

MAKING FIRE WITH A FIRE-DRILL

by Jim Buller

One of the simplest, and most common world-wide primitive fire starting method is the hand-drill. To make fire with a hand-drill, a straight round 'spindle' is spun back and forth between the palms of the hands while being pressed into a socket on a 'hearth' or 'fire-board.' The friction, created by the speed and pressure of the spinning spindle, generates heat. 'Charred dust,' which is also created in this process, is collected in a 'notch' going into one side of the socket on the fire-board. Once the notch has filled with charred dust, assuming everything else is being done right, the spindle is spun even faster and given extra pressure to create enough heat to bring the charred dust up to combustion temperature, and produce a burning coal or 'ember.'

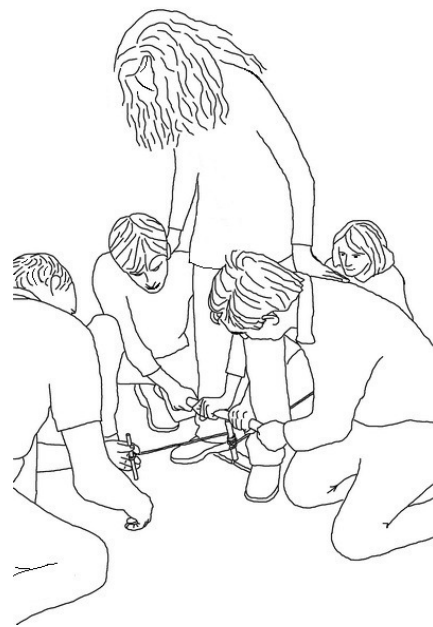
There are other forms of this basic fire-drill which use other ways of spinning, and putting pressure on the spindle. The most common is probably the bow-drill. To get fire by any of these methods, there are simply a lot of things that must be 'done right.' The right materials must be used. They must be carved into the right shape. The various pieces must be held together correctly, which also means that your body must be held in the right position. And finally, the right technique must be used! With enough practice, all this *can* become almost second nature, and appear 'easy.' But expect a lot of trial and error, together with a fair amount of frustration while learning the process.

Since we didn't have anyone to teach us how to make fire with a bow-drill, we had to learn this skill from a book. At the time, there were about three of us working on it together, and it took us several practice sessions. Adding things up later, it was roughly the equivalent of a full day's worth of trial and error, before we finally got our first coal. This experience underlines, at least to me, that if someone did not already *know* how to make fire with a fire-drill, they shouldn't expect to be able to do it on that first evening before a cold night of a survival situation—simply because some books say it is possible, or because they saw someone do it, or even if they had someone coach them through the process with a pre-made fire-drill set so that they got fire once! Like many other wilderness skills, you must invest some time and effort preparing ahead of time if you want to be able to rely on these skills in a survival situation.

Group Cord-Drill

A while back, I saw a picture somewhere on the internet of a group doing a bow-drill using a stick about two feet long for the hand-hold/pressure-plate. Since the group of students I was working with at the time had been trying, unsuccessfully, to make a bow-drill fire, I turned them loose on the idea. They got a coal on their second try!

When one person is learning to make fire with a hand-drill or bow-drill he/she has to get *everything* right. For example, the spindle has to be kept steady so it doesn't wobble around, while spinning it at a sufficient speed and applying the right amount of



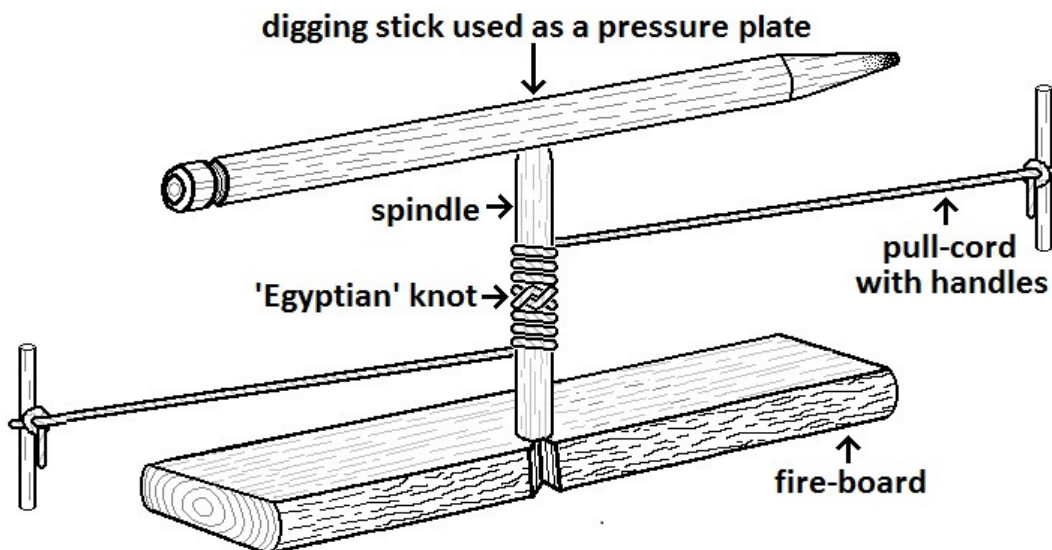
downward pressure. This has typically been a quite a challenge. However, with the group method each person only has to focus on doing one or two of these things, and getting them right. Of course the flip side of this is that one person can mess things up for the whole group.

Since that first experiment with a group bow-drill, we have found ways that increase the chances of a group getting fire even more. From our experience, it seems that if there is at least one person in a group of otherwise unskilled individuals who knows the principles of how a fire-drill works, their chances of actually getting a fire are significantly greater, than if that person tries to do it all by themselves.

There are already many resources available that teach individual fire-drill methods. But other than that one picture, and some giant fire-drills which are mostly just for fun, I have not seen any descriptions of how to work a group fire-drill. So, since one of the focuses of this book is to present a group approach to wilderness survival, the group fire-drill method is what will be shared here. This method also makes fire possible for those who are simply not strong enough to get a coal on their own —such as might be the case with children.

Choosing the Right Materials

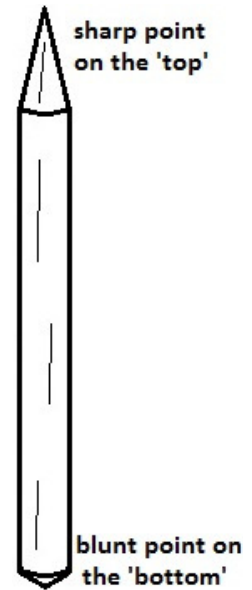
Try what is know as the ‘thumbnail test’ on your local woods. Press your thumbnail into a corner on a piece of the wood. If you can make a slight dent then it should work. If you cannot make a dent, the wood is probably too hard to work well. On the other hand, if your thumbnail makes a large dent the wood may be too soft, and you will end up just drilling through it rather than creating enough friction to reach combustion temperature. Some woods that work well are the various cedar, cottonwood, poplar, and willow species. As a last resort, you might try pine, but be sure to pick a piece that doesn't have any pitch —which will only gum thing up. The wood also needs to be dry. It is possible to make a fire with damp wood, (see the note later in this section), but expect it to be much more difficult, and take considerably longer. Using different woods for the fire-board and the spindle appear to create a bit more friction, but you can make the spindle and fire-board from the same wood.



Carving the Spindle

Unless you can find a straight dead branch or sapling trunk with the right measurements, you will need to carve a spindle. The spindle needs to be about 8 to 12 in / 20 to 30 cm long, and $\frac{1}{2}$ to $\frac{3}{4}$ in / 10 to 18 mm in diameter. It must also be *straight*. If it has any more than the slightest curve in it, the spindle will wobble when spun, and be very difficult, if not impossible to control. The spindle will be much easier to carve, and be stronger if it is made in-line with the 'grain' or growth rings of the wood rather than at an angle to the natural grain of the wood. Split some straight grained wood roughly to size and then round it with a knife.

Point both ends of the spindle. However, make the 'top' end pointed at essentially the same angle as a sharpened pencil. Whereas make a much more blunt point on the 'bottom' end.

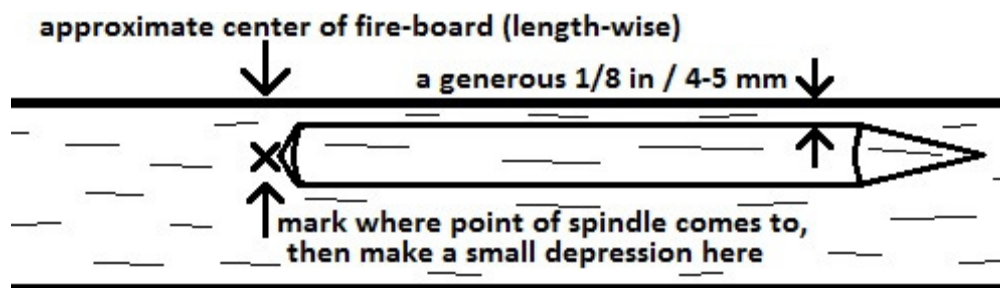


Carving the Fire-Board or Hearth

Split out and/or carve a 'board' that is about $\frac{5}{8}$ to $\frac{3}{4}$ in / 1.5 to 2 cm thick, about $1\frac{1}{2}$ to 3 in / 4 to 8 cm wide, and 1 to 2 ft / 30 to 60 cm long. You can flatten a round branch on both top and bottom for the fire-board, or split it out of a larger piece of trunk wood. The board needs to lay flat on the ground, and not 'teeter-toter.'

But before you start carving, notice the 'growth rings' on the end of the wood. If at all possible, these lines should be running up and down, rather than horizontal, compared to the 'flat' of the finished board. Although it may be possible to get fire with the growth rings running horizontally, it will be more difficult as you first 'hang up,' and then 'break through,' the 'layers' created by each ring. On the other hand, more friction seems to be created by 'drilling' against the edges of the growth rings—which would be the case if they are running up and down.

When you have finished carving bot spindle and fire-board, lay the spindle along one edge of the fire-board with the bottom point of the spindle close to the center, length-wise, of the fire-board. Roll it away from the edge a generous $\frac{1}{8}$ in / 4-5 mm. Mark where the bottom point of the spindle comes to on the fire-board. Remove the spindle, and make a shallow depression in the fire-board at this spot that is just deep enough to receive the bottom point of the spindle.



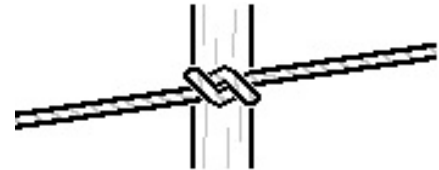
The Pressure Plate

Choose a handle diameter stick about 2-2 $\frac{1}{2}$ ft / 60-75 cm long of the hardest wood you can easily get a hold of. Your digging stick may work well for this. Find the

natural curvature of the stick. On the underside of the natural curvature, make a small depression at the approximate center, length-wise, of the stick. This depression will receive the upper point of the spindle.

Pull-Cord

You will need about 4 or 5 ft / 1.2-1.5 m of cordage. This group strap-drill method appears to be able to use cordage that would be marginal for a bow-drill, but it is still best to use cordage that is pliable and tough. Tie the center of the cordage to the center of the spindle with a simple overhand knot. Some people use fancier knots, but the simple overhand knot works well. This technique is known as an 'Egyptian Knot,' which refers to the practice of securing the cordage to the spindle with a knot, and then wrapping the cordage around the spindle several times both above and below the knot more than to any particular type of knot. It will also make the drilling process a lot easier if short sticks are tied to each end of the cordage for handles —the two half-hitches knot works well.



A Tinder Bundle

Although it is not part of the fire-drill set as such, a tinder bundle is also a very important part of this process. So before you spin up a coal, prepare some tinder. Tinder is dry shredded, almost as fine as hair, material that will easily grow a coal and catch fire. Look for dry grasses, shreddy inner and outer barks, shredded pine needles, downy seed fluffs, the stringy fibers at the base of palm fronds, and similar material. Fine wood scrapings can also work. If necessary, shred the tinder even more by rubbing it between the palms of your hands. It needs to be almost hair-fine and somewhat fluffy.

Some materials, like cattail down and dried grasses, catch fire easily, but don't grow a coal very well. Others, like shredded inner cottonwood bark, grow a coal wonderfully, but don't like to burst into flame. Also, many dried grasses, are stiff and won't form a good 'nest' for the coal. Instead they allow the coal to fall through the bundle. You will have to experiment with what is available in your area, and may find that a combination of materials actually works best. In relatively dry weather, these considerations may not be quite so critical, but when the weather makes things marginal, it is important to have tinder that will both grow the coal, *and* burst into flame.

In wet conditions, the only thing that might work would be to make the tinder bundle from pitch-wood scrapings, or at least adding a generous amount of these scrapings to the center of a bundle. Giving the coal a chance to heat and dry the tinder before blowing it to flame can also be a useful technique when things are damp. However, if you are relying on a fire-drill, or some other primitive method to start your fire, the best practice is to carry dry tinder with you.

Make the tinder bundle by wrapping some tinder into a nest shaped bundle about the size of a



large fist. The bundle's density should be somewhat spongy, firm but not compact. If possible, place a generous spoonful of the driest, finest tinder material, some dry crushed well rotted wood, pith from the center of a plant stalk, or similar material, in the center of the nest to help grow the coal. If fine tinder is scarce, a handful of larger material, such as pine needles, can be wrapped around a smaller tinder bundle, but this is usually less than ideal.

Place the tinder bundle close at hand in a safe dry place. Also, be sure to prepare the fire-pit, have a couple handfuls of pencil size and smaller dry twigs, along with a couple more handfuls of finger size twigs, and some fuel wood ready before you spin up a coal. There is nothing worse than blowing a hard earned coal to flame, and then having the tinder bundle burn up as you're scrambling around trying to find some kindling.

Positioning the Group

Once the set is carved, and above materials have been prepared, you are ready to start drilling. This group method can be used with anywhere from two to five or more people. The most efficient way seems to be with two people, so that is what we will give directions for here.

The Anchor/Pressure Person

Find something to sit on, such as a rock or log, with a relatively level and preferably dry area in front of where you sit. Place the fire-board on the ground in front of you so that you can put one foot on each end of the fire-board to keep it from moving around. Wrap the cordage around the spindle three or four time both above and below the knot. Be sure it is wrapped in the same direction that it comes out of the knot, which will be in opposite directions above and below the knot. Place the spindle in between the pressure plate stick and the fire-board with the 'top' point of the spindle in the depression on the pressure plate stick, and the 'bottom' point of the spindle in the depression on the fire-board. Hold the ends of the pressure plate stick so that it is braced firmly against your shins. For the time being, position the fire-board under your feet so that the spindle is straight up and down, both front to back and side to side. (The top of the spindle may need to be angled a bit forward later on.) Rotate the pressure plate stick so it is 'top dead center' to the spindle. Otherwise the spindle will tend to slip out of the depression, either to the front or to the back.

The anchor/pressure person's job is: (1) To hold the fire-board in place so that it doesn't scoot around during the drilling process. (2) Keep the spindle straight up and down, both front to back and side to side. The spindle should be held firmly against your shins so it does not wobble around at all. (3) Provide the downward pressure on the spindle. If necessary, two other people can sit on either side to help provide more pressure.

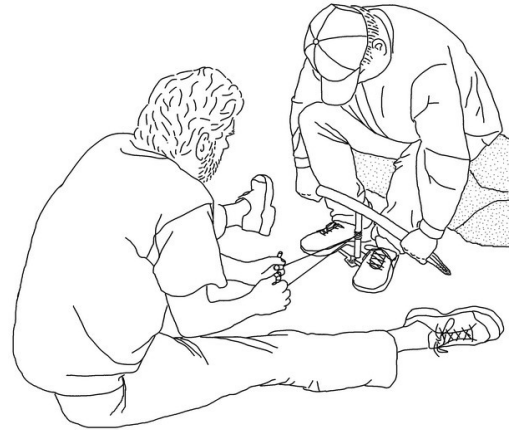
The Cord-Puller(s)

The cord puller sits on the ground in front of the anchor person to pull the cordage back and forth to spin the spindle. As you pull the cord back and forth, try to keep your hands level with the center of the spindle, so the cord will wrap evenly on the spindle, (in other words, don't pull 'up and down' at an angle). Also, don't allow any

slack in the cordage between yourself and the spindle. Sit back far enough so the cord can be pulled 12 to 18 in / 30 to 45 cm back and forth without hitting your legs or body. Set a good rhythm and make smooth long strokes. Two people can act as cord pullers, one to each side. Or, another person can kneel behind the main cord puller and reach over them, placing their hands over the main person's hands to grip the stick handles and help pull the cord back and forth.

The Drilling Process in Action

Once you are in position, and understand what you need to do, start pulling the cord back and forth to spin the spindle. Get a good rhythm is going, then start applying downward pressure on the spindle with the pressure plate stick. As things heat up, you should see smoke coming from where the spindle is spinning in the fire-board.



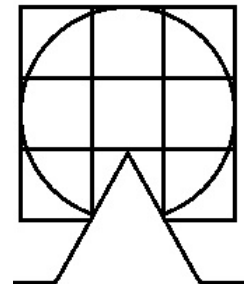
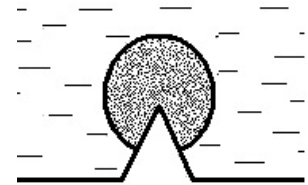
Seating the Spindle

Even though this process should produce some good smoke, don't worry about trying to 'make fire' just yet. Before you will be able to make fire you will need to cut the 'notch,' and before you can cut the notch, you need to 'seat' the bottom of the spindle into a matching socket on the fire-board. As the spindle is spun under pressure it will drill into the fire-board so that the initial depression deepens and broadens into a socket with the same dimensions as the end of the spindle. Notice the charred dust that is formed in this process —more about that later. Once the diameter of the socket in the fire-board matches the diameter of the spindle, stop drilling, and cut the notch.

Cutting the Notch

A burning coal forms when the charred dust created by the drilling process heat up to its combustion temperature. The notch provides a place for this dust to collect, and then once the notch is filled with dust, it holds the dust in contact with the hot end of the spindle. The notch must also be wide enough to let sufficient Oxygen in for combustion, but not so wide that the spindle will be pulled out in the drilling process. Enough 'shoulder' needs to remain on the edges of the socket to keep the spindle in place. To put it another way, the notch needs to go into the socket deep enough to provide adequate contact for the charred dust, but not so deep that the spindle will 'wallow out,' or drill its way out through the notch —although this is something that seems to happen every now and then despite our best efforts and intentions.

Someone has come up with the idea of a "law of thirds" to help find the correct dimensions for the notch. As I understand it, the socket in the fire-board is mentally divided into thirds, both from side to side, and from front to back. The notch is a triangular cut from the edge of the fire-board that goes a third of the way into the socket, and cuts



across the center third of the width of the socket. Personally, I just envision an equilateral triangle that cuts 'not quite' to the center of the socket.

If at all possible, cut the notch with a sharp knife, so its sides will be smooth and straight. Once a coal has formed, you will want to be able to pull the fire-board away from it without the roughness of the sides of the notch scattering the pile of dust containing the coal—which means you would have to start all over again. A sharp saw can be used to cut the notch, but saws have a tendency to make the notch bigger than it should be, and a sharp knife will make smoother sides. If you don't have a tool to cut the notch, it can be ground out with an appropriately angled edge of a rock.

Spinning Up a Coal

Now that the notch is cut, you are ready to 'make fire.' Put the fire-board back on the ground with the notch facing outward so you can watch what is happening there. Place a leaf or thin chip of wood under the notch so you can pick up the coal once it forms. Get back into position. Rewind and replace the spindle and pressure plate stick. Start pulling the cordage back and forth. Once a good rhythm is established, gradually increase the pressure. As things heat up, you should see smoke coming from between the spindle and fire-board, and the notch should start filling with charred dust. Keep up a steady pace until the notch is full. If the spindle flies out, rewind it, put it back into place, and start over. Try not to lose the dust that has already collected in the notch, as the notch must be full of dust before you can get fire. If the spindle appears to be starting to drill out of the notch, scoot forward on your seat so that the spindle will be angled back into the fire-board slightly, (see Trouble Shooting section below).

When the notch is full, spin the spindle a little faster, increase the pressure a bit more, and pray for fire. Watch for smoke coming out of the pile of charred dust itself, rather than just from in between the spindle and fire-board. When you see smoke coming from the pile of dust, stop.

Up until now there has been a lot of energy going into the drilling process. But now it is time to relax. Carefully remove the pressure plate stick and spindle so as not to disturb the young glowing coal. Tap the fire-board with the pressure plate stick, or something else, to loosen the coal from the notch before lifting the fire-board.

Gently fan the burning coal with your hand allowing it grow into the pile of charred dust. Notice that the charred dust forming the ember sticks together rather than remaining loose like the rest of the dust. This is called 'coalescing.' So let the coal coalesce and grow a bit, so that it doesn't fall apart when you transfer it to the tinder bundle. Continue gently fanning it off and on during this process as necessary.

After the coal has grown into most of the dust pile, gently transfer it to the center of the tinder bundle 'nest,' Then, fold the bundle around the coal, (somewhat like a 'taco'). Gently and steadily blow on the coal so it will spread into the tinder. Smoke should begin pouring out of the bundle, so hold the bundle above the level of your face so you can turn your head down and to one side to get some fresh air. Work with nature. Turn your whole body so that any wind will help to blow on the coal, rather than blowing the smoke into your face. Before you start blowing on the coal, it is a good idea to position yourself so that you can quickly place the tinder bundle safely,



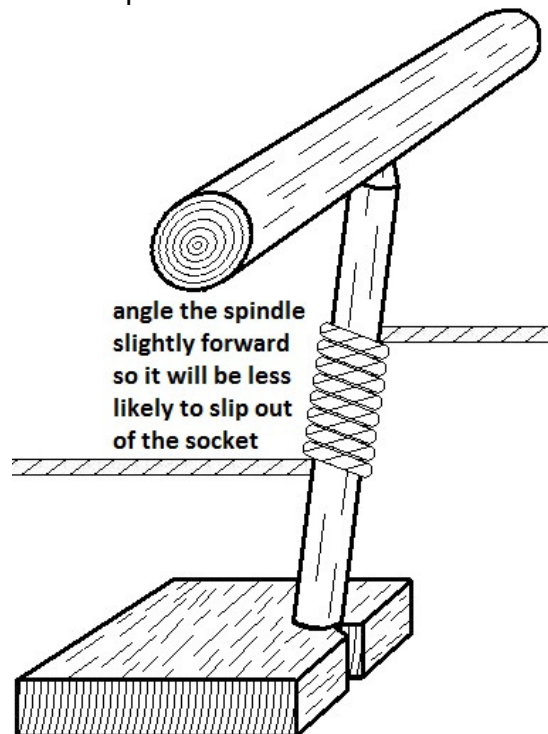
and directly into the fire-pit once it bursts to flame. Hopefully you already have some kindling ready to start your fire with.

What If the Wood is Wet

Do your best to find and use dry wood to make your fire-drill set. Especially if you will be using the set to make fire again in the future do everything you can to keep it dry. once it is made. However, you can still make a fire if the wood is wet, or if it gets wet—it will just take a lot longer. Put your set together and start drilling, but don't expect to get fire just yet. Drill just long enough to heat up the end of the spindle in the socket of the fire-board, probably until you get that first whiff of smoke. Then stop drilling, while still keeping everything in position, especially the spindle in the fire-board. Let the heat that was generated dry the wood for a couple minutes. Then drill for a bit again to reheat the wood. Stop and rest again for a couple minutes, still keeping the everything in place while the wood dries some more. Continue drilling and drying until the wood, at least in the area of the end of the spindle and socket of the fire-board is dry enough to produce a coal.

Trouble Shooting

- What if the spindle keeps flying out?
 - > Be sure spindle is straight up and down in its side to side alignment.
 - > Be sure the pressure-stick is 'top dead-center' to the spindle.
 - > Carve the depressions a little deeper.
 - > Re-point the top, and possibly the bottom of the spindle.
 - > If the spindle is starting to 'wallow out,' or drilling out through the notch, sometimes it is possible to save things by the anchor person shifting their position to angle the spindle back into the fire-board just a bit. You might also try turning the fire-board around, so the notch is away from you and the spindle will be pulled against the back of the socket as it is spun. But then you will not be able to readily tell when you have a coal—you may have to just stop and take a look. If none of this works, make another socket. Re-point the bottom of the spindle, and make another depression in the fire-board a couple inches / 5 cm to one side of the first socket. Re-seat the spindle to the fire-board, then cut a new notch, and try again.
- Plenty of smoke but no coal.
 - > Add a bit more pressure.
 - > Take longer strokes with the pull-cord
 - > Drill a little faster.
 - > If the notch is too narrow, there won't be enough for oxygen coal to form. Slightly



- widen the notch. But don't make it much wider than 60 degrees, or you will risk the spindle wallowing out.
- > The wood may be slightly damp. See instructions for wet wood.
 - > Try again with some different wood. Especially if the spindle has difficulty seating in the fire-board, (the fire-board wood may be too hard), or if the spindle seems to drill right through, (the fire-board wood being too soft).
- Not even getting any smoke.
 - > Take longer strokes, increase speed and/or pressure.
 - > Try different woods.
 - Squeaks!
 - > Increase pressure. Squeaking is caused by the ends of the spindle and the insides of the sockets becoming fire-hardened, or 'glazed.' Although this isn't a problem at the top end of the spindle, it will keep you from getting a coal on the bottom. Look at the inside of the socket and the bottom of the spindle to see if they are dark and glazed, or 'polished' looking. Increased pressure is needed to break through this fire-hardening. (Sometimes adding a few grains of sand can help to break through the glaze.)
 - The coal goes out before the tinder bundle bursts to flame, or the tinder bundle just won't burst to flame.
 - > Possibly the tinder bundle is too loose. This allows, or even causes, the coal to fall apart and filter through the tinder and out of the bundle. Stiff dry grass is notorious for letting this happen. Add about a 1½ in / 4 cm diameter pad of some very fine tinder material or 'coal extender' to the center of the tinder bundle 'nest,' and try again.
 - > As mentioned earlier, ideal tinder needs to both grow a coal, and burst to flame. There are some tinders that do a great job growing a coal, but are difficult to get to burst to flame. If you are having trouble getting a flame, this might be the problem. Try some different tinder, or mix some other tinder material into the tinder bundle.
 - > If the tinder is damp, the cooling effect of the moisture could keep the bundle from catching flame. Do all you can to find dry tinder, and then keep it dry. Even the moisture from your hands can cause problems if you hold the tinder for any length of time. So, unless the weather is fairly dry, carry the tinder to camp in a bag, or basket, or something else, rather than in your hand.
 - > If you are forced to deal with damp tinder, use the driest tinder you can get, and make the coal as large as possible. If possible, place a thick pad of coal extender in the center of the bundle. Carefully place the coal on this pad. Collect all the charred dust you made, and place it on top of the coal—but be careful not to smother it. Carefully fold the bundle together and let the coal heat and dry the tinder. Only blow on the coal enough to keep it alive. Add more coal extender to grow the coal if possible. Let the tinder bundle heat and dry like this for several minutes before trying to blow it to flame.
 - > If you know you have good tinder, the problem may simply be the way you are blowing on it. Blowing too hard can scatter the coal. Not blowing hard enough will keep the tinder from heating up to combustion temperature. How to blow 'just right' is hard to put into words. You will just have to experiment. This re-emphasizes the importance of practicing ahead of time, before you need to rely on these skills for survival.