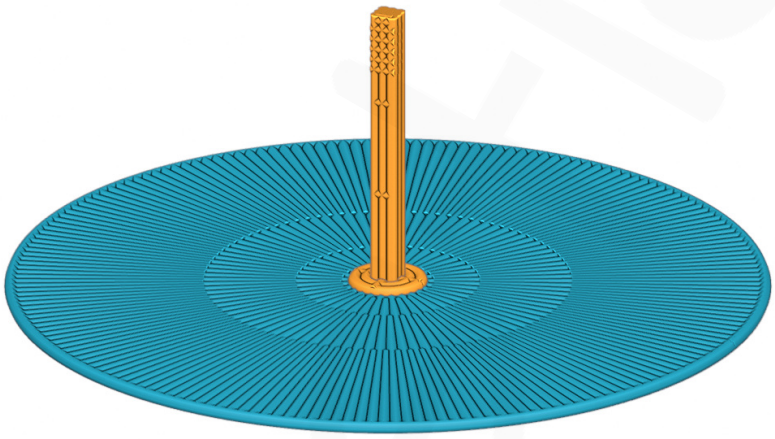
MAKE • DISCOVER • COLLECT

Spinning top with your own pattern

Ages 10 and up; beginners, teenagers and adults. Assistance with assembly in accordance with the device instructions. • About 45–70 minutes, including 25–40 minutes of work with the pen; no time limit.



Build a three-dimensional spinning top with a disc featuring your own radial pattern and a short PLA shaft. Join the parts, let them cool and test the spin on a smooth tabletop.

Your outcome

Build a small toy that you can set spinning yourself.

Construction illustration. The instructions show the successive stages. Full-size (1:1) templates are supplied on a separate sheet.

What you need

A 3D pen, the selected filament and equipment available in your workspace. See the complete list below.

Equipment

☐ 3D pen for PLA	**1 pc.**
☐ Transparent mat for PLA	**1 pc.**

Preparation

☐ Templates T01 and T02, printed at 100%	**1 copy each**
☐ Ruler with mm markings	**1 pc.**
☐ Paper scissors	**1 pair**

Test area

☐ Smooth, level tabletop	**30 × 30 cm clear**

Filament — amounts include extra

☐ PLA 1.75 mm — your own disc colour	**3.3 m · ≈ 9.9 g**
☐ PLA 1.75 mm — your own shaft and joint colour	**0.3 m · ≈ 0.9 g**

Total filament: 3.6 m · approximately 10.8 g

The quantities include extra filament. Grams indicate estimated net filament mass, excluding packaging.

Before you start

Your own colours

Choose the colours for the disc, shaft and joints. The illustration is an example. You can divide the amount of PLA for the disc among your own colours; repeat them in opposite sectors while keeping the amount of material similar.

Help with joining

When fitting and welding, ask a helper to hold the cool edge of the disc and the upper grip of the shaft. The person operating the pen has unobstructed access to the joint from above and below. Do not touch the nozzle or hot PLA.

1. Place the mat securely, flat and fully on the tabletop, away from the edge of the table.
2. Print both templates at 100% scale, with no fit-to-page option. Use a ruler to check the 20 mm reference line. Use scissors to cut out the 90 × 90 mm disc rectangle and the 25 × 60 mm shaft rectangle, leaving the entire drawing intact.
3. Under the mat, in a clear 130 × 100 mm area, place the disc on the left and the shaft on the right, align their top edges and leave a 10 mm gap. The sheets must not overlap and must remain in this arrangement while both parts are drawn.
4. Set up the pen according to the instructions for PLA. Prepare your own colours; set down the nozzle only as specified by the manufacturer.

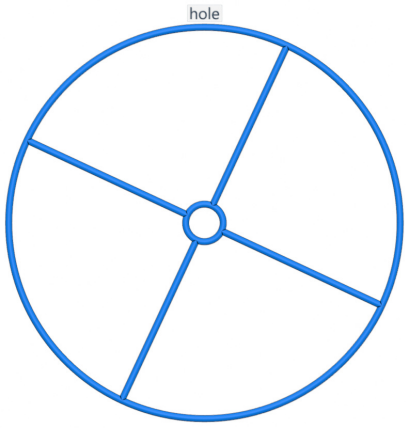
Estimate for a beginner: preparing the templates, outlining and filling the 70 mm disc, making the three layers of the 40 mm shaft, cooling, assembly with a helper, your own spin tests and tidying up. The pace and cooling depend on the person and the pen; neither the time nor the physical test was measured.

How to read the instructions

The large image shows the completed stage. Small views show the action and current parts. ×N means repeat the whole action N times, cooling and checking each time. Illustrations are not at 1:1 scale.

STAGE 01 / 07 • Session 1

Build the disc outline



Two outlines joined by spokes

NOW Disc

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

PARTS FOR THIS STAGE

1 × Disc · PLA | template T01

This describes the entire disc made in stages 1–3; perform the actions in sequence according to the stage descriptions. First connect the outline and the small circle with four radial lines, then add eight more. Fill the sectors in opposite pairs with straight strips running from the small circle to the rim.

Start shorter strips on the existing fill where the gaps widen toward the rim; do not apply them again near the hole. The approximately 1.2 mm wide strips should merge into a single flat layer. Leave the hole empty.

Print the templates at 100%, with no fit-to-page option; the reference line should measure 20 mm. Cut out the paper rectangles: 90 × 90 mm for the disc and 25 × 60 mm for the shaft.

Place them under the transparent mat: the disc on the left, the shaft on the right, their top edges aligned and a 10 mm gap between them; a clear area of 130 × 100 mm is required. Do not overlap the sheets. Choose your own colours. Outline the large and small circles and join them with four spokes.

✓ **Check**

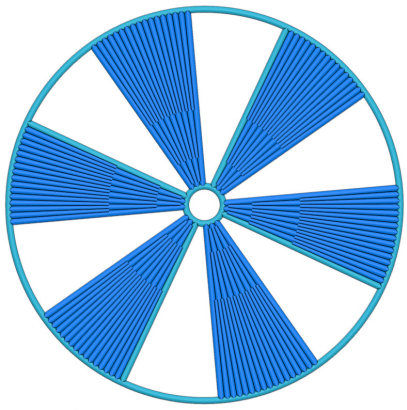
The hole is open, and both outlines are closed and joined. The mat lies flat and fully on the tabletop.

If it does not work

Bridge a gap on the surface with a short strand. Correct an incorrectly printed template before drawing.

STAGE 02 / 07 • Session 1

Start the radial fill



Six sectors: three opposite pairs

NOW Disc

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Add the remaining eight radial lines. Fill six alternating sectors, in opposite pairs. Lay straight strips from the small circle to the rim. Start shorter strips on the fill where the gaps widen; do not apply them again near the hole. Merge adjacent strips into a single flat layer.

✓ **Check**

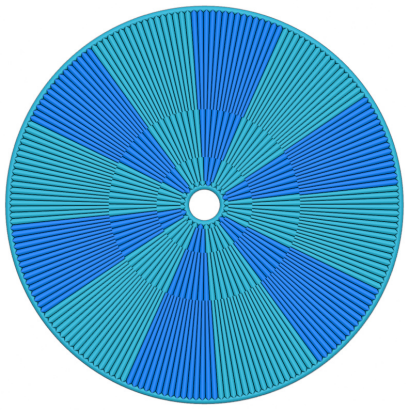
Six filled sectors and six empty sectors are visible. The fill is fused to the spokes.

If it does not work

Fill gaps with short strands on the surface, to a similar degree on both sides of the centre.

STAGE 03 / 07 • Session 1

Complete your own pattern



Complete disc with an even fill

NOW Disc

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Fill the remaining six sectors in the same way. Keep a similar thickness on opposite sides. You can change colours: repeat the colour sequence in opposite sectors. Leave the central hole open. Wait until the disc has cooled completely.

Check

The disc is flat, measures about 70 mm and is fully filled with no large gaps.

If it does not work

Build up thin areas in opposite pairs. Remake a noticeably warped disc on the template.

STAGE 04 / 07 • Session 1

Make the shaft with a grip

Axis tip • technique diagram

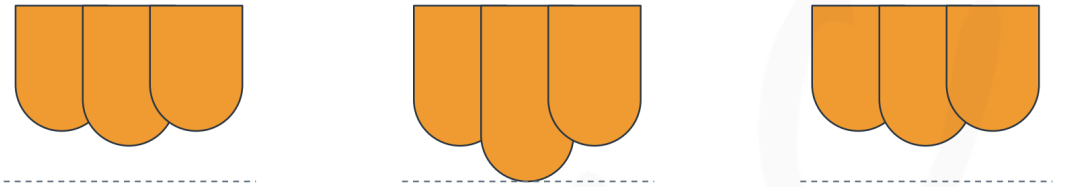
Three layers form one blunt axis tip.

1 • S04a

2 • S04b

3 • S04c

Top view: tip section of each new layer. Line = farthest end of the axis.

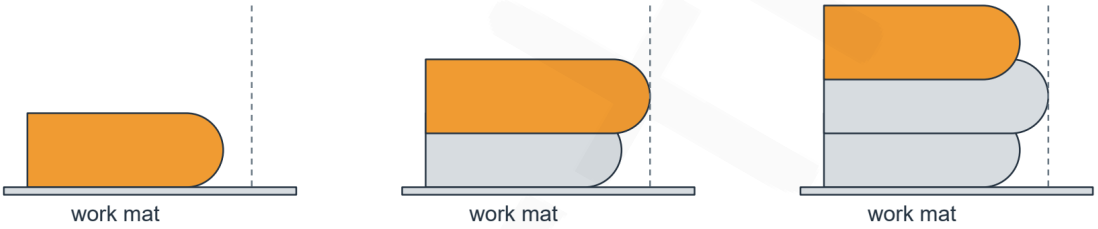


Center slightly longer than the sides. All three end earlier.

Only the center reaches the line. Sides align with the center of layer 1.

Ends as in layer 1. Do not cover the projecting center.

Side view: outlines of the completed layers. Each new layer rests on the preceding one.



Finish the supported strand: stop feeding PLA without drawing a thread into the air.

Once cool: the blunt central tip of the second layer must project farthest.

Technique diagram: three supported layers and the recessed ends of eight strands. End projections and profiles; not to 1:1 scale.

PARTS FOR THIS STAGE

1 × Shaft with grip · PLA | template T02

Three layers of three strands, approximately 1.1 mm each. Only the center strand of the second layer extends farthest; the other eight end slightly earlier (S04a–c). Support: first the work mat, then the preceding strands. Crosswise ties fuse the axis together, and the upper 6 mm forms the grip.

Lay three supported strands, middle one slightly longer. Add a supported middle layer: extend its center about half a strand thickness past the base center; end its sides at base center. At supported ends, stop PLA to leave blunt ends without pulling threads. Add a supported top layer, ending as base.

Stop all eight surrounding strands before middle center. Add crosswise ties and an upper 6 mm grip. Make axis about 40 mm. Cool both parts fully.

Check

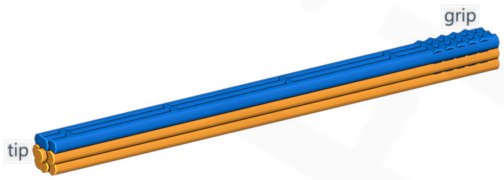
Check the cold axis: straight, fused, with a grip. From both sides, its tip is blunt, central and farthest down; eight ends are recessed. Every layer was supported.

If it does not work

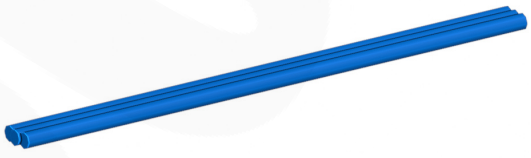
Reconnect loose strands on the surface, then cool. Remake crooked, pointed, off-center or equal-ended axes as shown.

Make the shaft with a grip — construction details

Three layers, bindings and grip

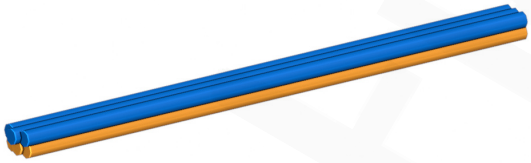


First three strands of the shaft



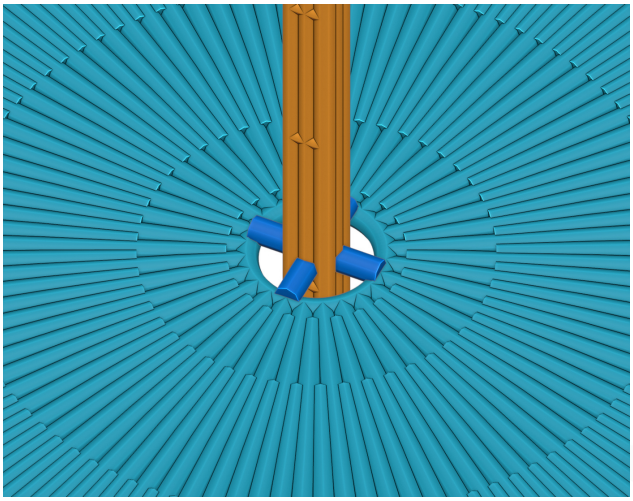
Make the shaft with a grip — construction details

Second layer and rounded end

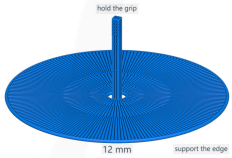


STAGE 05 / 07 • Session 1

Fit the shaft in the centre



Four opposite tacks



Position of both parts before tacking

NOW Complete model — all previously made parts

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

PARTS FOR THIS STAGE

1 × Disc-to-shaft joint · PLA | template follow the written method

This describes the entire joint made in steps 5-6; follow the step descriptions in order. Make four opposing tack welds on the supported, cooled parts, then two touching rings around the axle on each side of the disc. Build the rings from the existing disc toward the axle; let each short section cool before changing your grip.

Finished cross-section [mm]: 2.3 × 1.3. Support: The helper holds the cool rim of the disc and the upper grip of the shaft; the joints remain exposed. The shaft passes through the actual hole. Do not apply force to the hot joint. Strand direction: Four tacks from the rim of the hole to the shaft, in opposite pairs.

Then make two adjacent rings above the disc and two below it, using short sections on the existing parts. Cooling: Wait until fully hardened before changing sides; after making both joints, leave the model to cool completely. Tip access: Access from above and at an angle from below.

The helper raises the whole model above the surface, keeping their fingers on the rim and upper grip, outside the nozzle area.

Once cool, remove the parts. The helper holds the cool edge of the disc and the upper grip of the shaft. Insert the tip through the hole; leave about 12 mm below the disc. With no PLA, check the centre and the right angle from two sides.

Then make four tacks above the disc, from the rim of the hole to the shaft: two opposite each other, then the remaining two. The helper holds the parts until they harden, out of the nozzle's path.

✓ **Check**

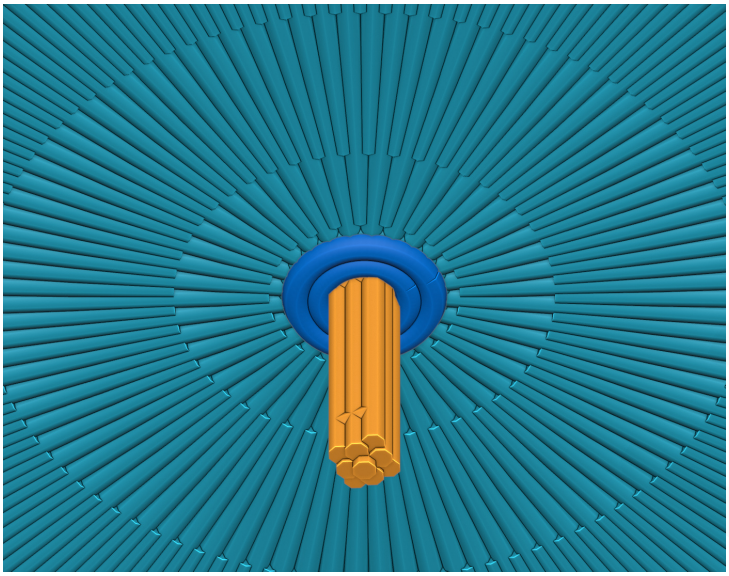
The shaft went in freely and is centred and perpendicular. Each tack touches both parts.

If it does not work

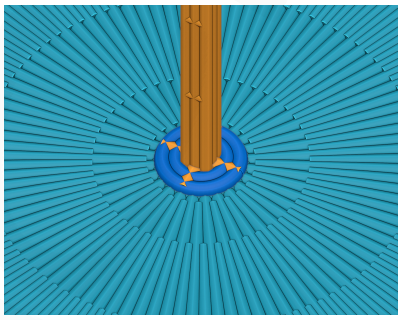
Do not force the shaft in. Correct the fit or position before tacking; join a loose contact while the parts are supported.

STAGE 06 / 07 • Session 1

Reinforce the joint



Continuous collar underneath



Continuous collar on top

NOW Disc-to-shaft joint

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

With the parts supported, join the tacks with two rings of PLA above the disc: one next to the shaft and one next to the rim of the hole. Fuse them into a continuous joint. Once it has hardened, the helper raises the model by the cool edge and grip. Make the same joint underneath, away from fingers.

Wait until the model has cooled completely.

Check

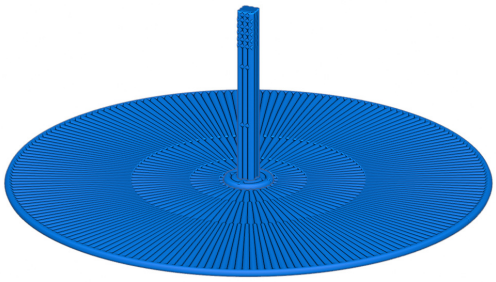
On both sides, the joints connect the shaft to the disc all the way around. The shaft does not move in the hole.

If it does not work

Fill gaps with short sections on the existing joint. Support the parts until they harden.

STAGE 07 / 07 • Session 1

Spin it and see your pattern



Starting position for your own test

NOW Complete model — all previously made parts

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Once fully cooled, gently check the shaft mounting by hand. Place the rounded tip on a smooth, level tabletop. Spin it by the grip and let go. Watch the colours and see whether the spinning top completes several full rotations. Try several times with similar force. At the end, put away the pen according to its instructions and tidy up.

✓ **Check**

The axle stays firmly fixed, the edge of the disc does not rub against the tabletop, and the spinning top makes several full turns. Check this on your own.

If it does not work

If the joint is loose, add to the welds while supporting the parts, then let everything cool completely. If the assembly is permanently crooked or off-center, or the disc is uneven, remake the entire model from new parts by following steps 1-6.

Finished — check the outcome

Check

Once cool, the shaft is rigidly joined to the disc.

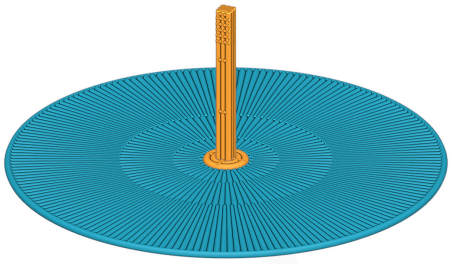
Check

The disc is centred, perpendicular to the shaft and filled to a similar degree on opposite sides.

Check

When you test it on your own, the spinning top makes several full turns; the axle stays firmly fixed, and the edge of the disc does not rub against the tabletop.

Storage

Store the model in a cool place away from sunlight and heat. Repair it on a suitable 3D-pen work surface using the same material as the part.

View 1