

HOW TO MAKE A ROCK SPHERE



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For the San Francisco Gem and Mineral Society

In the words of Robert Smithton, SFGMS rock sphere instructor who has made about 200 spheres, “First you need to find a rock.” This manuscript is intended to guide those interested in making a rock sphere from start to finish. It is primarily based on observations that I have had when making spheres and tips that I have gotten from others at the club and off the internet. This guide is intended to help you utilize the sphere-making equipment at SFGMS. There is more than one way to “grind a sphere,” and those that become interested in sphere making may want to consult additional sources of information.

Creating a rock sphere involves many cuts utilizing the large slab saws. You will need six cuts to create a cube, four cuts to trim off corners, and eight cuts to trim off edges to transform the cube to an 18-sided polygon. I don’t know what the right term for this polygon is so I will refer to it as an angular ball. In any event, use of the slab saws to make the cube and eventually the angular ball is time-consuming. It is critical to make your cuts as accurate as possible to make the later stages of the shaping of the sphere easier.

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The angular ball with all its cuts.

1 Find a rock

One of the first things is to visualize a cube in the rough rock fragment or cobble-boulder that you want to create the rock sphere from. This will give you an idea of the largest sphere that you can create. Your sphere could be smaller if there are portions of the rock that you do not want to include in the sphere because it's the rind of the rock (not pretty) or it has fractures. For now, just consider the size of the rough rock to be your only consideration.

Shape of the rock

Block

A rock that is blocky with roughly equal dimensions is the easiest to envision a cube in. You can frequently mark up a rough rock cube with a sharpie to lay out your initial cuts.



Rectangular-Tabular

A rock that is rectangular-tabular has variable dimensions of length, width, and thickness. The shortest dimension will determine the maximum size of your cube and eventually sphere.



Pyramid

A rock that is pyramid-shaped can be utilized but the maximum cube and eventually sphere size is determined by the sharpness of the angle (slant) of the sides of the pyramid.



Boulder

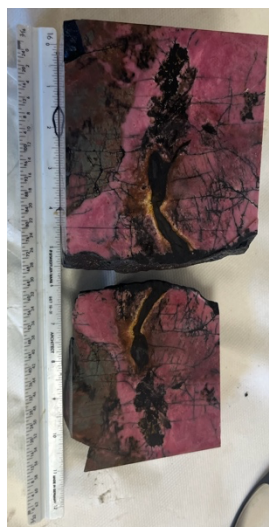
Rocks from stream beds are often subrounded or rounded by the erosive action of the stream. Most of the time you will just try to envision your cube in whatever form of the boulder that you have. Rarely, you may have a rounded form that will allow you to skip some of the cube and face cutting. Talk with an instructor.



Condition of the rock

The best rock for a sphere is crystalline or cryptocrystalline (quartz, agate, jasper) and massive (no fractures that aren't cemented or healed). It is also helpful if the rock is a uniform hardness.

2 Trim your rock to create a cube with six faces



There are a couple of options for choosing the first cut of a face to make the cube. One option is to cut a face that shows the features you want your sphere to present. If your rock is uniform in texture, color, etc., this not an issue. The second option is to a cut face that is easiest to set up in the saw. A lot of times one face will be near flat, and you just cut a thin bread slice to reveal your cube. Sometimes, if a rock has multiple near flat faces you can use a sharpie to define your initial and other cuts to create the cube.

Once you have an initial face, you can cut either a perpendicular face or a parallel face to your initial cut. **NOTE: IT IS IMPORTANT TO MAKE THESE CUTS PARALLEL TO OR AT A 90 DEGREE ANGLE TO MAKE A NICE CUBE.** That being said, you are unlikely to make a perfect cube, but the closer you get, the easier it will be in the later stages of the cube trimming.

Use a steel square, level, or other tools (they are located in the toolbox, but you may want to bring your own) to make sure that you are getting the adjoining cube faces at 90 degrees and that opposite cube faces are parallel. Whenever possible mark your cut line with a sharpie. You can use the sharpie line to sight along to the saw blade. Use a steel rule that extends from the face of the saw blade to the sharpie line to help make sure you are making a straight cut.

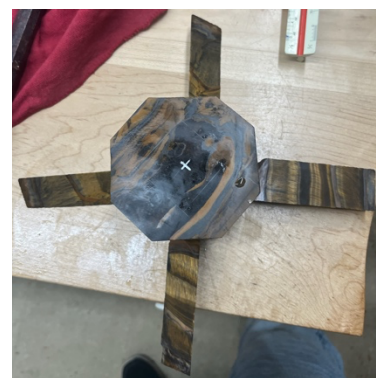
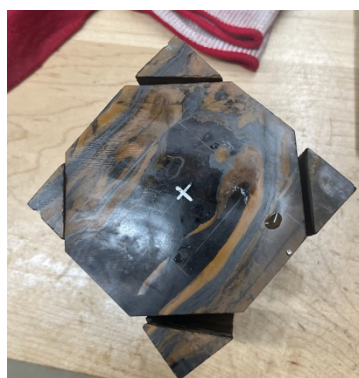
Try to first get your rock set up so that it is near the alignment you are wanting to cut. Depending on the size and shape of your rock, you frequently will need to use wood blocks and wood shims to help the saw vise get a secure grip on your rock. Snug the rock in the vise and check the cut alignment. You can then move the rock in the vise in or out so that the saw blade and the sharpie cut mark are aligned. If everything is not aligned, readjust. If

everything is aligned, tighten the vise securely so that the rock cannot move during the cut. When you tighten down the vise the sample might move, so it is necessary to check the cut alignment after the rock has been fully secured. **NOTE: NOT CHECKING THE ALIGNMENT JUST BEFORE YOU CUT IS A FREQUENT CAUSE OF CUBE IMPERFECTIONS. CHECK THE SECURED ROCK WITH AN INSTRUCTOR BEFORE YOU START YOUR CUT.**

Once you have two or three faces accurately cut, it usually is easier to make the remaining face cuts since you have planar surfaces to check the alignment against and more of a flat surface to secure with the vise. You will be making six cuts to create the cube.

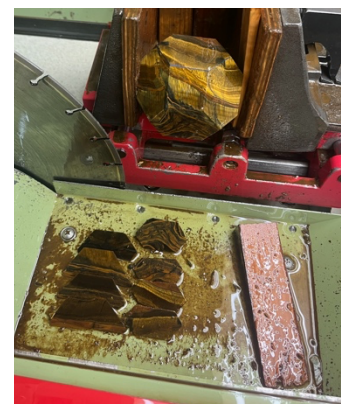
Once you have your (near) perfect cube go to the next step. Clean the saw.

3 Corner trim the cube to create a polygon with 10 faces



Take your cube and mark sharpie lines to cut 45-degree cuts off of the corners of the cube. Once you do this the cube will be an octagon when viewed from above. The size of the cut will vary depending on the cube size. There is a chart on the wall near the sphere making equipment corner of the lapidary equipment room that tells you the length of the line from the corner of the cube needed for the 45-degree corner cut. Mark the cut on the top of the cube as well as the cuts on the sides of the cube. This gives a good reference line to sight your cut along the saw blade. As in the case of any cut, get the alignment of your cube close to your cut mark and then snug the cube in the vise. When you are satisfied with your alignment tighten the vise, recheck your alignment, and have the setup checked by an instructor. Make the four corner cuts. Clean the saw.

4 Edge trim the polygon to create a polygon with 18 faces



Following the corner trimming, you should now have a rock that looks like an octagon when viewed from above. The octagon will be set in the vise to cut the edges of the octagon at a 45-degree angle. Again, consult the chart on the wall near the sphere-making equipment corner of the lapidary equipment room that tells you the length of the line from the corner of the cube you need to be for the 45-degree corner cut. It is the same length as you made for the corner cuts. Mark the cuts with a sharpie. Edge cuts will overlap so you may want to use a different color sharpie for alternating edge cuts, so you don't get confused when setting up the cuts. Use a 45-degree angle shim or a 45-degree square. A 45-degree square with a level is even better. As in the case of any of the previous cuts, get the alignment of your octagon close to your cut mark and then snug the octagon in the vise. When you are satisfied with your alignment tighten the vise, recheck your alignment, and have the setup checked by an instructor. Make the eight edge cuts. Clean the saw.

5 Grind the edges of the polygon to a very rough sphere



A grinding wheel with two coarse wheels is located near the sphere-making equipment corner of the lapidary equipment room. There is a sign on the grinders that notes that these grinding wheels are reserved for sphere making. This is partially because the grinding you will perform is a little different than that which you might do for a typical “cabochon” and the sphere sizes can be a little bigger than what we typically like to use on the grinding wheels.

The purpose of grinding the edges of the angular ball polygon is to round the polygon so that it will be ready for the 3-axis grinder stage that follows. If you made nice, accurate cuts beforehand, you can think of the center of each of the 18 faces of the polygon as being a point on your sphere. Try to visual a circular arc extending from the center of one face to the center of an adjoining face. You can use a contour gauge to give you an idea of the amount of grinding you might need to do. Trace the outline of the contour gauge placed over the polygon on a piece of paper and then draw a semi-circle that fits within the tracing from the contour gauge.

Grind the edges down a little bit. You should see your flat sawn-cut faces get a little smaller as the edges are ground down. Once you have ground down the edges a bit. Spin the “lumpy sphere” around a few different axes until it spins relatively easy. You do not want to totally eliminate a face but just work the edges lightly toward the center of the face. If you set your lumpy rough sphere on the counter and it has a little “wobble and roll” to it, you are good to move to the 3-axis grinder to create your rough sphere.

Clean the grinder.

6 Use the three-axis grinder to create a sphere



Move on to the next piece of equipment which is the three-axis grinder. There are three motors, each with an arbor at the end of hinged metal arm. A grinding cup is installed on each of three arbors. Consult the chart on the wall near the sphere making equipment corner of the lapidary equipment room that tells you the diameter of cup to use for your sphere diameter. You will see there is a little overlap from one sphere cup to the next. I generally choose to use the smaller diameter cup if I am in an overlap area. Take your lumpy sphere and position it in the center of the area between the three cups. The cups have sintered diamond cutting blades on the edge of the cups that cut about like a 50 grit. Use the chain-linked springs at the top of the hinged arms to apply uniform pressure from all sides. Generally, you will want to have the same length of chain from the attachment point at all three points. You may use a bungee cord or belt to help snug the arms. The necessary snugness is a little subjective so check with an instructor. Fill the drip water bottle and set it so that it will drip above the center of the rock sphere as it grinds. Put a pan with a sponge in it below the sphere. The pan will catch your cuttings and the sponge will catch your sphere should it dislodge during grinding.

Start the machine. Early on, the grinding may be a little bumpy as the sphere is a little bumpy. The sphere may try to work its way out of the center point of the three grinders. You may need carefully to tap it back into the center and/or shut down the machine and readjust the grinding cups and the sphere. In a relatively short time (a few minutes) you should have a relatively stable spin of the sphere that is being worked into a near-perfect sphere. Something to watch for is the spin of the sphere just going around one axis. The sphere needs to move around a bit so that the surface of the sphere gets uniformly ground and you don't get an edge cut into the sphere by the cups rotating on the same spot of the sphere. You may have a rock feature that you can see to judge that the rock is moving around a little bit or you can put a sharpie mark(s) on the sphere. You may want to put a sharpie bulls-eye on the center of one or more of the smooth faces. The center of the faces should be the last area to disappear (get ground) by the rotating grinder cups. If you need the rock sphere to move a little bit you can just apply a little pressure to one arm with your hand until the rock sphere shifts. Make sure the grinding cups are evenly spaced and do not touch each other. This stage is frequently the longest stage in the sphere-making process. You will need to stay by the machine to make sure that your set-up does not have excessive vibration, the sphere doesn't get stuck on one axis, the sphere cups don't touch, there is a constant water drip on the rock sphere, and the collection pan does not overflow. When you are done with the sphere, it will be essentially in its final shape and it should roll easily on the counter and have no easily visible flat surfaces.

Dispose of the cuttings, clean the cups and the device.

7 Use the three-axis grinder to smooth and polish the sphere



Move to the three-axis grinder with grinding and polishing pads. The setup is the same as the three-axis grinder with the sphere grinding cups, but instead of cups you will be using “flat” grinding and polishing discs, one on each of the three grinders. The setup with the three-hinged arms, the chain-link springs, and bungee or belt as necessary, is the same as for the sphere cups. Usually, it is easier to get the rough sphere situated, but you still need to watch the smoothing and polishing operations for all the reasons previously noted. The coarsest disc grit is 50, just like the sphere cups, with the next discs being 100 grit and then 200 grit. You may be able to get some additional shaping of the sphere with the 50 to 200 grit discs, but past that point you are really just polishing. Try to eliminate any flat spots on the sphere with the 50 grit discs. Deeper scratches should be largely eliminated by the 200 and/or 400 grit discs. After that, just consider that you are polishing with the 600-6,000 grit discs and, if desired, the buffing pad. **NOTE: IT IS VERY IMPORTANT TO CLEAN THE DISCS BEFORE AND AFTER USE AND TO KEEP THE DISCS OF VARYING GRIT SIZE SEPARATED. IT IS ALSO A GOOD IDEA TO CLEAN THE BACKING PADS. IT IS VERY FRUSTRATING TO GET SCRATCHES FROM A COARSER GRIT CONTAMINANT ON A FINER GRIT DISC.**

There is no set time to be on a particular grit, but I have found that generally about 45 minutes to an hour is required for coarser grits (50 to 200 grit) where you still may be doing some grinding and shaping and less as you proceed upward through the grits. Use your “lapidary eye” to look for scratches and the development of a polished surface to let you know when to switch pads. You should now be holding a beautiful polished sphere. Dispose of cuttings and clean the device and the pads.

GENERAL NOTES

The above is a general guide on how to make a sphere using the equipment at SFGMS. There are other ways to “spin a sphere” and you are encouraged to go online to look at videos made by hobbyists and companies that manufacture and sell sphere-making equipment. If you have any questions about operations, be sure to ask an instructor. If you see any worn, broken, or damaged equipment, notify an instructor so it can be repaired or replaced.

Polygon with 18 sides

- Cube cuts (6)
- Corner cuts (4)
- Edge cuts (8)

