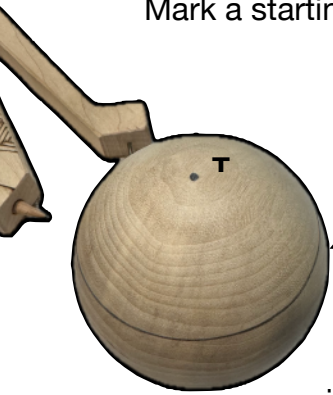


Singapore Ball Point Layout Sheet

1) Measure the diameter of the sphere in mm. Multiply the diameter x .526. Set the compass to that measurement using the digital caliper. Mark a starting spot on the sphere.



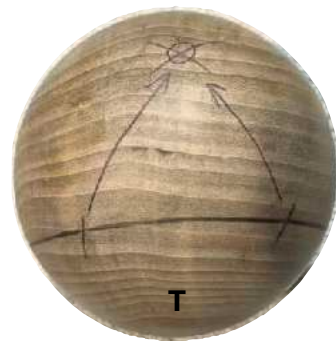
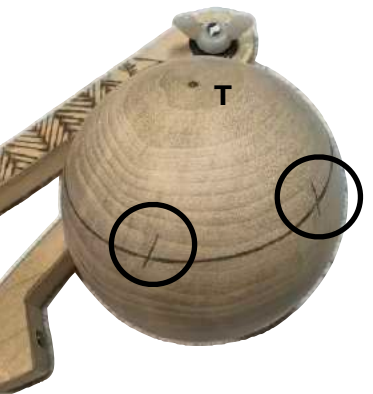
2) Place point of the compass on the starting spot. We'll call this the Top of the sphere. Make a little "T" near this spot for Top. Make a circle on the sphere with the compass.



3) Make a mark on the circle. Use this intersection to place the point of the compass and draw an arc on the circle. Continue this around the circle until you have divided the circle into 5 equal parts. If the 5 sections don't come out exactly, adjust your compass, erase the marks and try again. *It's important that these 5 points are close to perfect.*

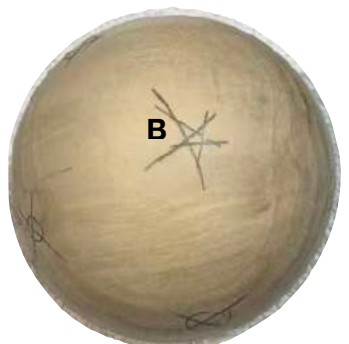


4) Keeping the same measure on the compass, use two of the points you just created on the circle to make an intersection on the side of the sphere that has no points yet. Repeat this 5 times until you get another 5 points similar to the ones on the circle. They will be located between the 5 points from the circle (just on the opposite side of the sphere).



We should now have our starting point (T), a ring with 5 points on the circle and 5 more points towards the bottom of the sphere.

5) Using these 5 points on the bottom of the sphere, using the same measurement on the compass, draw an arc on the bottom of the sphere from each of the 5 points. These will intersect at the bottom of the sphere or create a small star with a pentagon (5 sided figure) in the middle. The bottom point is in the middle of this pentagon. Mark it with a "B" for Bottom. If you are happy with the placement of the 12 points you just made, use an awl to indent the 12 points. Draw a small circle around these 12 points.

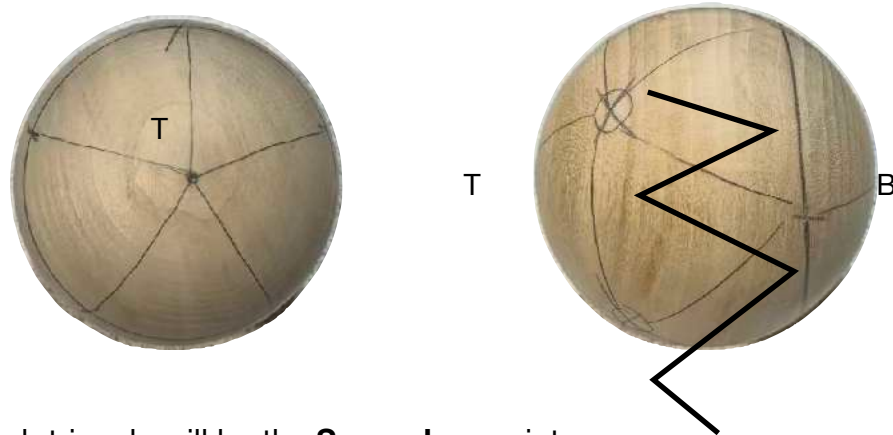


The 12 points we just made, Top, Bottom and two rings of 5 points are called the **Primary** points.



Using the **Primary** points we will now identify 20 equal triangles that will give us the 20 **Secondary** points.

6) Using a pencil, draw lines to connect the Top with its surrounding 5 points. Then turn to the bottom and connect the Bottom to its 5 surrounding points. We now have 10 triangles. In the middle of the sphere, connect the points in a zig-zag fashion around the sphere to create the remaining 10 triangles. We should now have 20 equal triangles.



The center of each triangle will be the **Secondary** points.

7) To mark the center of each triangle, set the compass to slightly over half the distance between two of the primary points. Draw an arc from the three points of a triangle towards the center of the triangle. The spot where these three arcs intersect is a **Secondary** point. Mark that point and use an awl to indent the point, circle it. Repeat this process for each of the 20 triangles.



The 12 **Primary** points plus the 20 **Secondary** points represent the **32** points of the Singapore Ball. Leave the pencil marks on until after drilling and widening each hole.

After using the cage (donut chuck) to drill and widen each of the 32 holes, sand the ball with 320, apply finish to the exterior and into each hole. I use Mahoney's Oil or wipe on poly to finish the sphere.

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Singapore Ball Sheet

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Part 1

Sphere selection and preparation

- Maple, Birch, Boxelder, Cherry - close grain, light color
- Choose item with no issues
- Sand to 320

I will make a sphere either by turning one on the lathe by hand or using a sphere jig if I plan on doing multiple spheres. Typically the sphere will be between 60mm and 70mm in diameter. This sphere will have no cracks or issues.

Part 2

Layout of points - draw lines to place points on surface of sphere

- Determine diameter of sphere in mm
- Use compass to place primary points on sphere (12)
- Use compass to determine secondary points (20)

To begin with I used light colored spheres so I could see the placement of the lines and points. Correct layout is essential to a successful sphere. After making a few Singapore balls, I started to use darker woods and spalted woods. Before marking any holes with the awl, make sure your primary holes are correct. If they are not, don't be afraid to erase or sand off the lines you made and redo the lines. Having equally spaced holes on the Singapore ball is essential. Use the "hole placement sheet" for step by step guidance on hole placement. Place primary holes first and then determine secondary holes.

Part 3

Use lathe to drill and widen holes in sphere

- Secure sphere in jig, drill first hole to depth
- Widen the bottom of the hole to become a teardrop shape
- Rotate sphere within jig to the next point
- Repeat process (32 holes)

You will need a way to hold the sphere securely so you can use the Jacobs chuck and drill bit to drill the holes to their correct depth. Determine the diameter of the hole you are going to make. I typically use a 9mm diameter hole with a 17mm depth. I like to have a depth almost twice the diameter of the hole. This prevents the spike from getting stuck sideways in the hollowed out hole. Use the reference sheet named "Singapore Ball Specs" to help determine hole diameter and depth. The cage (donut chuck) that I use has two rods placed in it to help speed up the drilling process. There are several videos online about how to make a donut chuck. Once in the chuck, I line up a marked hole with the tip of the brad point drill and secure the ball in the chuck. I drill the hole to depth with the help of a depth stop. Don't forget to occasionally check the accuracy of your depth stop. It's horrible when you drill 17mm holes and the stop slips and you have several 20mm or 21mm holes. After drilling a hole, widen the hole with the hockey stick tool. Start at the bottom and clean out moving towards the mouth of the hole. DO NOT cut 1mm to 2mm below the hole. Leave the hole diameter the same as it

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was drilled near the mouth. Check the hollowing and then proceed onto the next hole. When all holes have been drilled and hollowed, check depth of each hole. Sand sphere with 320 to remove any pencil lines or burnish marks. Apply finish to surface and to each hole. Lately I've been using wipe on poly and applying several coats to the exterior and then buffing. I've also used Mahoney's Oil to finish spheres and spikes.



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Part 4

Create spikes for sphere

- Round square stock for spikes
- Determine diameter of spikes and add 0.25mm
- Determine length of spikes
- Turn spikes, *measure*, sand, *measure*, apply Mahoney's oil/Yorkshire Grit
- Insert spike into hole
- Repeat process (32 times)

Now that the sphere is completed it's time to choose a wood for the spikes. Usually I choose a contrasting color. Another consideration is the hardness of the woods. One of the woods, either the sphere or the spikes needs to be softer than the other in order to allow some "give" when putting the spikes into the hole. Here is a chance for you to use some of that exotic scrap that you may have laying around. Depending on the diameter of the hole in your Singapore ball, you might also be able to use pen blanks cut into fourths to supply the spikes. I shape my spikes into a teardrop shape. I place the blank in pin jaws and create a cylinder. I then mark the length on the rounded blank and partially cut with the thin parting tool. Now that I have the length of the spike, I shape the bottom part of spike. I round it off and then start cutting towards the tip. I want the spike to come to a point but not be sharp. I'll then measure with the calipers the diameter of the spike. Using the mark left from the caliper I continue to refine the shape and diameter of the spike. After getting the diameter I wanted, I sand with 200 and then 320 sandpaper. I apply Yorkshire grit or Mahoney's oil to the spike and then part it off. I will insert the spike into the sphere. Getting the first spike to size is probably one of the more difficult ones to do. Once you have that first one done you can adjust your caliper or cutting process and the following spikes become easier to do. If a spike doesn't fit the first hole you try, try another one. Depending on the accuracy of the hole drilling, there may be another hole that the spike will fit into. Repeat this process until all holes have spikes.



Materials and tools needed:

Wooden Sphere - (~64mm about 2 1/2")
Digital Caliper
6B Pencil & Eraser
Metric drill bits
Platform tool rest - flat top
Bowl gouge - Small
240 and 320 grit sandpaper
Mahoney's Oil for spikes
Thin parting tool

Wood for spikes - (about 12mm)
Compass - see pattern
Awl
Sphere Cage
Hockey stick scraper
Spindle gouge - Small
Finish of choice for Sphere
Metal Drill Stop Collar

Singapore Ball Specs				32 spikes			
(Sphere diameter in mm - hole depth x 2) x .3142 = Hole Diameter							
Ball Dia. Mm	Ball Dia. Inch	Hole Depth	Hole Depth x 2	Times .3142	Hole Dia Max		
51	2.0	10.00	20.00	9.74	9.5		
51	2.0	13.00	26.00	7.86	7.5		
56	2.20	10.00	20.00	11.31	11.0		
56	2.20	12.00	24.00	10.05	10.0		
56	2.20	13.00	26.00	9.43	9.0		
62.10	2.4	9.00	18.00	13.86	13.5		
62.10	2.4	10.00	20.00	13.23	13.0		
62.10	2.4	11.00	22.00	12.60	12.5		
62.10	2.4	12.00	24.00	11.97	11.5		
62.10	2.4	13.00	26.00	11.34	11.0		
62.10	2.4	14.00	28.00	10.71	10.5		
62.10	2.4	15.00	30.00	10.09	10.0		
62.10	2.4	16.00	32.00	9.46	9.0		
62.10	2.4	17.00	34.00	8.83	8.5		
62.10	2.4	18.00	36.00	8.20	8.0		
62.10	2.4	19.00	38.00	7.57	7.5		
62.10	2.4	20.00	40.00	6.94	6.5		
62.1	2.4	21	42.00	6.32	6.0		
63	2.48	15.00	30.00	10.37	10.0		
64	2.52	14	28	11.3112	11.0		
64	2.52	15	30	10.6828	10.5		
64	2.52	16	32	10.0544	10.0		
64	2.52	17	34	9.426	9.0		
76.2	3.0	18	36	12.63084	12.5		
76.2	3.0	20	40	11.37404	11.0		
76.2	3.0	18	36	12.63084	12.5		
76.2	3.0	16	32	13.88764	13.5		
Measurements below are for 12 primary holes only							
40	1.6	10			9.5		
40	1.6	9			11.4		
40	1.6	8			12.5		
40	1.6	7			13.3		
40	1.6	6			14.2		
40	1.6	5			15.2		

