll still have space for your tool collection to grow.

Chapter 21
Napkin Rings

Materials:

- Hardwood scraps

Tools:

- Ryoba
- Square
- Low bench
- Drill/brace
- Knife
- Mallet
- Sanding stick
- Pencil

We've just finished a bunch of big, furniture-type projects, but we should remember that woodworkers can make smaller, prettier and more fun objects for our homes and families. To finish up our introduction to woodwork, let's make a set of napkin rings. This is a small, low-pressure project that lets us use up little scraps of nice wood. We can also be creative with shapes and decorations.

Start by finding some scraps of thin stock. Something around half an inch (13 mm) works great. If you don't have anything like this laying around, you can always rip down some thicker stock. It's great practice.

My pieces are 2" (51 mm) wide, and I'm going to bore a 1¼" (32 mm) hole in them. If you want a larger hole, make your stock a little bigger. It's especially handy to make your napkin rings from long pieces of stock. That way, you can bore out the hole for each one and do some shaping while the ring is still attached to a long board that's easy to hold. Then you can cut your ring off the stock and finish shaping it.

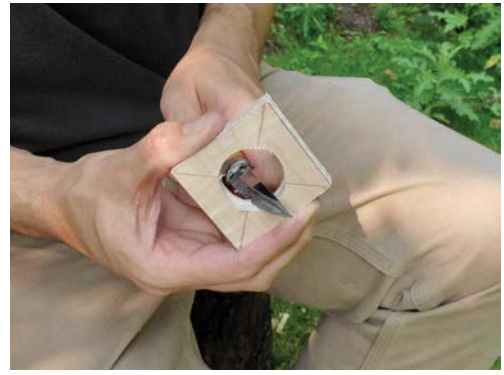
To bore your holes, mark a square at the end of your stock, connect the corners to find center, and bore your hole. Since my stock is thin, I can get a clean hole even with a spade bit in a brace. Start by drilling until the center spur of your bit just barely pokes through the other side of the stock. Reverse the piece and begin drilling from the other side. Just drill until the hole is neatly scored all around the edge. Then flip the piece back over and finish drilling the original hole. Taking the hole in three stages helps you get a clean edge all around.

Once the hole is drilled, you can start shaping the piece, or you can crosscut it off the stock and hold it in your hand to add decoration. I tried a different design for each ring and there are lots of good techniques for detailing these pieces.

Tip: Spade bits work best at high speeds. If you have an electric drill, let it spin up to full speed with just the spur touching the wood, then slowly feed the bit in.

This thin walnut will make great napkin rings and I got it from a furniture shop that was throwing it away. In the picture, I've marked a square on the end of my board and found center.

Drilling the hole carefully from both sides gave me clean edges. For now, I'm leaving it attached to the main board.



The inside of this maple ring was still a bit rough, so I'm shaping it with the knife.

If you'd like to leave your ring square, you can bevel the edges with your knife. Use a controlled push-cut, or a steady pull-cut with your thumb tucked down and out of the way. Clean up the bevels with your sanding stick.

You can also dress up a square ring by adding a **scallop** detail to each edge. You can just wrap a piece of sandpaper around any cylinder (I used a spray can) and work the center of the edge until you get the shape you're looking for.

If you don't like square rings, cut the corners off to form an octagon. You can make all the edges the same length or alternate short and long edges like I have in the picture. If you'd like to add even more detail to that octagonal shape, try making little notches in the center of each edge with your knife. Combined with the octagon shape, the notches can make your ring look natural and organic.

I can easily bevel this edge with a push-cut.

Sandpaper wrapped around a spray can will add a scallop detail to the edge of this piece.

Your Ryoba excels at details like cutting off these small corners. You can also use your knife to add decorative notches to any shape.

As you work on your rings, feel free to experiment. Try different shapes and cuts with your knife. Try drilling small holes. If you end up with something really ugly, throw it away and make another one. Woodwork is creative work, and you should always trust your gut and try new things.

Once you have four or five completed rings, they're ready for the table. We'll add a little finish in the next chapter.

The completed napkin rings can dress up your table, and your family will appreciate it when you make little things for the house.


ZINSSER
Bulls Eye
Shellac
Traditional Finish & Sealer
Acabado Tradicional y Sellador
CLEAR

Chapter 22
Simple Finishes

Believe it or not, you don't have to finish your projects. You can sand them smooth and just leave them to start developing "character." The hard, glossy finishes you see on store-bought furniture are a new invention and didn't exist until a few hundred years ago. Before that, wood finish ranged from the basic (beeswax) to the disgusting (cooking fat). Either of these could be rubbed on the wood to give it some protection, but neither was very effective. The modern woodworker has a lot of options, probably too many. Start looking at finishes at the hardware store and you might get confused. Let's simplify.

Before I get into clear finishes, consider paint. These days, we mostly see woodwork finished with glossy transparent finishes that show off the wood grain. But painted furniture has been around as long as paint has. I love wood grain as much as the next guy, but a whole room of natural wood furniture can look dark and overwhelming. Painted furniture can add lightness to your living space. Painting is also pretty easy. Pick an interior paint and follow the manufacturer's directions. Brush-painting is probably the best option for most projects, but you can spray smaller pieces with off-the-shelf spray paint. Just be sure to do it outside.

I painted this cabinet with a traditional milk paint. It was easy and I love how it looks.

You can also buy old-fashioned **chalk** or **milk paints**. These finishes are generally much less toxic than more modern paints and they give a rustic finish that many people like. Both chalk and milk paints are traditional finishes (they're really made from chalk and milk). You can buy both of these paints premixed in cans or you can buy powdered versions that you mix with water. I've used milk paint a few times and I like it. It gives a flat, even finish that looks nice for simple projects.

Whatever finish you choose, be sure to make a few test pieces on scraps left over from your project. You need to know how your finish looks on the actual wood you used. You also need to know the drying time and whether or not that color really looks good, so don't use any new finish directly on a project. Always do a few test pieces first.

For most of the projects in this book, a simple clear finish is probably best, so here are a few options.

Boiled Linseed Oil

Linseed oil is pressed from flax seeds. It's edible, and the raw oil can be used for finishing wood. Unfortunately, raw linseed oil takes days to dry. To speed things up, manufacturers add metallic driers to make **Boiled Linseed Oil**, which cures far more quickly, but is somewhat toxic. It's safe to handle; just don't eat it.

Boiled Linseed Oil comes in many different containers. I like the metal ones.

Boiled Linseed Oil (or **BLO**) is idiot-proof. Pour some on a cotton rag and wipe it on your project. Give it a few minutes to soak in and then wipe off any excess. Let it dry overnight. You can do multiple coats of BLO, but I've never seen any improvement from extra coats. Instead, I usually finish up with a coat of paste wax and buff the project with a soft cloth.

Tip: Boiled Linseed Oil heats up as it dries. If you leave a rag soaked in BLO, it might spontaneously combust. Put your used finishing rags in a lidded jar full or water or spread them out on a concrete floor to dry overnight. Then you can safely throw them away.

BLO is a cheap and easy finish and it's especially good for your first projects where you'll want to get done and not risk messing up at the very end. It's also fast. If you're in a hurry to give someone a gift you've made, wipe on a coat of BLO, wipe it off, and hand it over. Just tell the recipient that the finish might feel a little oily until the next day. They probably won't even notice.

As I put BLO on this napkin ring, you can see the color deepen.

The downside of Boiled Linseed Oil is that it's not very protective. It doesn't form a hard film on the wood and won't provide any protection from scratches and dents. BLO gives a bit of protection from water and dirt, but not a lot. Adding a coat of wax improves the protection a little bit.

A coat of BLO makes even the pale spruce of this Milking Stool jump to life. Later, I'll add a few coats of polyurethane to protect it.

Why should you use a finish that offers so little protection? Because it's fast, easy, attractive, and cheap. Many projects don't see hard use; they just sit on a shelf. Boiled Linseed Oil also makes wood look much better. BLO darkens wood and increases the contrast between the light and dark parts of the grain. Woodworkers call this "popping the grain" and it's a dramatic effect. Sand a piece of pine and wipe on a coat of BLO and you might be stunned at how attractive this cheap wood suddenly looks. The effect is even better on woods like maple and walnut that already look nice.

Here's the really good news: BLO is compatible with almost every other finish, so you can wipe on a coat, enjoy the lovely "popping" of the grain and when the oil is dry, you can apply a more durable finish to seal in all that color and protect it.

Shellac

When shellac was first imported to Europe in the 1800s, it was a game changer for furniture finishing. Up to this point, woodworkers used paint or soft finishes like beeswax, or simply left wood raw. Shellac was the first "film finish." It sits on top of the wood and forms a hard, clear barrier that offers good looks, long life, and excellent resistance to humidity. Shellac and other film finishes also seal woods, closing the pours and making them much less likely to pick up dirt.

Premixed shellac comes in a can like other common finishes and is sold at most big retailers.

Shellac is literally bug juice. It is the secretion of the lac beetle, which nests on trees in India and Thailand. The beetles live in hard little tubes made of the resin they secrete. This hard resin is scraped from trees, refined and made into shellac finish. Dry shellac is nontoxic. You can even eat it; in fact, you probably have. Shellac is widely used as a sealer on candy and pills. (But it's still not food, so don't eat the shellac you buy for wood finishing.)

You can buy shellac as flakes that you dissolve into denatured alcohol or you can buy premixed shellac in cans. The finish you mix yourself is somewhat higher-quality and you have a lot of control over its color and thickness, but homemade shellac has a short shelf life. The shellac sold in cans works well and has added stabilizers that keep it fresh much longer. I always use the stuff in the can.

Like all finishes in a can, you must stir shellac before you use it. You must also remember that the only solvent in shellac is alcohol, which evaporates very quickly.

Shellac is the perfect finish for this desktop organizer. It gives great protection and it's fast. Here, I'm applying it with a cloth pad. Larger projects require a nylon-bristle brush.

A coat of shellac will dry in 10 minutes and that's convenient, but you also have to work fast when applying it.

For small pieces, you can apply shellac with a cloth pad. Take a piece of clean cotton T-shirt and cut out a 6" square. Fold this square so that all the cut edges are in the inside and you have a smooth pad. Dip your pad in the shellac and wipe a *thin* coat on the surface of your project. Take even strokes and try to overlap each stroke just a bit. Shellac dries so fast that you generally can't go back and fix little mistakes, so if you leave a dry spot by mistake, just leave it.

Your first coat will be dry in 10 minutes and you'll want to scuff it to level the surface and prepare it for the next coat. You'll need a piece of "0000" **steel wool**. This is finest variety and is pronounced "four aught." It's cheap and easy to find. Rub your project lightly with the steel wool. You want to see the shine disappear off the shellac and the surface should be level and smooth. The steel wool will leave fine fibers on your project. I usually wipe these off with my hand or blow them off, but you can also wrap a magnet in a rag and rub that over your project.

When your project is scuffed and clean, apply another coat of shellac, wait 10 minutes, and scuff lightly. Then you can apply a coat of **paste wax** (I usually use a piece of steel wool to rub on the wax; I just leave a piece in the wax can all the time.) Give the wax a few minutes to dry and then buff it with a soft cloth. The resulting finish will look nice and feel lovely to the hand.

Clear shellac also comes in a spray can. Spray shellac is even easier to apply. Just spray on two or three coats and then scuff and wax it like I explain above. Scuffing *between* coats isn't usually necessary with spray shellac. Do your spraying outside. Shellac isn't toxic, but the propellants in the aerosol can are.

Shellac is the perfect finish for projects that will see some wear, but not hard use. Use shellac on any small gift like a box. It's also a good choice for many furniture projects. A small side table finished in shellac will look good for decades, and shellac is still used on musical instruments.

Shellac has two downsides: it won't stand up to hard wear and it is dissolved by alcohol. For most furniture projects, shellac is more than strong enough, but it can by chipped by hard objects and worn away by friction. As for alcohol, you don't have to worry about drinks like beer and wine, but hard alcohol will ruin shellac. Spill a gin and tonic on your piece and your finish will come right off.

For pieces that will see hard use and may come in contact with alcohol, we need a stronger finish.

Polyurethane

Polyurethane is a plastic, resin-based finish. It's the hardest and most wear-resistant finish that you can pick up at your local home center and it's one of the top choices for wood finishing.

Modern polyurethane is transparent, tough and easy to apply. Polyurethane is extremely durable and will stand up to years of hard use, even on a tabletop. Poly (as it's often called) isn't totally clear. It's a little bit yellow and it will give your wood an amber hue. Most of the time, this yellowing makes your work look nicely aged. Since poly is a plastic, it can look like a coat of plastic sitting on top of the wood, and some woodworkers don't like this look. But there are several ways to get around this "plastic" look and still get the durability that poly is known for.

Oil-based polyurethane can be used straight from the can, but I thin it with mineral spirits.

Basic Technique

For small projects, I recommend satin wipe-on polyurethane. This finish comes pre-thinned and is easy to apply with a rag. Make a pad like you would for shellac, wipe on a coat of poly, and let it dry overnight. In the morning, lightly sand your finish with 220-grit paper. Polyurethane isn't very good at sticking to itself and you need to give the finish some "tooth," so the next coat has something to grab on to. Wipe off the sanding dust (a cloth dampened with mineral spirits works well) and apply another coat of finish. Let it dry overnight and repeat. The third coat can be lightly sanded and rubbed out with wax and steel wool just like you did with the shellac. Finish by buffing with a soft cloth.

Left: A milking stool I made years ago and finished with poly. It now has a distinct yellow color. Right: The pale, spruce Milking Stool we made. It will benefit from a finish that gives it a little color.

For a larger project, use regular satin or semigloss poly in a can. You need to do larger projects with a brush, and this can involve a lot of preparation and cleanup. I avoid this trouble by using disposable foam brushes. These brushes will leave bubbles in pure poly, but you can thin your finish out just a little and the bubbles will pop on their own.

Pour some poly into a clean container and add about 10 percent mineral spirits. No need to measure. Just add a bit of mineral spirits and stir until the poly looks a little thinner. Dip a brush about halfway into the poly and brush your project, using slow, even strokes and overlapping them a little. You want each coat to be thin and even. Thin coats dry faster and collect less dust.

Polyurethane is very slow drying, so once you have a coat on the project, you can go over the surface again with the same brush and even things out. Do this once and then walk away. You're doing several coats, so there's no need to get it perfect.

The next day, lightly sand your project, clean off the sanding dust, and brush on another coat. In between coats, you can wrap your foam brush in plastic wrap to keep it from drying out. The same brush will usually do at least two coats, and I try to minimize waste when I'm working.

After the third coat is dry (at least overnight, but longer is better) sand it lightly and then rub it out with steel wool and wax followed by buffing with a soft cloth. The final finish will look nice and be very durable.

Wipe-on poly is convenient and can be applied with a rag.

The bootjack will see hard use, so I'm finishing it with oil-based poly. I've thinned the finish with mineral spirits so I can use a foam brush.

Avoiding the "Plastic" Look

Polyurethane *is* plastic, so it can look too glossy and artificial on your work. Here's how to avoid that.

First, poly is sold in several different levels of luster: flat, satin, semigloss, and gloss. Pure poly is gloss (the shiniest) and each of the other lusters have different levels of flattening agent added

to cut down on shine. If you want to avoid that "plastic" look, don't use gloss poly; not only is it difficult to get a glass-smooth finish, high-gloss surfaces are unforgiving, and they show every scratch.

I finish with satin or semigloss poly. Both of these finishes look nice and are less likely to show scratches. You can rub them out with wax and steel wool, and you'll get a pleasing surface with a bit of shine, but it won't look artificial.

Thinning the poly and limiting the number of coats also helps keep finishes looking natural. I always thin my poly out of the can to make it flow better and avoid bubbles but thinning also keeps the final finish lighter. Even after three coats, I have less finish on the wood than if I used the poly straight out of the can. Thinned poly also soaks into the wood more, so if you're using an open-grained wood like oak, more of that grain will show through.

Of course, less finish means less durability, so you need to strike a balance between the look you want and toughness of your surface. If a piece is going to see hard use, you might want to apply more coats of poly and just live with a heavier coating. Using a lower-luster product like satin or semigloss will still make your work look more natural.

As you do more projects, you'll get a feel for which finishes you like. Over time, you'll probably gravitate to a short list of trusted favorites. I've covered my favorites here, but you should experiment with products I haven't mentioned. There are many good finishes out there, and I certainly haven't tried them all.

Now that you know several good finishes, you're ready to protect your projects and make them look nice. There is a lot more to know about finishing, and I have a list of recommended books at woodworkforhumans.com.

The Way Forward

I've written this book to give a complete introduction to woodworking. Unfortunately, there's no such thing as "woodworking." Woodcrafts are as diverse as cabinetmaking, bowl-carving, barrel-making, turning on a lathe, and chairmaking. Each of these crafts uses wood, but their approaches are *very* different. The cabinetmaker works with boards of dry hardwood. He or she works at a bench with a large set of precision tools. Alternately, the chairmaker might work exclusively with green wood and do all their work outside. The chairmaker's tool kit is small and deceptively basic, especially compared to that of the artistic furniture maker. The turner works at the lathe and makes all kinds of round objects, practical and artistic.

All these crafts use wood as their primary material and they all shape wood with edge tools. No matter what kind of woodwork you pursue, you need to understand grain direction, cutting, splitting, sawing, and finishing. If you've read this book and done the projects, you have these skills. You should be ready to move into any craft that interests you.

If you really liked making the tool tote, you might be interested in cabinetry. Modern cabinetmakers build dressers, desks, chests, and lots of other fine indoor furniture. You'll need planes and chisels and joinery saws to add to your basic kit. Eventually, you'll need a sturdy workbench.

If you enjoyed making the milking stool and the small bench, you might like chairmaking. These craftspeople split furniture parts from green wood, shape it with blades, and bend it with heat and steam. Chairmakers often work at a basic, low bench, and the one we've made might be all you need.

If you were most attracted to making the butter knife and the mallet, you might enjoy carving. From the simple projects in this book, you can move on to spoons, bowls, and even masks. Carvers do a wide range of work, sometimes in green wood, sometimes in dry wood. You'll need

several different knives, chisels, and gouges. You might spend some money on a fancy carving ax. I recently did and it's a lot of fun.

You might have enjoyed the projects in this book but found them a bit slow. Maybe you're a power-tool woodworker at heart. This path might be the most dangerous and expensive, but machine-tool woodworkers make excellent pieces. Many people find the precision of machines very satisfying.

It could even be that you're not a woodworker at all. Maybe you'd rather be a blacksmith, a leather worker, a bookbinder, or a weaver. All of these traditional crafts still exist, and they're all practiced by energetic, passionate people. You could take up any of these crafts, and skills you learned in this book would give you a good start.

And maybe you don't even want to make things. Maybe you'd rather read or enjoy the outdoors. Well, now you have a little kit of tools, a place to store them, and a small bench. Maybe the next time something breaks in your house, you won't call a repair person. Perhaps you'll just take your tool kit and fix it yourself.

I think that's pretty great, too.