



Kendama

A Toy

Arnold Ward

Earlier in my life, I was a juggling fanatic. I traveled to different cities that hosted juggling festivals where people shared tricks, bought props, took classes, and participated in competitions and shows. Strangely, the juggling community is a lot like our woodturning community, except for the hobby itself. In the early 1990s, the kendama showed up at the International Jugglers' Association's annual festival (juggle.org) and has since become popular in the juggling

community. I bought a kendama and enjoyed it for years.

When I bought my first lathe, I thought a kendama would be easy to make; however, learning to turn well enough to create one took a few years of practice and learning. My woodturning addiction quickly overtook my juggling addiction. I now have a method of making the kendama correctly, but before you decide to make one of these for your child or grandchildren, be aware that they can be very dangerous.

A kendama is not a suitable toy for young children. The solid ball swinging on a string can break a window or knock out a tooth. They are great for middle-age youth and adults who have a little common sense.

The kendama is like the traditional cup and ball game, except this version is much more complex. The kendama is best known in Japan the

way the yo-yo is known in the Western world. It consists of a ball attached to a string, with three separate cups in which the ball can be caught. The three cups are known as the large cup, the small cup, and the center cup. The center cup is the smallest and is located on the bottom of the stick. The ball has a hole in it that can be caught on the pointed tip of the stick. There are other places the ball can be caught as well, as the player advances in his or her skill of the game. Like the yo-yo, the kendama has many tricks with specific names and skill levels. From what I have read, the kendama has been in Japan for more than two hundred years. Its origin is unclear, but it has roots in several different cultures. Its name translates roughly to *stick ball* where *ken* is the main body and *tama* is the ball.

The official kendama I have is not very heavy, but is made from a fairly hard wood. There is no telling what type of wood it is since it was made in Japan, but the wood is plain, with no features. Domestic close-grained woods such as maple, walnut, or cherry should work fine. The toy will take some abuse and the ball will get nicked, so a soft wood is not suitable. Also, avoid heavy woods or you will create a weapon instead of a toy.

Dimensions

The dimensions I used were taken with a digital caliper and do not correspond with imperial or metric units, so I

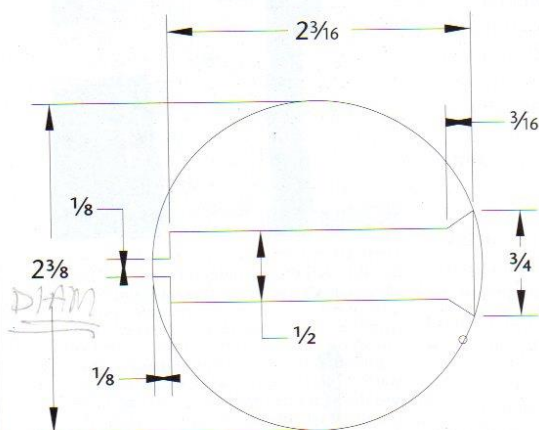
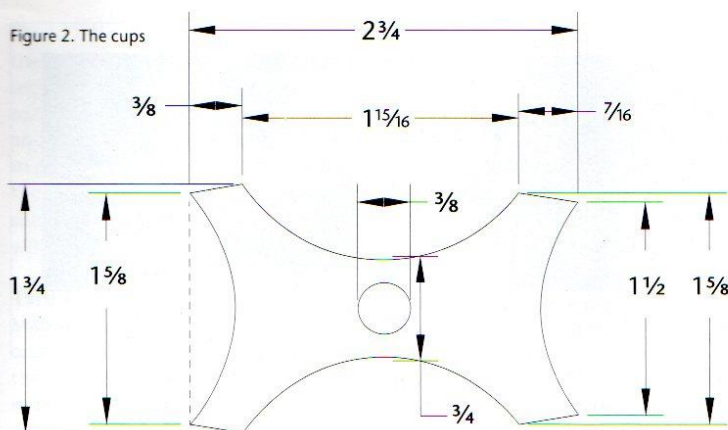


Figure 1. The ball



made my own rough approximations (Figures 1, 2, 3). It is not important to achieve these exact dimensions, but it is important to have the wood square and to drill the holes correctly. From what I see on the Internet, kendama can come in all shapes and sizes, but the Japanese Kendama Association considers only certain ones official. I could not find any official dimensions (at least not published in English).

Prepare the wood

Start by squaring your stock. There are three pieces required: the ball, the stick,

and the cups (Photo 1). The blocks for the stick and cups must be square and the ends must also be square. If not, you will likely have problems keeping the pieces on center when they are rechucked for the various holds. For the ball, start with a block slightly larger in diameter than needed to ensure you can work your way down to the size required.

The ball

I suggest cutting semicircles from card stock to match up with your pieces. You will need the template of the outside of the circle to compare to the

ball and the circle template to compare with the cups later (Figure 4).

Turn the ball first (Photo 2). By doing so, you can match the ball with the cups as they are being made to verify that the cups are deep enough to fully accept the ball. There are many instructions available for making spheres (AW vol 25 no 4). I like to make my kendama ball just slightly larger than the final dimensions and then achieve the final size by rotating it frequently and shear scraping small amounts away each time it is rotated. When the ball is nearly at its final dimension, as checked with the template, do the final sanding and finish with 220-grit abrasive. The ball can be painted later if you desire, but either way it will be beaten up after use, so there is no need for a polished finish.

Drill a hole in the ball. (This hole will be used for catching the ball on the stick.) To accomplish this, I used a doughnut jig to hold the ball (Photo 3). This step can be done on the drill press as well, but the hole requires a countersink around it that is difficult to make with the drill press, unless you have a large countersink bit. My doughnut jig has a recessed hole in the bottom board that centers and accepts the ball. The top layer gets screwed over the ▶

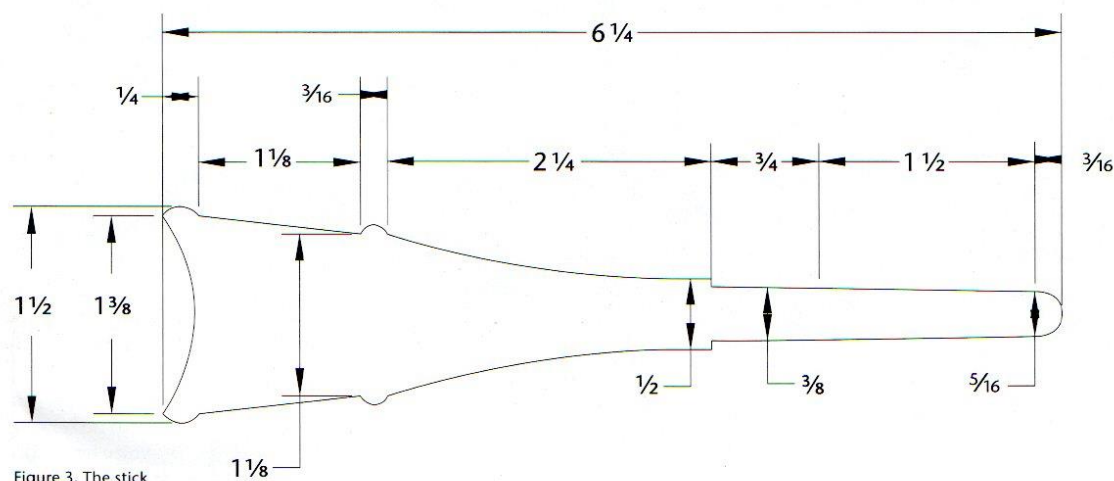


Figure 3. The stick

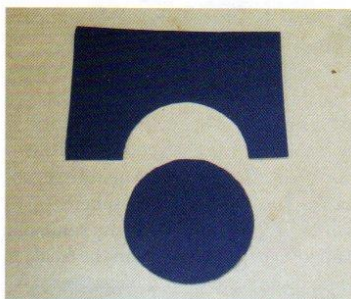
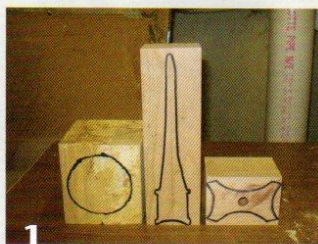


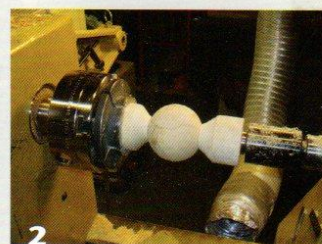
Figure 4. Template for matching the cup to the ball.

ball and holds the ball firmly. I suggest using $\frac{1}{2}$ " (13 mm) plywood for the top part of the doughnut. Otherwise the board may crack. Place the ball in the jig such that the grain of the wood is parallel to the lathe bed. (You will be drilling into endgrain.)

Mark the drill bit to just less than $\frac{1}{8}$ " (3 mm) of the diameter (depth) of the sphere. Before drilling, start by turning a small starting dimple in the sphere.



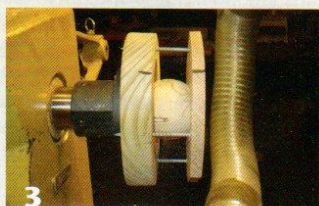
1 Three blocks of wood are needed to make a kendama.



2 Turn the ball.

Leaving the tailstock loose, push the tip of the drill bit into the hole (Photo 4). Let the tailstock align with the hole, and then lock down the tailstock. If you get any wobble in the drill bit when you first start drilling, loosen the tailstock, clean up the out-of-round hole with a gouge, and try again. Try to make the drill bit run as true as possible (Photo 5). Finish by turning a countersink around the hole (Photo 6).

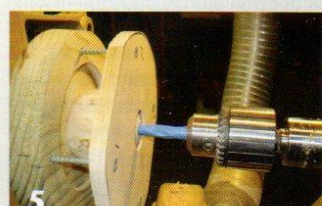
The hole for the string is best made using the drill press. To drill this hole in the correct position (directly across from and centered with the first hole), clamp a scrap board to the table of the drill press. Drill a $\frac{1}{2}$ " (13 mm) hole in the wood. Insert a short $\frac{1}{2}$ " dowel rod into the hole so that it sticks out a couple of inches (Photo 7). Place the ball onto the dowel rod (the dowel rod will be inserted into the previously drilled



3 Place the ball in a doughnut jig.



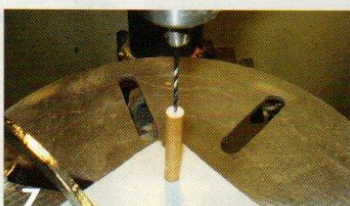
4 With the tailstock loose, push the tip of the drill bit into a small hole that you turned in the ball. Let the tailstock align with the hole, and lock down the tailstock.



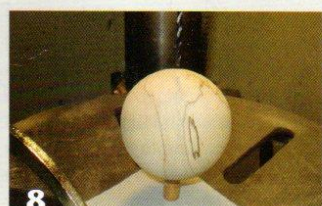
5 Drill a hole to a depth of just less than $\frac{1}{8}$ " (3 mm) of the bottom of the ball.



6 Turn a countersink around the hole.



7 Clamp a scrap board to the table of your drill press and drill a $\frac{1}{2}$ " (13 mm) hole. Insert a short length of $\frac{1}{2}$ " dowel rod into the hole. The center of the dowel rod should line up with the next drill bit you will use.



8 Drill a hole for the string through to the first hole. The two holes should end up centered.

hole). Drill a $\frac{3}{8}$ " (3 mm) hole through the top, all the way through the wood into the other hole. This alignment makes it possible to thread the string and tie a knot that will hold the string in place (Photo 8). It is important that the hole for the string is exactly opposite the stick hole otherwise some tricks will be very difficult to accomplish.

The cups

Make the cups next. There is one cup on each end, one slightly smaller than the other. The center forms what I call twin cups, separated by the stick. Start with a block of wood no smaller than $1\frac{1}{2}$ " (48 mm) square and make sure the block is square. The exact length should be $2\frac{3}{4}$ " (70 mm). Mark the profile of the cup form on the outside of the block of wood (Figure 2).

Drill a $\frac{3}{8}$ " (10 mm) hole all the way through the center of one side of the block to the other side. Make sure the hole is dead center and square to the surface. You can find the center by drawing diagonal lines from corner to corner and center punch the cross point. Do this on both sides. If the drill exits the other side the slightest bit off center, then get another block and try again. Make sure your drill press is squared up, your block is square, and your diagonal lines are accurately drawn.

Mount the block into a 4-jaw chuck. While the lathe is turning, scribe the diameter of the small cup on the end of the block (Photo 9). Then hollow out the cup, leaving the outside of the block square. Use the circle template that matches your ball diameter to ensure you end up with a cup that fits the ball (Photo 10). Also, take the ball itself and test it with the cup to make sure it does not bottom out in the cup (Photo 11). The ball should contact the outer edge.

Flip the block over in the chuck jaws and repeat this process on the other end using the larger cup size.

The next step is to turn the profile of the cups piece. Mount the block between the headstock and tailstock using two bungs, each in the shape of a hemisphere, which are cut to match the curves of the cups.

Turn bungs

To make the bung for the tailstock, a block of wood needs to be mounted onto the rotating part of the live center. How you accomplish this depends on the type of live center being used. I prefer a live center with a threaded tip that I can use to screw onto a soft block of wood. If you have a live center that has the whole head rotating, you must make the block of wood slide over the entire rotating part. Some live centers cannot be used because there is no way to attach an auxiliary block.

After you have attached the wood to the live center, mount the live center into the headstock and tape the wood to the center so it does not rotate. Turn a hemispherical shape on the end of the wood to create a bung, using the template semicircle and the actual cup from the block of wood to test the fit (Photos 12, 13).

Insert another block of wood into a 4-jaw chuck and turn a hemisphere on it that matches the other end of the block.

Mount the cups block between the bungs and turn the rest of the piece (Photo 14). The $\frac{3}{8}$ " (10 mm) hole should ▶



9 Mount the block into a 4-jaw chuck. On the end, scribe a circle the same diameter as the small cup.



10 Use the template to test the diameter and depth of the concave area. The bottom of the ball (circle) should not touch the bottom of the concave area.



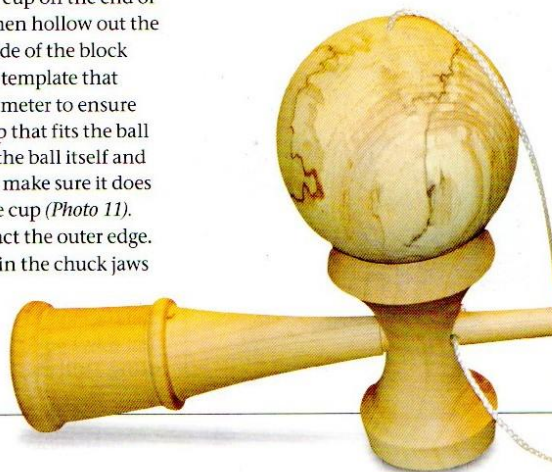
11 Use the ball to test that it does not bottom out in the hole. Flip the block over in the chuck and hollow out the other end to create the large cup.

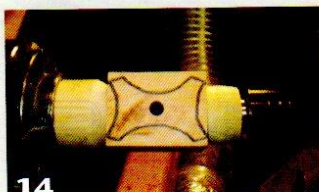


12 Turn a bung for use with the live center of your tailstock. Use the template to make sure the cup will fit onto the bung.

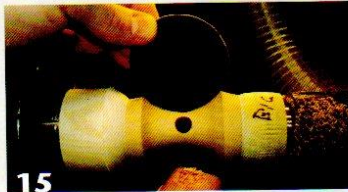


13 Test the fit with the cup itself.





14
Make a second bung for the drive center. Mount the cup block between the two bungs.



15
Use the template to check the diameter of the curve. Note that the hole should be dead center.



16
Use the ball itself to check for a good fit.

be dead center. The concave curve between the cups should match the diameter of the ball. You can use the circle template to check for the curve as you turn (*Photo 15*), but always check the final curve with the ball you turned to make sure it matches (*Photo 16*).

The stick

For the stick, the block of wood will be $\frac{3}{8}$ " (10 mm) longer than the finished stick (*Figure 3*). (The extra $\frac{3}{8}$ " length will eventually be removed from the tip to eliminate the dimple left from the live center.) The block should be perfectly square. Mount the wood into a 4-jaw chuck (*Photo 17*). Scribe the cup size onto the bottom. You can use

dividers set to $1\frac{3}{8}$ " (35 mm), which is the diameter of the cup. Hollow out the cup. Test-fit the cup with the ball to ensure that the ball contacts cleanly on the outside edge of the cup (*Photo 18*).

When the cup is complete, reverse the block of wood in the chuck and use the tailstock with a live center (*Photo 19*).

Start turning the point of the stick. As you approach the nontapered part that holds the cups, advance slowly. Remove the tailstock and check the fit frequently by inserting the stick into the hole between the cups (*Photo 20*). The fit should be snug enough to hold the two pieces together, but not so tight that the pressure of the stick in the hole will split the wood of the

cups. The two sections can be glued together later, so if the fit is just a tad too loose, the glue should take care of minor slippage. If you turn the diameter of the stick too small, I suggest starting over—the cups should not wiggle on the stick.

Turn the rest of the stick, getting as close to the chuck as possible, while being safe (avoid the chuck jaws!). Carefully cut off the extra $\frac{3}{8}$ " (10 mm) from the tip, round the end off and sand it smooth (*Photo 21*). Then remove the stick from the chuck.

Put a scrap block into the 4-jaw chuck. Cut a flat on the face of the block. Use a Jacobs chuck mounted into the tailstock to hold a $\frac{3}{8}$ " (10 mm) drill bit. Drill a hole into the scrap block to receive the tip of the stick (*Photo 22*).

Insert the stick into the hole. It should fit snugly. If it is not snug, use a piece of tissue paper to tighten the fit. Just make sure the stick stays centered. Use the same bung on your live center that you used to turn the cups to provide support (*Photo 23*). Finish turning the base of the stick (*Photo 24*).

Attach the cups to the stick and ball

Smashing the string between the stick and the cup hole, using just a friction fit, connects some kendamas, but I find that the cups frequently work loose that way. I prefer drilling a hole for the string. Drill a $\frac{1}{16}$ " (1.6 mm) string hole



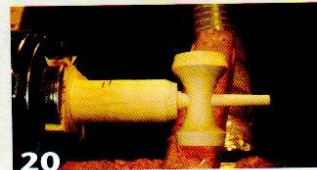
17
Mount the stick blank into the chuck and mark the size of the bottom cup.



18
Hollow out the bottom cup and test-fit the ball.



19
The wood is remounted and ready to turn to the profile of the stick.

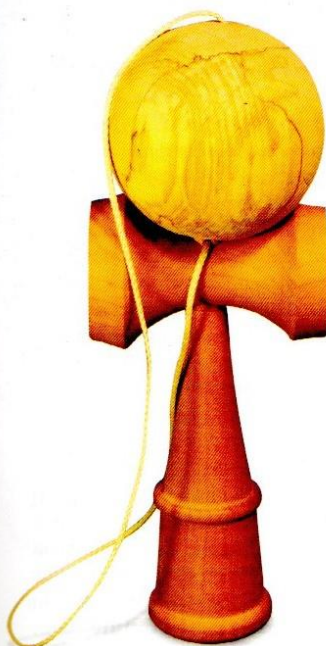


20
The profile of the stick should be such that the fit is snug.

through the stick at the point where the stick exits the hole in the cups (Photo 25). The string hole should be perpendicular to the two cups. (If you hold the kendama in front of you and form a cross, you should be able to see through the string hole.)

You can leave the cups-and-stick joint a friction fit if you want, but if the connection is the least bit loose, glue may be required. If you glue the cups to the stick, make sure the string hole is aligned perpendicular to the cups.

Use a braided string that does not wind up on itself. I found that masonry string works well. The string should be about 18" (46 cm) long. Use a toothpick to help thread the string into the holes in the ball and the stick. Tie a large knot in the string on the opposite side of the stick (Photo 26). After threading the string through the small hole in the ball into the larger hole, pull the string out and then tie a large knot in the end of the string. Pull tight and you are ready to play.



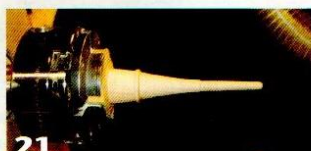
Play the game!

There are different skill levels for kendama play, so you might want to find the various skill charts on the Internet and include them if you are using the kendama for a gift. Doing so will make the game more challenging and give the recipient some ideas of what tricks to try.

Additionally, check out kendamakyokai.com/index_english.html and kendama-world.com/acatalog/TK16-Kendama.html. Also, search for *kendama* on the Internet and on

Youtube.com to see all the tricks firsthand, most of which are nearly impossible to do! ■

Arnold Ward is a woodturner and juggler living just outside Cincinnati, OH. He is an active member, newsletter editor, and officer of the Ohio Valley Woodturners Guild. Arnold has been hooked on woodturning since high school, but fell in love with it after buying a house and finally a lathe. He enjoys making technical pieces, especially ones with movement or novelty, much like the juggling he spent his earlier years practicing.



21 Finish-turn the stick, removing the extra length at the tip, then sand.



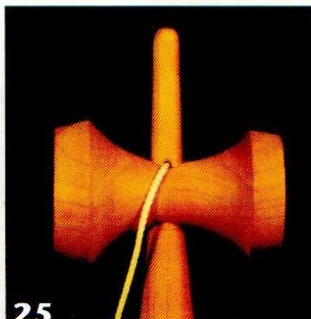
22 Use a scrap piece of wood, held in the 4-jaw chuck. Cut a flat on the face of the wood, then drill a $\frac{3}{8}$ " (10 mm) hole into the wood.



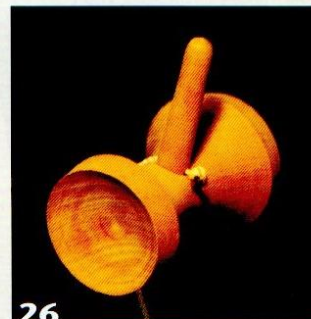
23 Mount the stick back onto the lathe. Use the bung for support.



24 Finish-turn the base of the stick.



25 To attach the string, drill a hole in the stick perpendicular to the axis of the cup.



26 Thread the string through the stick hole and tie a large knot. Thread the other end of the string into the string hole in the top of the ball, pull it through the larger hole, and tie a large knot.