Amazing Automaton III

A cardboard creation to inspire delight!

Build time: 6-8 hours

Materials necessary: Cardboard, wooden skewers, hot glue and glue gun
Introduction

This cardboard automaton is a machine that uses cams to make letters or cutouts move up and down. These instructions are intended to be a starting point, rather than a guide to make only one project. If you want, you can follow the instructions exactly to make a copy of the design I made, or you can use them more as inspiration. If your automaton looks different than mine at the end, that would be an excellent innovation! This is also designed to use easily available materials, so if you think of something that I didn’t use that you think would be a great addition to your automaton, please add it!

Useful Words to Know

Automaton: a non-electronic moving machine.
Axle: a rod or shaft that runs through a wheel or set of wheels.
Corrugation: the zig zag layer in cardboard that makes it stronger.
Flush: a construction term meaning “even with” or “in line with”
Perpendicular: at a 90 degree angle to.
2 1/4”: Two and one quarter inches.
Instructions

There is a template for pieces that accompanies these instructions. You can use that if you like, but I will also include measurements for all of the parts if you choose not to use it. If you print it out on a regular sheet of printer paper, everything should be exactly the right size to trace and use.

Before you start, it is a good idea to draw a sketch of what you want your project to look like. I included a photo of my drawing so you can see an example of how I thought about things before I started working, and how my design changed as I worked on the project. I would also read through all the instructions before you start building, because it is very helpful to see how all of the parts fit together, and the instructions make more sense if you understand how the finished machine works.
The first thing I made for this automaton was the wheel that will move all the other parts. I drew and cut out a 2 1/4” circle using a compass and an Exacto knife. If you don’t have an Exacto knife, a box cutter or some scissors will work just fine for cardboard cutting. I used an awl, which is a special tool for poking holes, to poke a hole in the center, and a second hole 1/4” away from the edge to hold the pin. If you don’t have an awl, an Exacto knife, a sharp pencil or a skewer will do a good job poking a hole as well.

Make sure your holes are a snug fit to the skewers, because we want them to be held tight to the cardboard when we glue them. I used some hot glue to glue a 3” piece of skewer to the back of the wheel to serve as an axle, and a 1” piece of skewer to the front of the wheel to be a pin. I tried to make sure the axle was flush to the front of the wheel so nothing would catch on it. If you have already built the TRY automaton, this process will be pretty familiar.

The axle that will link the wheel to the swinging arm is a rectangle that is 1/2”x2 3/4”, and the holes are 2 1/4” apart. Cut this out and keep it with all your other moving parts so it can be assembled later.
The next pieces I made were the moving parts that would eventually attach to the wheel. The up and down arm has the slot at the bottom so it only translates the up and down motion of the wheel. The pin can move sideways as it spins around, but it will only push on the arm as it moves up and down. The arm is 2 1/4” wide and 1/2” tall at the base, and the whole thing is 6” long. The narrow middle part is 1/2” wide. The slot is 2” long and 3/16” wide.

The swinging arm is the second moving part of the automaton. It is 1/2” wide and 8” long. I made sure to cut both this one and the up and down arm parallel to the corrugation of the cardboard to make it less likely to fold and crease. So if you look down the short end, you should see the zig-zag of the corrugation. The hole in the bottom is 1/4” from the bottom, and the second hole is 2 5/16” above the first. The skewers are 3” and 1” long. The longer skewer will be the axle that holds the arm, and the shorter one is a pin that will connect with the wheel.
Once most of the moving parts are made, it’s time to make the box. The back of the box is 6”x8”, the sides are 4”x8”, and the top and bottom are 4”x6”. I glued the left side, the bottom and the back together, so I could still have room to work and also make sure the box was supported at the correct angles. I poked holes for the two axles in the back of the box. The hole for the wheel axle is 1 3/8” in from the right side, and 3 1/4” up from the bottom. The hole for the swinging arm is 2” in from the left side, and 4 5/8” up from the bottom. I accidentally poked the swinging arm hole too high up, so that’s why you see two holes where the swinging arm should be. Now that we have the box ready to start attaching pieces to it, we need to make supports for the moving pieces.
The braces are to help support the axles that the swinging arm and the wheel have. Brace 1, for the wheel, has the hole 3 1/8” up from the bottom. Brace two, for the swinging arm, has the hole 4 3/8” up from the bottom. The triangle braces are lined up with the bottom of the brace to help support it when it gets glued on the bottom of the box.

The braces get attached to the bottom of the box, lined up with the holes in the back of the box that you poked for the axles. The wheel brace is glued so the front of the brace is 2” in from the front edge of the bottom piece of the box. The middle of the brace should be 1 3/8” in from the right side of the bottom. The swinging arm brace is glued so the front of the brace is 2” in from the front edge of the bottom piece, and the middle of the brace should be 2” in from the left side of the bottom. See the photo on the next page for how this step looks when it is done.
When your moving parts are all assembled, there might be some trouble spots to work out. I had the issue of my swinging arm running into the wheel, so I cut out 2 stoppers and put them in between the arm and the brace, which moved the arm out far enough that it didn’t run into the wheel. I also had to cut a notch in the side of the box so the swinging arm could swing all the way. Start by cutting only a little bit, and if you notice your arm is still running into the wall, cut a little bit more until it can swing without bending the brace. I also added some stoppers in between the linking axle and the other parts so they wouldn’t catch on each other as they moved.
I added the last two sides of the box, and cut holes in the top for the moving parts. The slot for the swinging arm is 1/2” x 2 1/2”, and 1 3/4” in from the front. The slot for the up and down arm is 1/4” x 1/2”, and is 2” in from the front. I also added a brace to help the up and down arm stay steady. I just used a scrap piece that was long and wide enough to provide support and glued it to the back. There are more pictures of the complete set up on the next page for reference.
Once made sure all of the moving parts were working properly, I cut out two more stoppers and glued them onto the pins that held all of the moving parts, being careful not to get glue on any of the moving parts. I then needed a stopper for the axle of the swinging arm, and a handle for the wheel axle. I used a compass to draw a 1 1/4” circle, and poked a hole in the center and one about 1/8” from the edge of the circle. I glued this onto the back of the wheel axle, making sure to be neat about my glue. Then I added decorations to it. In my original design, I had the idea of putting a magnifying glass on the swinging arm, but I decided I wanted to have a watering can watering a plant that would grow instead. When I make decorations, I sketch out the thing I want to have on paper first, and cut out the outline and trace it onto cardboard. Then I paint the cardboard with the colors that I want so it looks a little nicer. You could do the same thing, or you could use paper, toys, or other things you have to build with.
Conclusion

Hopefully by now you have a fully functioning automaton. I hope that you had fun making it, and that you made some mistakes along the way! I definitely did not get everything about this build right on the first try, and there were lots of parts I made more than once (some even 3 or 4 times!). I even started all the way over at one point, because things weren’t working they way I expected. Messing up is the best way I have found to get better at things, and an excellent way to make discoveries. I would love to see what you have created, and if you want to share it, take some photos or videos and have an adult help you share it using the hashtag #BakkenDiscovers. If you had fun building your first version, this is a great project to try different variations. Now that you know what you are doing, it will be even easier the second time around!