

Cardboard Automata



Cardboard Automata are a creative, playful way to make a mechanical sculpture while exploring simple machine elements such as cams, levers, and linkages. This fun tutorial by the [Tinkering Studio at the Exploratorium](#), San Francisco, introduces the basics of building automata, but you can take your piece much further and make it as complex and colourful as you like!

Cardboard Automata are a good example of integrating science and art. Don't forget that the decorations and the stories told by the automata are as important as the mechanical elements!

- Cardboard box of approx 15x15cm
- Scissors
- Masking tape
- Nail or screw
- Drinking straw
- Glue gun and glue gun sticks
- 3 x kebab skewer stick
- Thick (6mm) foam sheet
- Nut or washer (optional)
- Materials for decoration: thin coloured card, markers/pens, feathers, pipe cleaners and more!



Warning! This activity uses hot glue. Glue guns should only be used by children under close adult supervision.

Axle - A rod that passes through a wheel or cam

Cam - A rotating disk, which changes rotating to linear motion. Cams come in many shapes and they are designed to make contact with another part while rotating, which creates another set of movements

Cam follower - The part of a machine in sliding or rolling contact with a cam and given motion by it

glossary

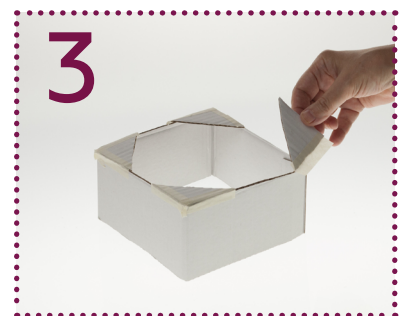
Part A - make a frame



1
Cut the flaps off the cardboard box.



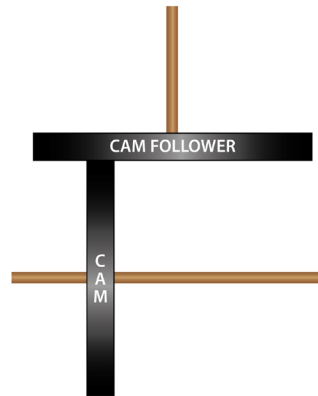
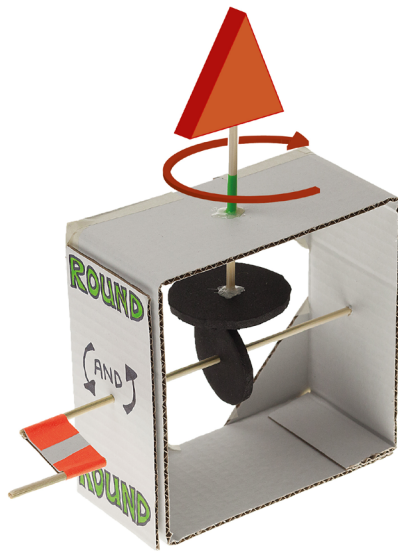
2
Then cut the box in two pieces. You now have two frames, but you only need one for your automaton. Keep the spare to make another one!



3
Cut triangles out of the cardboard box flaps and tape them into each corner of the frame for support.

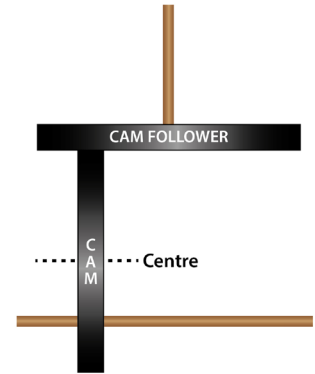
Part B - choose a motion

4 Choose the movement that you want your automaton to make - you can adjust this later if you want to try out different motions!

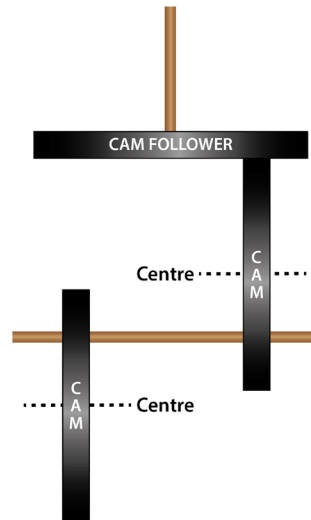
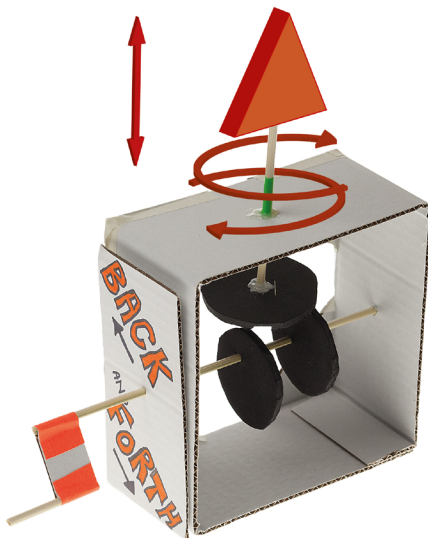


motion:
round and
round

motion:
up and down
+ round and
round



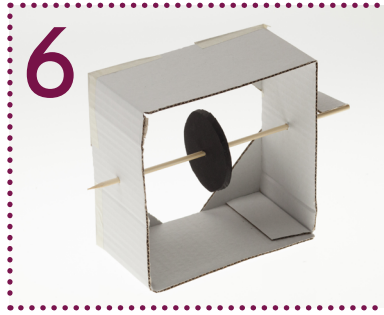
motion:
up and down
+ back and
forth



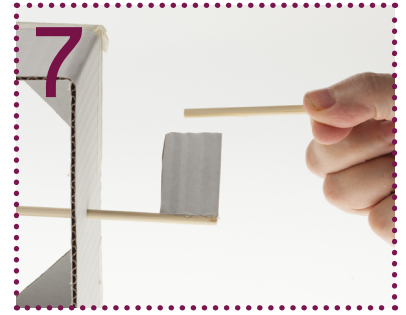
Part C - the cams, axle & handle



5
Now make the cam and a cam follower. Draw the shape of the cam and the cam follower on the thick foam sheet, and then cut them out. The cam should be about 6cm in diameter and the cam follower a little bit bigger. Tip: Cut these smoothly for the best motion

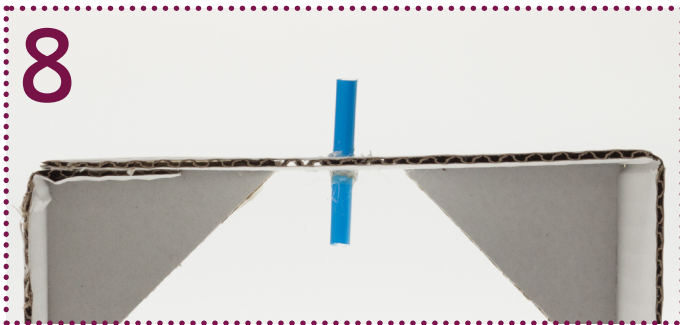


6
Make the Axle. Put your cam on a skewer stick inside the frame. Tip: the diagrams in step 4 will show you where to make the hole in your cam relative to the centre. Tip: Check if the cam and axle clear the top and bottom of the frame first, then make holes for the axle in the frame using a nail or screw.

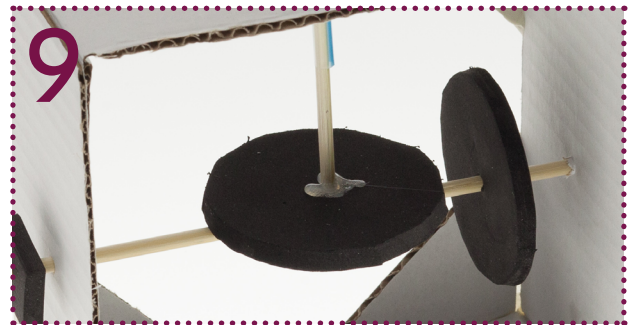


7
Make the Handle. Cut a small rectangle cut from the cardboard box flap, and glue this to the skewer stick axle as shown in the picture. Then glue a second piece of skewer stick to the other end of the rectangle to make a handle.

Part D - the cam follower

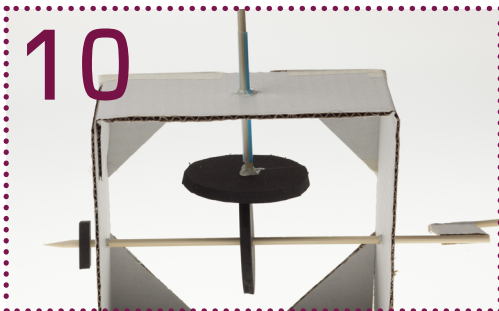


8
Poke a hole in the middle of the top of the frame using a pencil, and insert a drinking straw. Carefully glue the drinking straw in place, then trim the drinking straw to be 2cm long at each end.

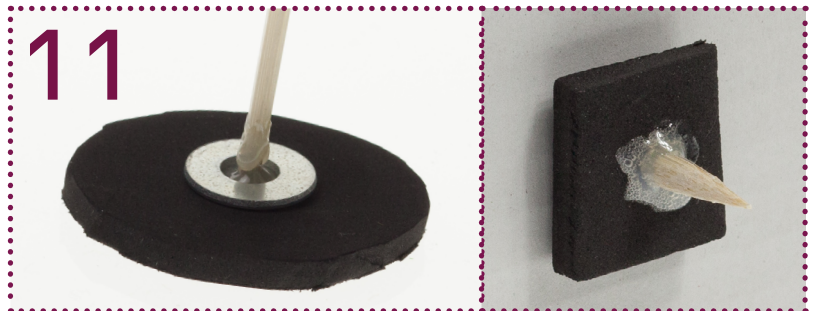


9
Add the Cam Follower. Glue your cam follower on the end of a third skewer stick and put it through the drinking straw. You'll see that the straw keeps the skewer stick from falling over.

Part E - test it!



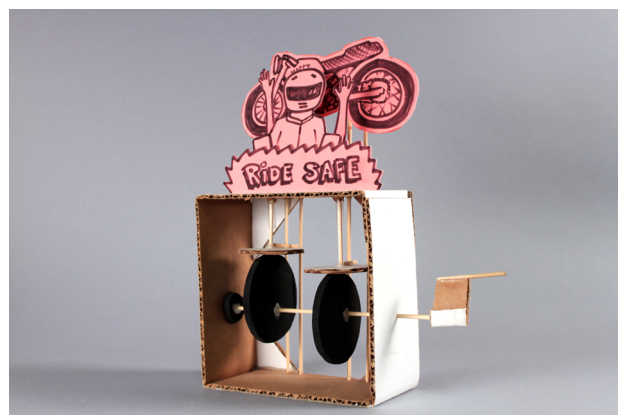
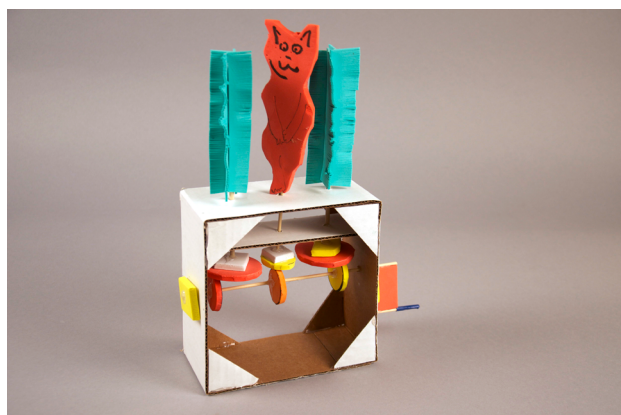
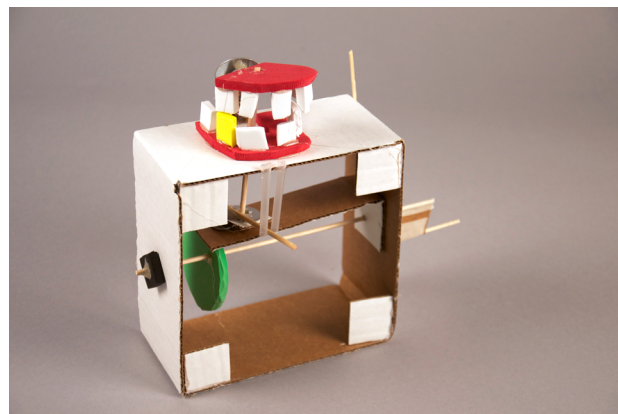
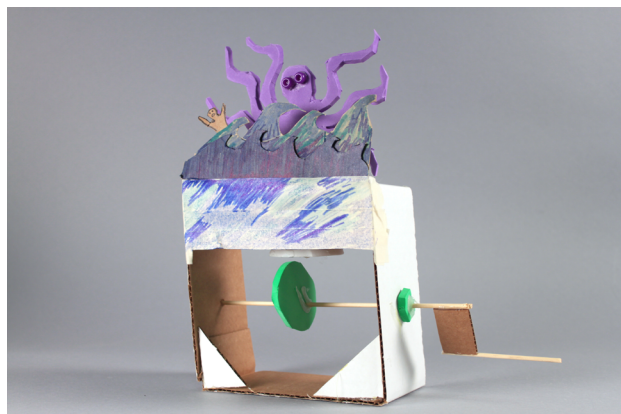
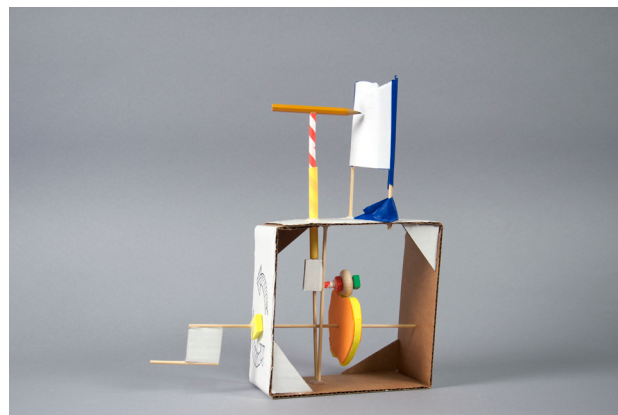
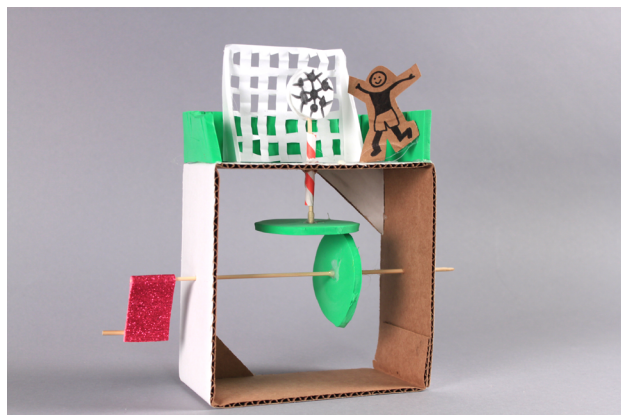
10
Move your cam so that it is under the cam follower. Then turn the handle of your automaton and adjust your cam until you get the motion you like (see step 4 for different placements). Once you have the right position glue the cam into place on the skewer stick axle.



11
Tip: If the cam follower is not heavy enough to rest properly on the cam, attach a metal washer or nut like in the above picture to add a little weight. Tip: If your cam and axle move out of place, add a small bushing made from a scrap piece of thick foam. Make sure to glue the bushing to the axle and NOT to the frame.

Part F - decorate it!

13 Decorate your automaton! Think about your automaton's motions as part of your design and decorating plan. Then let your imagination go wild! These imaginative automata were made in the Tinkering Studio at [Exploratorium](#).



If you want more inspiration or examples of creative and exciting automata have a look at the [Cabaret Mechanical Theatre website](#). They provided the beautiful step-by-step pictures for this tutorial!

Craft Club is a national campaign that champions craft in schools, galleries, libraries and anywhere else you can bring people together to share craft skills.