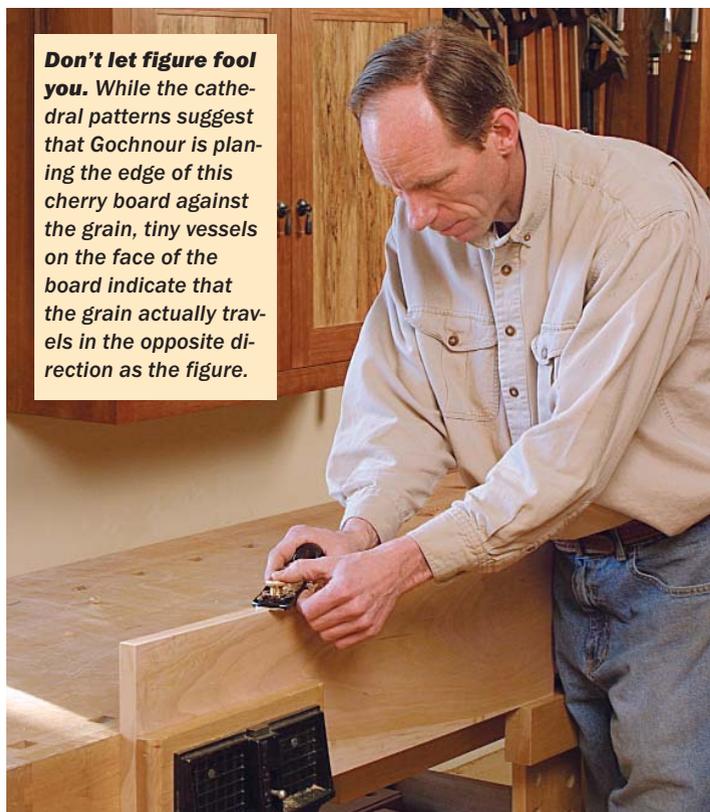


Determining grain direction



Don't let figure fool you. While the cathedral patterns suggest that Gochnour is planing the edge of this cherry board against the grain, tiny vessels on the face of the board indicate that the grain actually travels in the opposite direction as the figure.

Wood's beauty and appeal can be credited to the uniqueness and diversity of its grain. These same virtues, however, turn to vice when it comes to surfacing and smoothing lumber. The secret to achieving smooth surfaces with machine and hand tools is cutting in the direction of the grain. Sometimes grain can change direction on a single board. Depending on the species you're working with, grain direction is not always obvious.

While you have a 50:50 chance of success by guessing which direction the grain runs, you can increase your odds greatly by studying a board for clues, listening and feeling as you mill the wood or work it by hand, and making midcourse corrections when necessary.

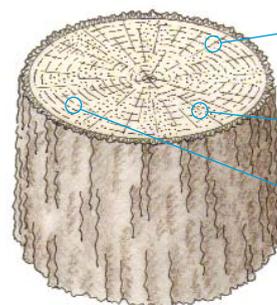
Rays, vessels, and figure are indicators

You can determine the grain orientation of various hardwoods by observing their physical characteristics. In some hardwoods, you can determine the grain direction by simply looking at the rays, which are wood cells that radiate from the center of a tree to its perimeter. They appear vividly in species such as oak, beech, and sycamore as dark, solid specs of varying lengths. Rays are visible on the surface of a plainsawn board in cross section, sandwiched between the fibers. Therefore, the long, narrow marks point in the same direction as the fibers, making them the most reliable indicator of the direction of the grain.

Rays can be difficult to make out on some species, in which case I look for vessels to determine grain direction. Vessels are wood

TO WORK THE EDGE, EXAMINE THE FACE

Determine the grain direction on the edge of a board by studying the orientation of rays, vessels, or figure on the face. Some species of wood display these characteristics more prominently than others.



Rays appear as flecks on the face of a board.

Vessels appear as long, open tubes on the face of a board.

Growth rings appear as figure on the face of a board.

RAYS

Wood cells that radiate from the center of a tree appear on the surface of a board in cross section as dark specks or lines. The rays on this oak board run opposite the cathedral patterns, proving that figure doesn't always go in the direction of the grain.



VESSELS

Wood cells that extend linearly on hardwood appear as long, open tubes on the surface and as small, open pores on end grain. Woods such as walnut (shown here), butternut, and mahogany have prominent vessels that make it easy to read grain direction.



FIGURE

Often referred to as grain, figure is the result of the annular growth rings intersecting with the surface of a board. In species such as alder and maple (shown), rays and vessels are difficult to make out, so reading the figure is the only option to determine grain direction.



Rules of Thumb (continued)



Glued-up panels pose a problem. It's not possible to examine the edges of a board for grain direction if it's in the middle of a glued-up panel, so you must rely on its figure to guide the way.

cells that extend linearly in hardwood and appear most prominently in species such as mahogany, walnut, and butternut. They appear on the surface of the board as long, open tubes and on the end grain as small, open pores. Vessels align with the direction of the grain, so identifying the direction vessels travel also indicates the direction the grain travels.

Because many species display neither rays nor vessels to the naked eye, figure (which often is referred to as grain) is the last characteristic I look at to assess grain direction. Figure is created when the varying densities and color of the annular growth rings intersect with the surface of the board. On the face of a plainsawn board, figure often appears in cathedral patterns (see the photo at top right). Most of the time, figure will follow the grain, so it can be used as an indicator. However, it's not uncommon for grain to run opposite the figure, so this isn't always the most reliable source. In woods that don't have prominent vessels or rays, such as cherry, maple, and alder, figure is the best characteristic to go by.

How to read a board

When cutting the surface of a board with a jointer, planer, or hand tools, you should use rays, vessels, and figure to determine the best direction to cut.

A good place to start is to inspect the edge adjacent to the surface you are working. The majority of the time, rays, vessels, or figure will travel diagonally across the edge of a board, revealing the grain direction. This will indicate how a board should be oriented so that the surface cut lays down the fibers in the path of the blade. This same rule can be applied when working the edge of a board. Inspect the adjacent surface to determine the grain direction.

In situations where the edges of the board cannot be seen, such as when handplaning glued-up panels or tabletops, I observe the orientation of the growth rings on the board's end in relation to the cathedral patterns on the surface to determine grain direction. If the growth rings arch upward when looking at the end of a board,

TO WORK THE FACE, EXAMINE ALL SIDES

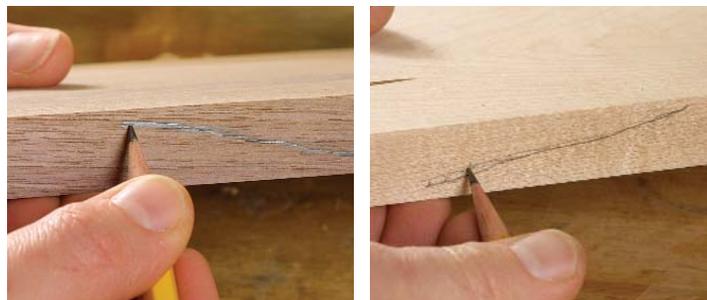
There are two methods for determining grain direction on the surface of a board. Once you determine the direction, you can joint or plane the face of a board in the direction of the grain to prevent tearout.

2. Study the rings and cathedrals.

1. Look at the edge of the board.

INSPECT THE EDGE

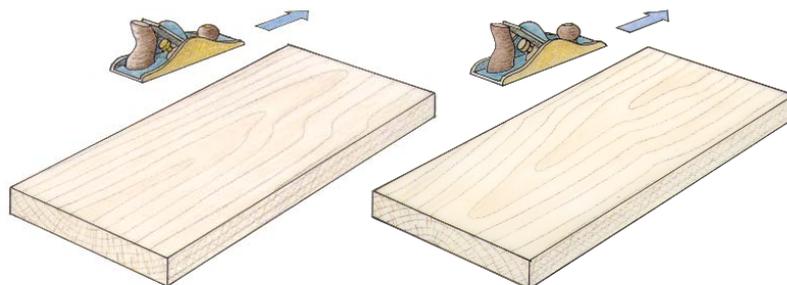
Studying the rays, vessels, and figure on the edge of the board can help determine the grain direction on its face.



The direction of the vessels on this piece of walnut (left) indicates the direction of the grain and determines which way the adjacent surface should be worked. On a maple board (right), the figure points the way.

READ THE RINGS AND CATHEDRALS

The growth rings on the end of the board appear as cathedrals on its face. Together, they create a topographic map of the grain.



If the growth rings arch downward, cut in the direction the cathedrals point.

If the growth rings arch upward, cut into the cathedral points.

Rules of Thumb (continued)

your cut should be made into the cathedral points on the surface. If the growth rings arch downward at the end of the board, the cut should be in the same direction the cathedrals are pointing.

Keep track of grain as you work

When milling lumber, you will have the best success producing smooth, tear-free material if you keep track of the grain direction on each board. When surfacing lumber, mark the edge of the board with a diagonal line that shows the direction of its grain. You can use the mark to determine the orientation of the board quickly when feeding it through a planer or jointer. When planing or jointing the edge of lumber, draw the diagonal mark on the face of the board. This marking system is especially useful when milling large quantities of wood. Make sure each piece is marked properly, and keep the wood stacked with the grain running in a consistent direction.

It's also important to know that the grain runs in the opposite direction on opposing surfaces of a board. So you must flip over the board, end to end, to maintain the same grain orientation. Flipping the board sideways will reverse the grain direction.

More than meets the eye

While rays, vessels, and figure can be a good indicator of grain direction, some woods invariably will deceive you. Also, it is rare to find a board in which all of the grain is going in the same direction. As I work, I watch, feel, and listen to the progress of my cut, always

assessing how the wood is responding to the blade. If I hear the snapping sound of breaking fibers while using machines, I ease up on the speed of the pass, lighten the cut, and try feeding the board in the other direction on the next cut. With properly tuned equipment, moderate cuts, and a slow feed rate, boards with changing grain direction can be accommodated.

Sometimes you will come across a board that tears out in every direction. This is especially the case with highly figured boards, such as bird's-eye maple or curly woods. Once you've discovered that you're going to get tearout in either direction, you can try a few tricks. One is to dampen the surface of the board before passing it across the blade. You also can try sending the board across the blade at a skew; that way you are cutting across the grain rather than attacking it head-on.

Handplanes are more sensitive than machines, so you will feel when a cut is going against the grain. Cutting with the grain should feel smooth, while cutting against it feels rough. Handplaning also is advantageous because you can reverse the direction of your cut when grain changes midway through a board. I try to avoid this practice, though, because I prefer to take long, continuous strokes.

With time, identifying the direction of the grain and working in its favor can become second nature, even with the most complex grain patterns. Keep in mind that in the real world, grain direction can be unpredictable. The goal then is to determine the direction that the majority of the fibers lay and work them in the most favorable direction. □