

CURIOUS CONTRAPTIONS

Cardboard Automata are a playful way to explore simple machine elements such as cams, levers, and linkages, while creating a mechanical sculpture.



(from The Exploratorium, San Francisco)

Example

<https://www.youtube.com/watch?v=PalJelp9N0Q>

Video Guide

<https://www.loom.com/share/d70c40efa5764776adee2ef49fcd2457>

Materials and Tools

Please reuse materials from your recycling bin as much as possible. You do not need all of these different materials. Please feel free to substitute for any material that you do not have at home.

Materials

- Cardboard
- Brochette sticks
- Straws
- Popsicle sticks
- Craft foam
- Elastics
- Wire
- Pipe cleaners
- Masking tape

Tools

- Hot glue gun
- Utility knife
- Ruler

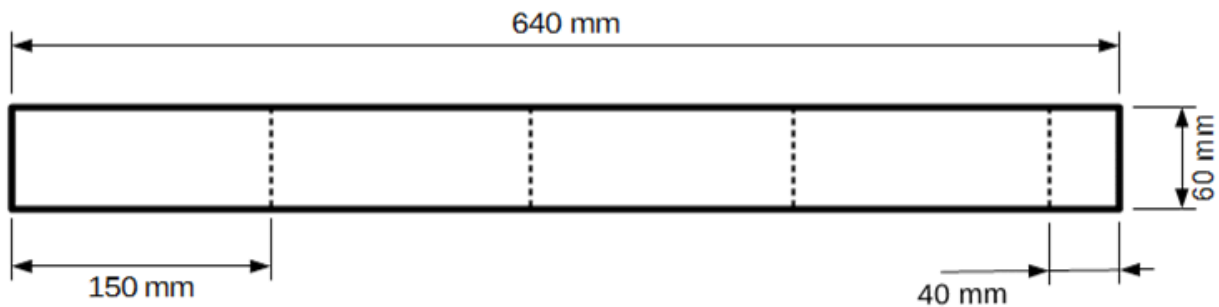
Instructions

The steps to build a box and the dimensions are provided as an example. You can reuse a box that is ready-made (a cereal box or a package). Your dimensions do not have to be the same.

The corners are added to stabilize a constructed box and will be useful whether you construct your own or whether you repurpose a pre-made box.

1. Make the basic frame for your automaton, a square 15 cm on each side, with a depth of 6 cm

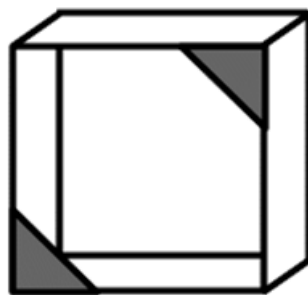
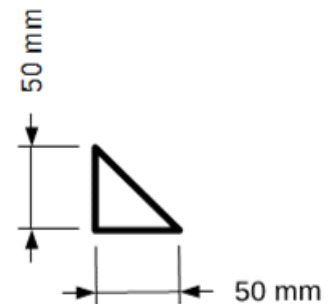
- A) Measure and mark out the piece of cardboard to cut (*the frame*)



- B) Cut out the frame
- C) Score (lightly press without cutting) the dotted fold lines
- D) Fold up the four sides of the square and glue it together using the small flap of cardboard and hot glue

2. Stabilize the frame

- A) Measure and mark out two triangles (*the stabilizers*)
- B) Cut out the pieces
- C) Glue them in opposite corners in order to stabilize the square frame



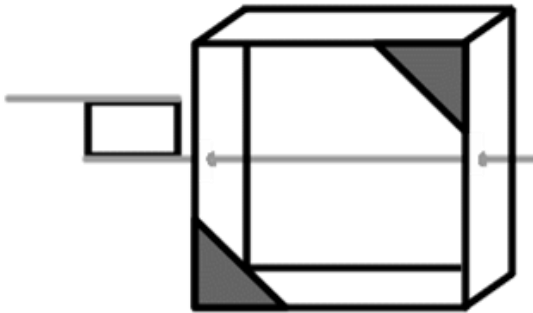
3. Prepare the axle and handle

- A) Cut a stick (*the axle*) long enough to stick out both sides of the box and to hold the handle
- B) Cut a rectangle of cardboard, for the handle
- C) Cut a smaller piece of stick, for the handle
- D) Assemble *the handle* on the axle using hot glue



- E) Cut 2 small squares of cardboard (*the bushings*)
- F) Put one bushing on the axle, next to the handle. If the bushing is loose, glue it *on the side of the handle, not on the side of the frame*

4. Prepare the holes for the axle. Insert the axle into the frame. Test that it moves easily



- A) The 2nd bushing will go on the end of axle outside the frame, opposite the handle.
Do not glue it in place yet

Individual Design

You now have the chance to design and build the movement you wish, based off the frame you built or repurposed

1. Decide on the type of movement desired. The following factors will influence the movement
 - A) Shape of the cam or wheel
 - B) Number of cams or wheels
 - C) Placement of the follower relative to the cam or wheel
 - D) Presence of levers or other mechanisms included in the automaton
2. Build and test many solutions. Adjust as much as you need to get the movement you like
 - A) Cardboard is cheap and plentiful. If you don't like the movement, try adjusting the piece or starting over
 - B) Remember to first attach a piece with a removable link (i.e. tape) to test the movement, then with a non-removable link (i.e. hot glue) to solidify it once you are sure
3. Decorate your automaton as you wish, using cutout shapes, paint, markers, collage, craft materials, etc. This is where you get to be creative!

Submission

Each person will produce a video – maximum 1 minute – that clearly shows the mechanism working and explaining the following points:

- Explain the mechanism. How does it work, in theory?
- Does your mechanism work as described in theory? In not, why not?
- Regardless of whether your automaton worked as desired or not, what would you change, add, or do differently if you had the chance to make your contraption work better? Note that this question asks about how it moves, not how it looks or how pretty it is.

You will submit a LINK TO YOUR VIDEO on Teams

You can either post the video on a public service (like YouTube or Vimeo) and submit the link on Teams, OR you can save the video to your Google Drive or OneDrive, then share the video with Mr. Magee at jmagee@emsb.qc.ca, AND THEN submit the link on Teams.

Evaluation

Your “contraption” and your video submission will be assessed according to the following criteria:

Construction (40%)

- Is the box stable; does it stand upright on its own?
- Does the handle move freely?
- Does the mechanism produce movement in the automaton on top of the box?

Design (30 %)

- You can explain the mechanism. How does it work, in theory?
- You can explain why your mechanism does or doesn't do what you expect it to do, in theory.

Reflection (20%)

- Whether or not your box works the way you expected it to, you can explain what you would do differently or better if you had to make another version of the same automaton.

Creativity (10%)

- Your automaton looks fun and interesting!
- You've put some effort into personalizing your creation.