Because of the waiting time, air-drying your own lumber may not meet the needs of woodworkers who want to go to their hardwoods supplier and exit with a stack of project-ready boards. On the other hand, you may find the process both cost-effective and fun. In fact, air-drying is something every practical woodworker should consider when that big oak, walnut, or maple tree keels over in the yard, and the tree guy asks what you’d like done with the wood. Rather than watch the logs being reduced to firewood and mulch, a woodworker can save big by having the wood slabbed and then drying it himself. Understanding the pros, cons, and costs of air-drying can make the effort worthwhile for woodworkers lucky enough to hook up with a local sawyer.

Other than cost savings, sawing up and air-drying your own lumber gives you more freedom of choice. While the available supply of kiln-dried and surfaced wood may be limited in terms of size, selection, and species, harvesting and air-drying lumber may expand your horizons, allowing you to procure unusual species or wood with highly appealing figure. You may even capture that special wide slab you always wanted for a dining table top.

After the machines stop and the sawyer leaves, when there is just you, a pile of sawdust, and a great yield of awesome boards cut to suit, that’s your cue to move to the drying stage. It’s not difficult, but it does require an understanding of what happens to wood as it dries. It requires planning… and patience. Here, I’ll help you make the right drying decisions so you can reap the savings, as well as an enviable supply of usable lumber.

Harvesting Homegrown Woods
If you’re interested in felling selected trees on your property and having them sliced up for drying, see the companion story “Harvesting Backyard Exotics” in the Oct/Nov 2014 issue of Woodcraft Magazine, No. 61.
Why dry wood?
When first milled, over half the weight of a board is water. As wood dries, the cells shrink roughly 10% in diameter, but only about 0.1% in length. This varies somewhat by species—and even in the same board, depending on its location in the tree. (See Figure 1.) This means that a 1"× 8"× 8′ board fresh from the mill, will shrink to roughly 7/8" × 7 1/4" × 8′ long as it dries. Even the most carefully fitted joint can open up, crack, and possibly fall apart if built of “green” lumber. While the old-time woodworkers may not have understood the exact mechanism for wood movement, they came up with innovative ways to deal with it that we use today. Frame and panel doors, trestle tables, and post and beam construction are all designed to allow wood to move without coming apart. When you see a sprung joint or cracked part in a piece of furniture, you can pretty much finger the culprit. Another problem with green wood is that most adhesives require dry wood for a reliable bond. Bottom line: proper, controlled drying avoids a host of problems that crop up in the natural world of wood, resulting in stable project stock.

The air-drying/kiln-drying combo
Air-drying lumber is an inexpensive and easy way to get the wood down to a usable moisture content (MC) for most projects. The downside: you have to wait a year or longer. In fact, many woodworkers keep a five-year supply of wood. Of course, this takes up real estate, so you’ll need room to store the wood. Even then, it may take another six months in a humidity controlled environment to finish drying the wood to kiln-dried levels.

If you are in a hurry to get your wood down to its final “indoor” MC, consider kiln-drying to finish it off. Doing this will still save you money. Some sawmills also operate a drying kiln service. (Ask your state forestry or wood products association for a local contact.) You may also find one online through a web search. The cost varies, but is typically around $.25 per board foot, though smaller orders may cost more due to handling. Note that moving your wood around can be labor intensive.

Defects and prevention
Fungus is probably the most over-looked drying defect in wood. It is responsible for discoloration such as blue stain (as well as spalting). If the boards are “dead stacked” with no air space between layers, fungal growth will occur.

Cupping occurs when shrinkage causes the board edges to curl in the opposite direction of the annular rings.

Figure 1: Profiles in Shrinkage

Stock sawn in a variety of shapes and from different parts of the log will shrink and distort in unique and predictable ways. Quarter “vertical” grain or quartersawn pieces provide the most stable and truest results.

Source: U.S. Forest Laboratories
Stain can be noticeable in as little as two days. This is why it is important to have all your materials and plan for drying before you get your boards and then to stack your boards for air-drying right away.

One of the characteristics of wood is that it shrinks and swells differently throughout. This is called anisotropic shrinkage. As mentioned earlier, wood moves very little in length, but as much as 8% tangentially to the grain and 10% perpendicularly to the grain (Figure 1). When some pieces have significant tangential and perpendicular grain movement, you may encounter all sorts of havoc when drying the wood. For example, wide boards may cup and bow, depending on the grain (Photo B and Photo C). Avoid the problem by using strap clamps as shown in the European-style stack of boards in Photo D and by using weight as shown in Figure 3.

“End checking” is another common drying defect (Photo E). The cells of wood are like straw, allowing moisture to exit more quickly from the ends of the log than from the faces and edges. Since the ends are drier, they shrink more, and the resulting stress causes cracks that may go several inches into the board. Many woodworkers simply trim off the split board ends, but a much better solution is shown in Photo F to slow moisture movement.

“Crook” describes a board that bows from end to end along the edges. It is usually caused by the center of the growth rings (pith) near the edge of a board. The “juvenile wood,” within a half-inch of the pith has different shrinkage properties than wood added later in the tree’s life. If the pith is off center, the board will crook or bend sideways (Photo G). If the pith is centered, the board will usually crack right down the middle. You can salvage the good wood by cutting away the pith.

Apply several coats of latex paint or “AnchorSeal” on board ends soon after the tree has been cut to reduce end checking.

Board ends crack when they dry out significantly faster than the rest of the board.

The off-centered pith in this board caused it to both crook and crack.
Proper drying can become a rewarding part of the woodworking experience. But myths about the process need to be exposed and dispelled:

- **Kiln-dried wood does not shrink or swell.**
  False. Wood is a dynamic material that responds to changes in humidity. Kiln-drying does not change this. When exposed to high humidity, the wood will absorb moisture from the air and swell. The idea behind kiln-drying is to bring wood to the *average* moisture content it will encounter in its intended environment. Finishes such as varnish and lacquer act as barriers to moisture so the wood does not move appreciatively with seasonal variations in humidity (dry in the winter, humid in the summer), but do not totally seal the wood. Drawers that are loose in the winter, but stick tight in the summer serve as a perfect example.

- **Given time, air-dried stock results in the same MC as kiln-dried stock.**
  Wood is constantly equalizing its MC to the relative humidity of its environment. (See Figure 2.) A stack of wood in Phoenix, Arizona will air-dry to a lower MC than it would in Seattle, Washington. In most places, wood will air-dry to around 12% MC. This is a big improvement over green lumber, but it will shrink another 2% or so in width and thickness when it is brought indoors where the average humidity will bring the MC down to 8%. To get to that level, wood needs to either be kiln-dried or be stored in a dry environment to equalize out.

- **One year of air-drying per inch of thickness is optimal.**
  True, but.... Wood will reach an equilibrium air-dry MC (or EMC) at that rate, but it will continue to lose moisture and shrink when brought indoors. The thicker the wood, the longer the drying time. (See “Monitoring the Stack.”)

- **Air-dried wood contains no internal stress.**
  False. Air-drying lumber over time can help reduce stress in boards. This is not so much the case with kiln-dried stock where commercial kilns must dry lumber as quickly as possible. However, the wood may still contain stress created by the way it was cut at the mill. (See “Defects and Preventions.”) Stress also forms while the tree grows. Its boards may move (warp) during the drying process, and move again during machining. Also, the color of air-dried lumber remains truer than that of kiln-dried stock.

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**Figure 2: Average Air-Dry Moisture Content**

<table>
<thead>
<tr>
<th>Moisture Content (EMC)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>6% EMC</td>
<td>6%</td>
</tr>
<tr>
<td>8% EMC</td>
<td>8%</td>
</tr>
<tr>
<td>9% EMC</td>
<td>9%</td>
</tr>
<tr>
<td>11% EMC</td>
<td>11%</td>
</tr>
<tr>
<td>13% EMC</td>
<td>13%</td>
</tr>
<tr>
<td>16% EMC</td>
<td>16%</td>
</tr>
<tr>
<td>16%&gt; EMC</td>
<td>16%+</td>
</tr>
</tbody>
</table>

EMC = Equilibrium Moisture Content

Source: U.S. Dept. of the Interior
Building your air-drying stack

Now that you understand how and why wood moves, let’s build a proper stack for air-drying. Start by selecting a functional location on solid ground. It should be level, protected from sun and rain, and provide good air circulation. An open shed or outside area with a metal roof over the top is ideal.

To dry a quantity of lumber containing 1” and thicker boards from 6” to 10” wide and 6’ to 10’ long, follow the procedure below to build a proper stack using the materials shown in Figure 3.

Put a sheet of heavy (at least 4 mil) plastic on the ground to keep moisture away. Then lay out the landscaping timbers to raise the stack off the ground by at least 4” to 6”. For 1” thick boards (4/4), the timbers should be about 20” apart to keep the boards from sagging. They need to form a flat surface, as the boards will conform to the timbers as they dry. Next, lay a sticker along each landscape timber. If the boards vary in length, start the stack with the longest ones. Put the slower drying boards (thicker or slow-drying species) on the bottom, since they’ll be the last ones to be ready for use. I recommend identifying the species with a tag, so they will be easy to sort after they air-dry. Leave an inch or two of space between the boards for good air circulation by using 50 woodcraftmagazine.com April/May 2015

Dealing with bugs

Insects cause major damage to lumber, often reducing beautiful boards to something resembling Swiss cheese. Beetles are among the worst offenders. There’s not much to be done after the wood has been infested, other than call it “character.” But there is a much larger issue with insects. Once brought into your shop or home, they may develop a taste for other wood. Powder post beetles are particularly difficult to deal with, as they bore into exposed wood, leaving a little mound of wood powder under their holes. Once this happens, you may need a professional exterminator to fumigate your stack or shop.

The best way to deal with bugs found in your air-drying boards is to cook them in a kiln. According to the U.S. Forest Products Lab, raising the temperature to a minimum of 135° F for at least ninety minutes will kill all bugs in a board up to 2” thick. If you can’t turn up the heat, consider chemical warfare. Other measures include fumigation and the use of borax treatments, such as BoraCare and TimBor (found at home centers and online). Both are non-toxic to humans and pets. Using a sprayer, apply either product to the wood’s surfaces and the bugs will die when they chew their way out.

Figure 3: Building a Conventional Air-Drying Stack

Materials List:
1. 4 × 12’ plastic sheet
2. 4” × 4” × 4’ landscape timbers
3. 8” × 8” × 16’ cinder blocks (for weighting the stack down)–or 2” wide ratcheting straps in lieu of weights.
4. ¾”-1” square wood stickers 4’ long between board layers for air circulation.
5. 2” wide ratchet straps (for stacking boards in the order cut as in the European-style log stack, Photo D)
stickers/spacers of the same thickness. Align the stickers vertically so they transmit the weight of the stack straight down to the ground. Having a second person makes stacking easier, since it allows you to each take an end of the board and set it straight down without moving the stickers. Go as high as you safely can. I stop at 6’.

With a stack that is out in the open, do what you can to keep the rain and sun off, while allowing good air circulation. Whatever cover you use should sit on a layer of stickers to allow air to flow over the top of the stack. If this is a one-time proposition, overlap some scrap lumber on the stack to shed water, and strap or weight it down. Metal roofing, like the kind you get at a home centers, is better. Then comes the hard part...waiting.

The European style involves stacking slabbed wood (with one or both edges left natural) to reconstruct the log (Photo D). This allows the craftsman to select matching grain and create book-matched tabletops. The same drying principles apply to this stacking approach. Once the stack is assembled, put a couple of ratcheting straps on it to keep it from warping badly. Once a week or so, tighten down the ratchet straps. They tend to loosen some as the wood dries and shrinks. The top slab protects the stack from rain, and the edges naturally shed water. Unlike conventional stacking, it is not an efficient use of space.

Monitoring the stack: Are we there yet?
Though wood air-dries one year for each inch of thickness, this does not take into account drying rates based on the season, climate, and time of year. Air-drying only brings the wood down to an MC that corresponds to the average outdoor relative humidity, though it does respond to seasonal humidity changes. After a long, dry summer it may pick up moisture in the fall. Species such as walnut and poplar have a porous structure that allows them to dry more quickly than white oak or maple.

For many projects, such as rustic furniture, air-dried stock (around 12% MC) is good enough. If the design allows for shrinkage without damaging the wood or causing joints to loosen, you can use air-dry lumber. But for fine furniture, musical instruments, and other less tolerant projects, consider kiln-drying the wood or drying it in your heated shop to bring it down to around 7% to 8%. You can do this at any point in the drying process. Drying wood in the shop, however, requires space, a fan to circulate air, and monitoring the MC. Once the boards hit EMC, they’re ready for use.

For accurate monitoring, invest in a good moisture meter when air-drying wood (see the one I used in the buying guide). It lets you keep track of the MC of the wood you dry as well as the wood you buy. Pin-type meters (Photo H) measure the change in electrical resistance as wood dries, but are generally only accurate after the MC falls below the fiber saturation point (around 30%). They range between $50 and $300. The better ones compensate for temperature and species, and have wired probes for monitoring MC at several places in a lumber stack. These wires are left in the boards for the duration of the drying process.

Pinless meters are more expensive, but take a reading by holding one against the wood. They lack probes that could mar the wood.

About Our Author
Dave Boyt has run a portable sawmill business for 12 years in Neosho, Missouri, specializing in sustainably grown and salvaged timber. With degrees in forest management and wood technology, he competently manages his family’s tree farm, producing walnut, oak, and other hardwoods. He also serves as the managing editor of Sawmill & Woodlot Magazine.
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