How to make a rotating cardboard automata

You will need

Cardboard box (cereal boxes or similar are fine) Cardboard to cut up (cereal boxes are fine) Topper/ ornament (some templates attached below) Small elastic band Small straw or thin tube that fits your skewer Wall tac, old potato or an eraser 2 wooden skewers Glue, sharp pencil, ruler Scissors Fancy paper/ paints/ pens optional



How to make your automata

 Decide what your topper is going to be, it can be anything you like but not too heavy.



The jellyfish was made with tissue paper rolled into a small ball with glue, some waste paper ribbon & plastic bits and 2 googly eyes that were found in a cupboard! There are some ideas at the bottom of these instructions that you can copy. Alternatively draw pictures of yourself, use photographs (ask first), cartoons or simply add shapes with coloured/ sparkly paper. Remember if your topper is a 2D shape might like it on the reverse too and you'll have to attach it securely to the skewer! Whatever you chose make sure that the skewer can turn around and you're your topper doesn't drag or catch on the box beneath it.

Decide which way up the box is going to be. If it's a rectangular shape it will make a difference to the size of your cogs. Find an object (or two; if the width and height are different to each other) [tip: try to ensure the height of the box is greater than the width or depth (if it's a square box it doesn't matter] You need to know the width and height & depth of the box as you will need to make 2 'cogs' that will be able to rotate within it [See picture 1]

- Once you know the width of your 'cogs' you can, if you want, cover your box or decorate it. We've left this one as it is so you can see we didn't cheat!
- First we need to make two discs; one is the driving disc (cam) the other is the follower. The driving disc will travel on a vertical axis and the follower will convert the motion into a horizontal movement so that the object (in this case your topper) will spin around. [see picture 1]
- Find an object with a circular base that fits vertically against your box (it doesn't matter if it's smaller but try to keep it nearly as big as the follower cog). Draw around the shape on your spare cardboard and then cut it out. Check it fits by placing it against the box. [see picture 2] Make sure there's a gap between the top and the bottom. If it doesn't rotate easily trim it slightly. When it is just right, draw around it and cut the required number of additional discs as suggested (If you are using thin cardboard, like a cereal box, cut 3 more discs, thick cardboard cut 2 more, corrugated cardboard will probably only need 1). Your cam needs to be strong enough to carry the weight of the skewer and your topper [see picture 3].
- Repeat these instructions for the follower disc but measure the width of your box!
- Locate the centre of each disc, [see picture 4] and poke a hole in <u>each one</u> with a sharp pencil and a blob of tac [see picture 5] (if you are using a potato we'll throw the potato away (or you can plant it to grow a new potato bush when we've finished but not yet!)).
- Glue your layers of cardboard together and let them dry
- Next make a hole in the top of the box for your rotating shaft to exit from. Stick the tac on the upper inside of the box then use the sharp pencil poke a hole through it. (Be extra careful as this is quite tricky - or ask an adult for help) The hole needs to be as wide as your straw or tube, and should be a snug fit. Cut the straw so that a small portion protrudes into the box and a small portion extends above the box. Glue into place. [see picture 6]

- Take some spare pieces of cardboard and make little treads for the bottom of the follower cam, this is similar to the 'teeth' on a gear and helps with traction. Cut 2 strips 1 cm width, length approx. 10 cms. When dry, cut the strip into small blocks approx. 2-3mm widths so you end up with little rectangles. Glue these to the bottom of the follower (orange in fig 1 diagram) in a clock pattern [see picture 7]
- Take one of the skewers and thread the 'follower' cam onto the skewer pushing it down to the bottom of the skewer Make sure that the 'treads' are facing away from the top of the skewer. Put glue around the skewer and around the discs where they meet the skewer to help secure it. Add a small piece of paper to the bottom of the skewer add a lot of glue to keep the skewer attached to the disc. [see picture 8] Allow to dry.
- Push the skewer up through the box, guiding it through the tube but not so it touches the tube so stop about ¹/₂ cm away from the tube base.
- This bit is tricky so take your time. Make the horizontal cam (We called it the driving disc), (cut a trial disc, make sure it fits and doesn't hit the top or bottom of the box), cut more discs if needed to strengthen it and poke holes into each centre. Glue the discs together.
- Glue a small elastic band on the rim of the disc [see picture 9] you need the band to fit snugly so if your band is too big, cut it and glue it on, trimming any excess off. This will help grip the follower treads and help turn the mechanism around; without it the cardboard tends to just spin over the surface and nothing much happens.
- Use a ruler to measure the length from the top of the inside of the box to the base of the follower including the tread. [see picture 10] Write this number down. Then measure the distance from the centre of the driving disc to the band [see picture 10] Add these two figures together. This is the distance our driving shaft needs to be so it fits snugly and works well.
- Turn the box on its side, use the ruler to measure to the total figure you had before. Mark the box then carefully, turn the box over and mark this side at

the same point. CAREFULLY poke a hole in the sides using the pencil. MAKE SURE the hole is only as wide as the skewer.

- Take the skewer and poke it through one side of the box and stop when it gets just beyond. Put the disc onto the skewer then continue to push the skewer through the disc until the skewer pokes out from the other side of the box. Push the disc so that it is in the correct position on the skewer where it will meet the following cam. Glue the disc onto its skewer in this position. [see picture 11]
- Check that as you turn it, the skewer rotates freely.
- Stand the box upright, and gently push the other skewer with the following cam down until it the treads touch the elastic band.
- Turn the skewer that sticks out from the side of the box to make sure that as you turn it the skewer rotates too.
- Take your topper and carefully measure it up to the skewer that is
 protruding from the top. Make sure your topper wont drag against the box.
 If you've got too much skewer simply cut the excess off (be careful these can
 be quite tough ask an adult to help) Finish your topper and glue it to the skewer.
 Allow to dry (you might have to use a clothes peg or paper clips to hold it in
 place until it is dry)
- When dry, turn your skewer at the side and your topper should go round and round.

YOU'VE FINISHED, WELL DONE!! We'd love to see your designs if you can send your pictures to us.



We've used colours to differentiate between the discs in the diagram- you don't need to colour them – if you have to use 2 different sizes you might want to write on them so you don't get confused when assembling the mechanism.

BLUE DISC. The driving disc (cam) needs to rotate on a vertical axis. So it must be smaller than the height of the box. <u>ORANGE DISC</u> is the follower. This cannot be wider than the box as it needs to rotate on a horizontal axis



Templates:

If your topper is 2D, decide if you are going to have the same design on both the front and back. If you are you will need to do a mirror image on the other piece of cardboard. If you used a recycled box remember to turn the outer packaging over see pictures to help you.

Make sure you leave a gap when gluing on so you have a pocket to slide the vertical skewer into.



REMEMBER to turn your template over if you are using recycled cardboard – otherwise your topper will show the outer packaging



DO NOT put glue here. You need to leave a space so you can slide your vertical skewer into your topper

REMEMBER – you'll need to do this for any topper

