

Tuning a woodwind

The placement and sizing of holes on a reed, flute or fipple flute determines the pitch produced by uncovering the hole. Vessel flutes are different.

Basic principles

The less taper there is to your tube, the more the upper register fingering will match the lower register.

Place the holes where the player's fingers can easily reach.

The higher the hole (nearer the mouth piece), the higher the pitch.

The larger the hole, the higher the pitch. (This is only true up to a hole with diameter 1/2 the bore diameter).

The pitch of higher notes is affected by the holes below, so tune from the bottom up.

The lowest hole is farther from the end than the distance between holes.

The smaller the bore, the easier to play the upper register.

The effective length of the vibrating air column required for a given pitch is absolute. The actual length of the instrument will be longer than that absolute and is influence by the bore size. Reeds produce a VAC longer than flutes of the same length.

A full diatonic scale requires 6 holes for a flute and 9 for a reed.

Most adults can finger a C instrument, 12-13 inches long; large hands can play lower keys. Cut your tube with extra length.

The natural end of a dipper gourd can be used for a reed bed, but this is not essential.

When measuring the VAC (vibrating air column) length, measure from the open end to the plug of a flute or the tip of a reed.

Tune the lowest note

When you have the mouthpiece working, cut the length of the instrument to give you the low note you want.

Do this a little at a time so as not to cut too much.

Blow through the tube and rub it with your hands to warm the inside. This will help make the pitch more stable.

Test the pitch you're starting with, then shorten the tube by cutting small amounts off the open end until you get your target. If you're not familiar with tuners, refer to the write-up [here](#).

Cut little bits at a time! See how much difference each cut makes. Toward the end, you can file material away instead of cutting. The reason for taking such care is that it's easy to raise the pitch but ridiculously hard to lower it. So don't go too high.

You will notice that the pitch meter gives slightly varying results. The pitch rises the harder you blow. Blow in a way that gives a nice strong sound. When you get close to the right pitch, test several times and believe the reading that comes up most often.



Mark the finger holes

All measurements are in mm (millimeters).*

Measure the VAC length (see above) _____

* If you don't already have a millimeter ruler, you're in for a treat. Small measurements are SO-O-O much easier in metric. Try looking for one in the office or school supplies section of your grocery store or pharmacy. Until then, you can convert inches to mm by multiplying them x 25.4. That means 1/4 inch is roughly 6mm.

Measure the the inside diameter of your tube (the bore). If it is more than 20mm calculate your correction factor:

bore size _____

- 20 _____ subtract 20

x .09 _____ multiply the line above by .09

x VAC _____ multiply the line above by the VAC.

The last line is your correction factor, used in the table below.

Fill in the table below. In the middle column, write the VAC length times the number in the first column. In the third column, add the correction factor above to the number in the middle column. If your tube was small-bore and you didn't calculate a correction factor, leave that column blank.

	x VAC	+ CF
0.54		
0.47		
0.39		
0.31		
0.24		
0.15		

The right hand column are distances from the bottom of the instrument to each hole in a diatonic scale. If you put holes in these locations, you can tune the instrument to play a major scale, with do being all holes covered, uncovering each hole from the bottom up, you get re, mi, fa, sol, la, ti. If you're making a tubular flute, (i.e., not a vessel flute) the next do in the scale is played by covering all the holes again and blowing harder. For a reed, the next note requires another hole higher than the chart shows. See [this example](#) for more about reed holes.

Measuring from the bottom, make lines across the tube at the distances in the table. Use the right-hand column if there is anything there. There could be reasons you don't like these numbers. If so, read [this discussion](#). Have the player hold the instrument as though playing it, lining up the fingers with the marks you drew. The fingers of the left hand go on the top 3 lines and the right hand takes the bottom 3. You can use any 3 of your 4 fingers, unless you have trouble moving the two smallest fingers independently of each other.

If the fingers have trouble reaching the marks, adjust the locations. You can adjust any hole to move it around the tube without changing its distance from the bottom. You can adjust the bottom notes of the top hand and the top notes of the bottom hand and so that each hand has a tighter cluster and there is more distance between the hands. Avoid changing the distance from the bottom of the instrument to either the lowest or highest hole.

Make a cross under each finger where it lies on the gourd, by drawing a longitudinal line to cross the horizontal line you already have. This will be the center for your sound holes. The idea is to put the holes where the player can easily reach them. When you have all the crosses marked, check to see that the fingers fall easily onto the crosses.

To test whether this layout is workable, drill a small hole at the second lowest position, 0.24 x VAC from the bottom of the gourd. The hole should be about half the size you eventually want it to be. Check the note with your tuner.

*** NOTE ***

The pitch indicated by an electronic tuner can vary. To stay accurate, tune all the holes relative to the one below, rather than to absolute pitch. To do this, play the two notes on one breath without changing the pressure

of the breath or the shape of your mouth. Simply cover the hole you're tuning, start blowing, and uncover the hole while reading the tuner. You will easily see if the interval is less than the interval you're trying to create.

- Ideally, the pitch of the test hole is one to one-and-a-half steps above the lowest note. If yours is in, or near, that range, this layout will work. Put masking tape over this hole and proceed to drill and tune the bottom hole, then each hole in turn from bottom to top, tuning each before drilling the next. If you have to make any hole bigger than you would like, move the remaining hole marks for that hand up a bit.
- If the pitch is 1/2 step or less above the lowest note, the holes are too close to the bottom. Make this one the lowest hole. Tune it. If the final hole size is good, move the marks for the next two holes up about as much as this one moved. You can move them up more or less if this hole is too big or small, respectively.
- If the pitch of the test hole is two steps or more above the lowest note, the holes are too high up. Make this one number 3. Tape it over and change the bottom 3 marks to put this in the number 3 spot.

Write the target pitch beside each cross. For a C whistle, the pitches will be D, E, F, G, A, B from bottom to top. If you aren't sure of your pitches, refer to the [explanation of scales](#).

A reed will have additional holes above the six you're making now. Put in these six, then use the same principles to place the others, noticing that the space between holes gets smaller as you go higher.

Flutes of all types can have more than six holes also. If you want more holes, decide what you want in advance and make room for the extras. For example, to make the 6-hole flute play in both its native key and the key for which its low note is the 5th, convert the top hole into two: the original note and the flat. For a C flute, that would give you B \flat and you can play in F. The flat will be lower than your top mark and both holes will be small.

Cut finger holes

Start with the lowest hole and work up. Tune each hole before cutting the next. If a hole gets bigger than you would like, move the next hole higher. If a hole is too small, move the next one lower. The 3rd hole will be smaller than the others (or closer to the one below).

Cut a small hole first, check the pitch (by comparing it to the pitch below) and make the hole larger a little at a time. If you're not familiar with tuners and pitches, the refer to [this write up](#).

When you're done, clean up the holes to remove any hanging bits of gourd.

Troubles...

Plug a hole

If you need to plug a hole, first be sure you need to. Tape over the hole with masking tape and get everything working, then fill the hole.

The easy way is to use a dowel the same size as your hole (even if you have to enlarge the hole. Glue in the dowel, then trim to the curved surface of the gourd. Paint the dowel to match the gourd color.

The harder way is to cut a circle from the discarded tube you used to make the flute. The curve and color will both match. Cut it a bit small to be sure you can get it in. Mark the longitudinal direction to make alignment easier. Glue with wood glue (casein) and carefully press in until all the edges align.

Pitch problems

Pitch varies depending on how hard you blow and the temperature of the air inside. Use relative pitch to tune the instrument.

Sometimes a whistle with a lot of taper will blow the first note of the upper register sharp. You can add a hole at the top of what you've got, if you still have fingers left for it. This might be a very small hole. If higher notes in the upper register don't fall out nicely under your fingers, experiment to find a fingering that works. On a

reed, if you need a note between all holes open and the start of the upper register, you might be able to get it by bending the open-hole note.