Cardboard Fundamentals

Created by John Park

https://learn.adafruit.com/cardboard-fundamentals

Last updated on 2024-03-08 02:59:32 PM EST

Table of Contents

Overview 3

- Materials
- Tools

Cardboard Types 4

- Corrugated Fiberboard, a.k.a. 'Cardboard Box'
- Paperboard, a.k.a. 'Carton'
- Mat Board

Cutting Tools and Techniques 7

- Cutting Mats
- Rulers/Straight Edges and Squares
- Marking
- Cutting: Knives
- Straight Cuts
- Cutting: Scissors
- Cutting: Rotary Cutters
- Circle Marking
- Circle Cutting
- Circle Center
- Creasing, Scoring, and Poking
- Crease to Bend
- Hole Punch
- Curved Lines
- Curve Cutting

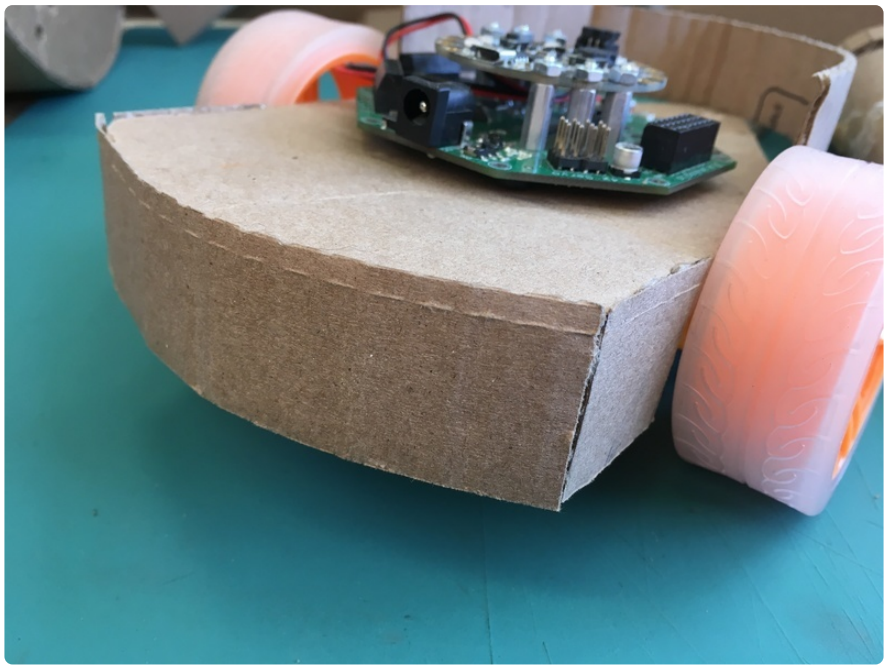
Adhesives and Joinery 20

- Double Sided Foam Tape
- Hot Melt Glue
- PVA White Glue
- Mechanical Fasteners
- Brass Paper Fasteners
- Rivets
- Screws
- Zip Ties
- Lap Joints
- Support

Links and References 29

- Cardboard Skills
- Cardboard Projects

Overview



Cardboard is awesome. This ubiquitous material is inexpensive (or free if you keep your old shipping boxes), sturdy, and easy to work with. It can be much faster to build with than wood, metal, or plastic, and the tools needed are a lot cheaper!

In this guide, we'll show you the fundamental techniques and tools you'll need in order to start building cardboard structures, mechanisms, and robots!

But this is just the beginning of this rich topic, so we've included lots of links to external resources as you continue to grow your cardboard construction skillset.

Materials

We'll cover materials in greater detail on the next page, but in general these are some of the most useful supplies to have on hand:

- Corrugated cardboard boxes, such as shipping boxes from online retailers including Adafruit! You probably already have some around your house
- White glue
- Hot melt glue and glue gun
- String or yarn
- Brass paper fasteners
- Paper clips
- Double stick foam tape

Tools

Just like the materials section, we'll cover tools in greater detail later in the guide, but these are the basics:

- Scissors
- Hobby knife
- Straight edge or ruler
- Pen and pencil
- Cutting mat or other sacrificial cutting surface
- Hole punch
- Compass for drawing circles (optional)

Cardboard Types

For our needs there are three types of cardboard that matter the most: corrugated fiberboard, paperboard, and mat board.

Corrugated Fiberboard, a.k.a. 'Cardboard Box'

This is the cardboard you'll get with most shipping boxes, including your Adafruit packages! Typical corrugated fiberboard is made of three ply construction -- two smooth outer faces with a wavy, fluted corrugation layer sandwiched in the middle.

Corrugated fiberboard is excellent for project construction because it is easy to cut, bend, fold, and drill, yet has quite a high strength to weight ratio. This strength is due to the stable arches inherent in the fluted corrugated inner wall.

Here are some primary types you'll encounter:

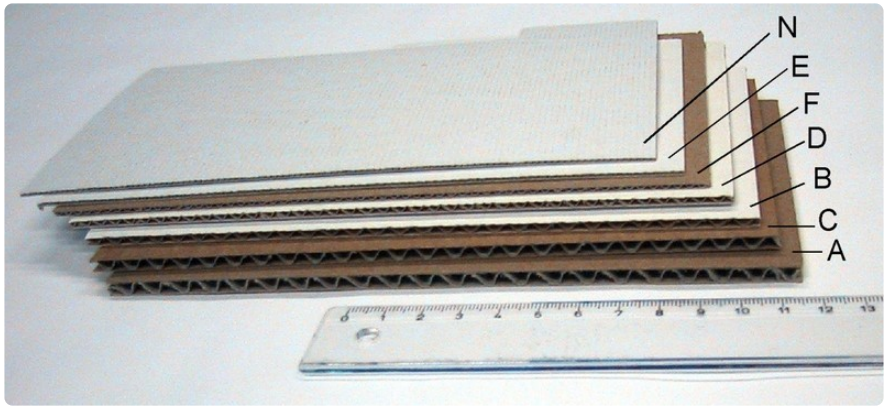
- Single face board
- Single wall double face board, a.k.a. '3 ply'
- Double wall board with AB flute, a.k.a. '5 ply'

Just like a piece of wood, corrugated fiberboard has a "grain" to it. This is due to the orientation of the corrugation layer. The fiberboard is much more resistant to bending against the grain and easier to bend with the grain.

Thicknesses

There are a number of different thicknesses of corrugated fiberboard made. The most common are designated by the fluting letters 'A', 'B', 'C', 'D', 'E', and 'F'. The most common, used in most typical shipping boxes, is 'A' flute, which is 3/16" (4.8mm) thick.

The thin cardboard in the Nintendo Labo kits, for example, is E-flute which is 1/16" (1.6mm) thick.



Paperboard, a.k.a. 'Carton'

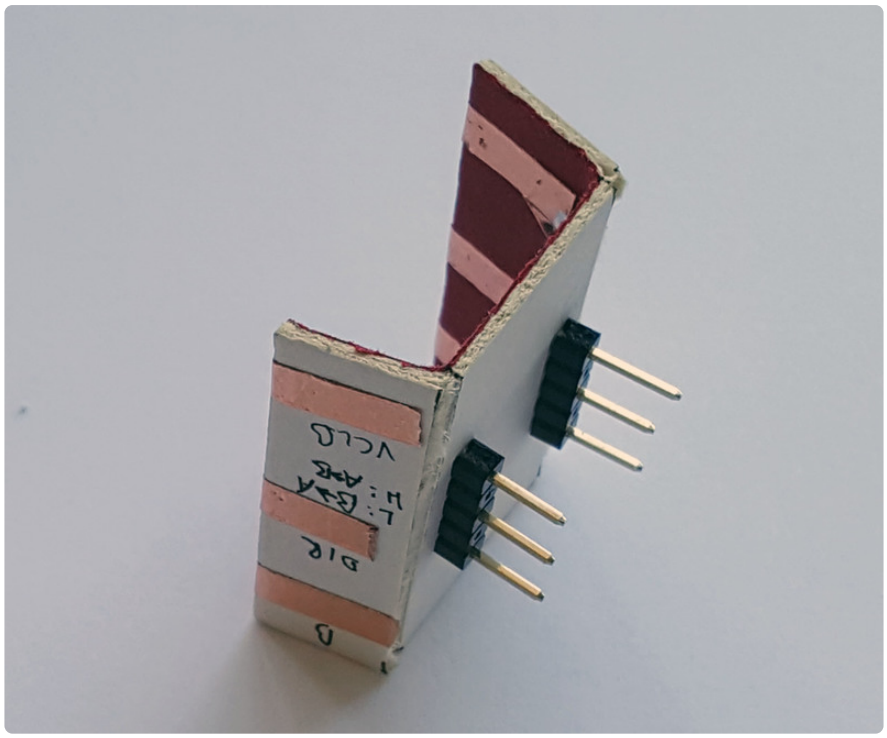
Also called 'chipboard', this is the single ply cardboard you find at the back of a notepad in a thick form, or making up your cereal box in a thinner form.

Paperboard doesn't have the strength of corrugated fiberboard, but it is much easier to bend and fold, which makes it ideal for forming small "papercraft" boxes.

Paperboard is also used to make tubes, such as those found in wrapping paper, paper towel, and toilet paper rolls.

Mat Board

Mat board is the material used in picture frame matting. It is a multi-ply, coated fiberboard with at least one smooth side. Great for cardboard circuits, as explained in this blog post by Bunnie (https://adafru.it/BgS).



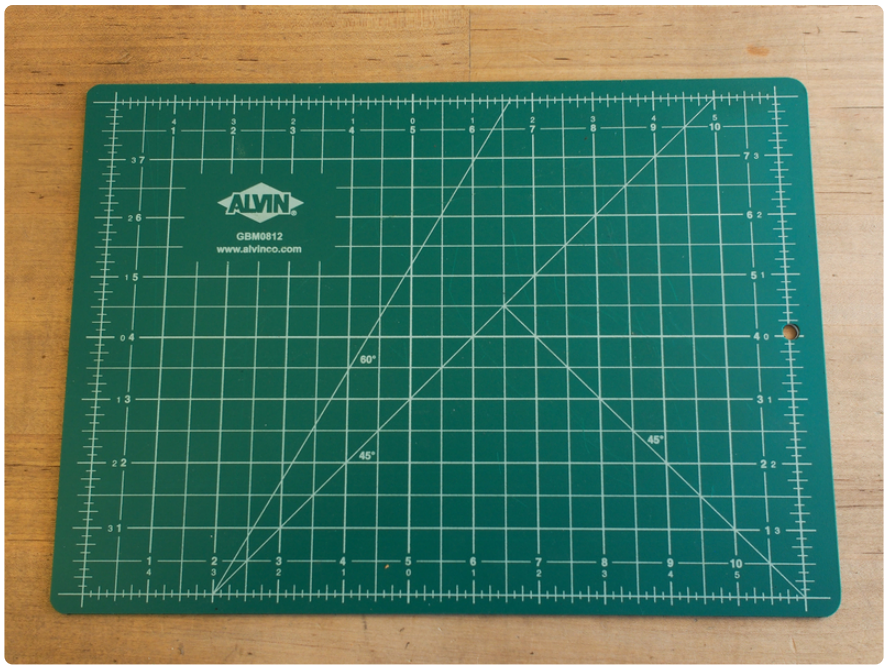
Cutting Tools and Techniques

Here are a number of useful tools and technique for safely and precisely working with cardboard.

Cutting Mats

Consider getting a cutting mat before you start slicing up cardboard on your floor/ desk/dining room table! You can use a layer of newspaper or magazines if you must, but a proper cutting mat will protect both your table top and avoid dulling the blade.

Most cutting mats also have handy rulers, guides, grids, and angles printed on them. They come in a variety of sizes.

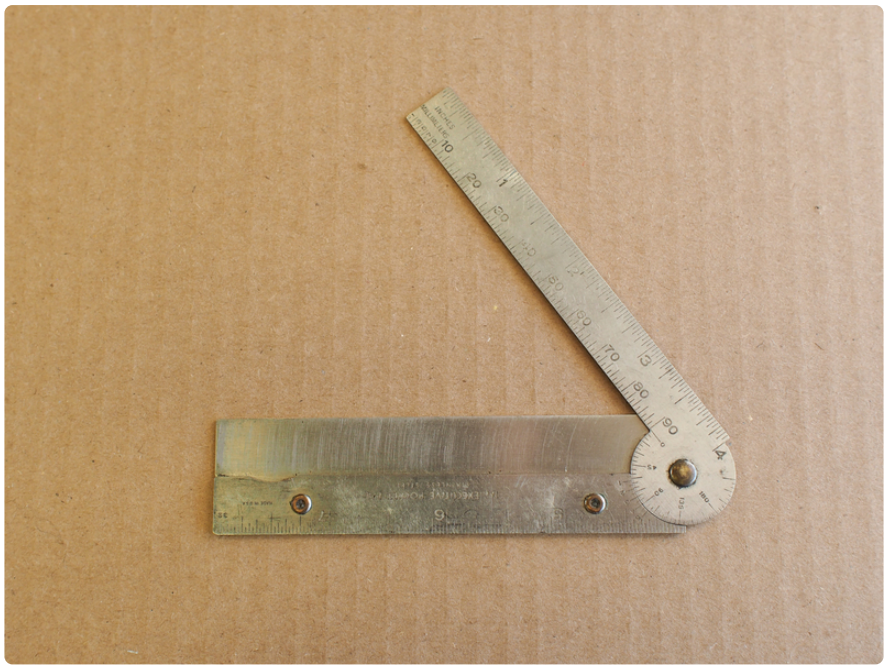


Rulers/Straight Edges and Squares

Metal rulers are best, as they prevent blades from cutting into the edge, or even traveling up and over, as can happen with wood and plastic.

To help you create parallel edges, a square of some kind can be a big help. If you have one straight edge to begin with, you can create perpendicular lines from there with a square.

Angle rulers and protractors can also be very helpful in making precise shapes at particular angles.



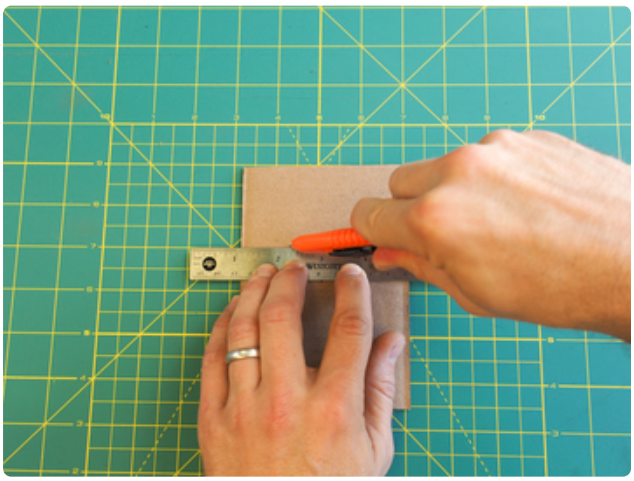
Marking

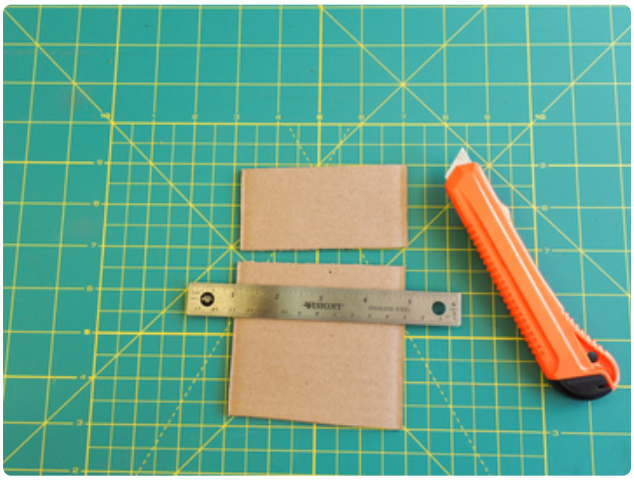
It's good practice to measure and mark where you intend to cut before doing so. Have a variety of pencils and pens on hand.

Cutting: Knives

One of the first things you'll need to do with cardboard is to cut it down to a useful size and shape for your needs. Utility knives and hobby knives are best, as they have very sharp, replaceable blades. Cardboard dulls edges quickly!

Other knives that work well are contractor's knives, for thicker cardboard and scalpels for curves and more intricate work. Both of these types also use disposable blades.





Straight Cuts

Here, a small straight edged metal ruler is used with a hobby knife to make a nice, straight cut.

Keep those fingers out of the way
Apply firm pressure to the ruler
Cut away from yourself, not toward your body

Cutting: Scissors

Scissors work well, too, but again, they can get dull from too much cardboard use, so you may want to designate an inexpensive pair for cardboard cutting, and know that it may need to be replaced periodically depending on how much cardboard crafting you do.

For most straight cuts you'll want to run the blade alongside a metal ruler or straight edge to prevent it from running off the line.

Cutting: Rotary Cutters

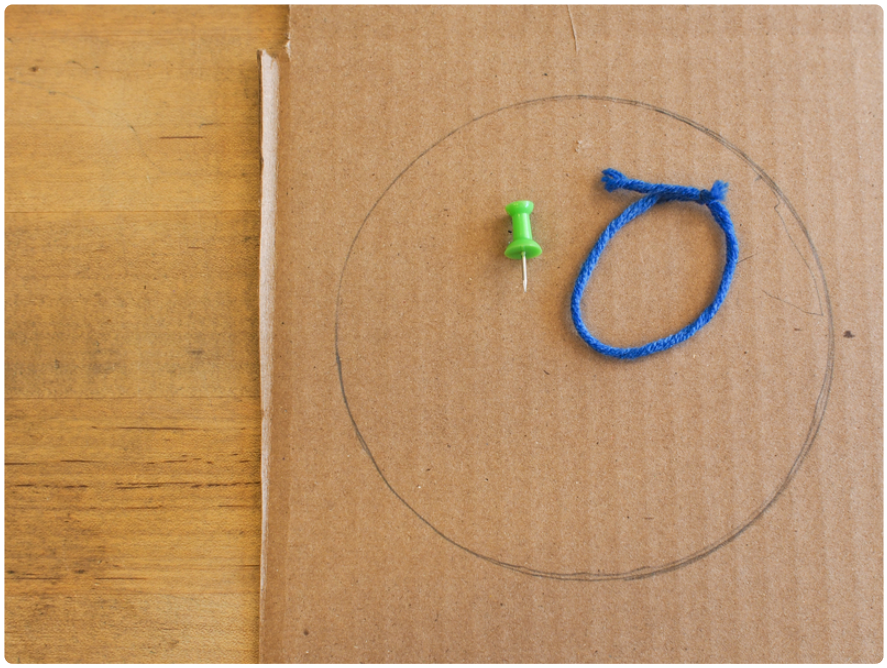
A more specialized tool you should consider if you do a lot of cardboard cutting is a rotary cutter. It looks like the smaller, sharper sibling of a pizza wheel, and is usually used for fabric cutting.

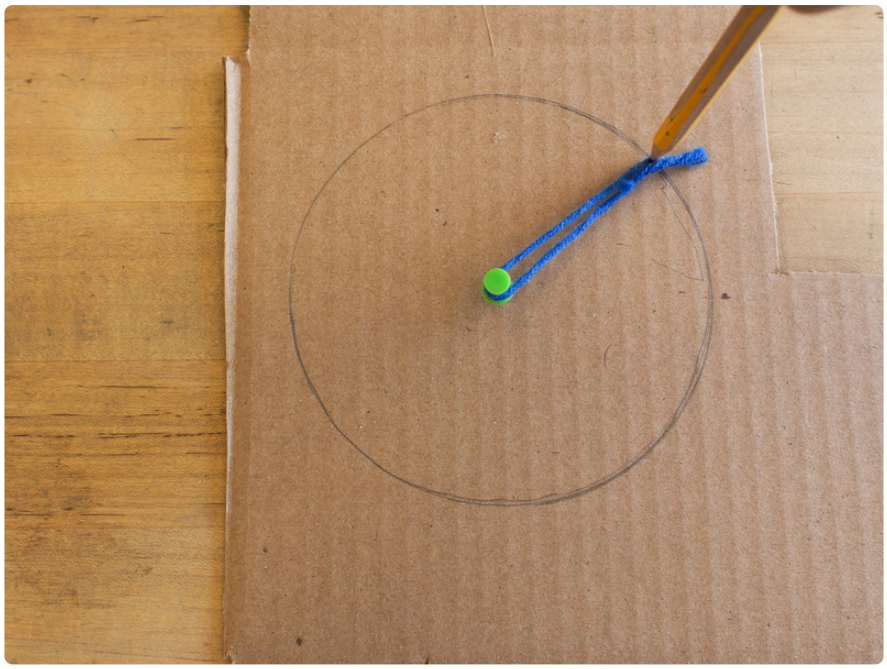
Again, run it alongside a straight edge or else you risk the cut curving off the line.

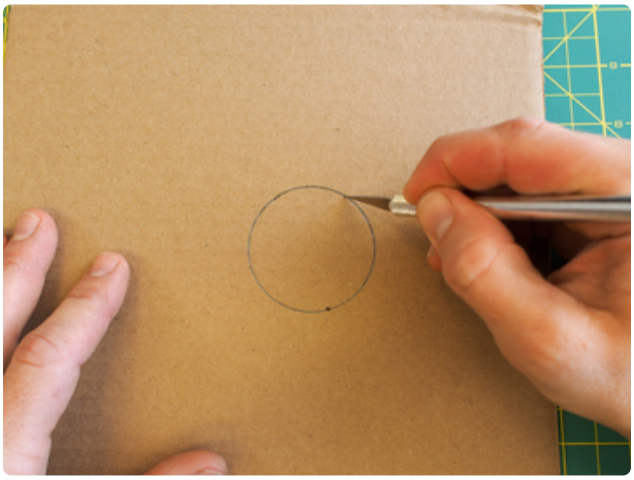
Circle Marking

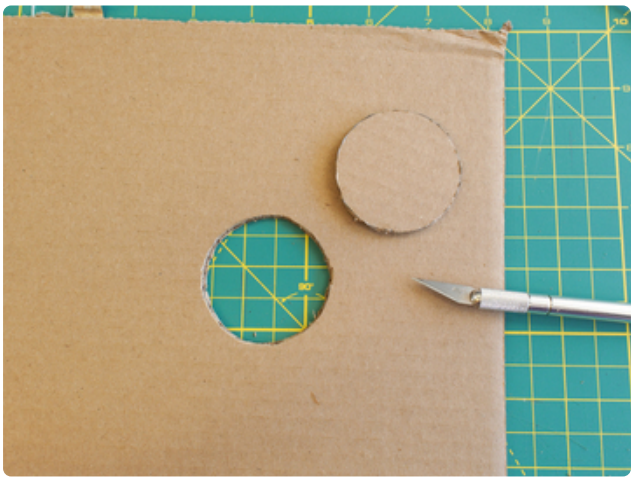
To mark circles for cutting you can use a compass, a circle template, round object to trace such as cups and containers, or you can use a thumbtack and a loop of string or yarn!

Circle Tool
WindFire Designs
Mark Whiting
Tim Everton







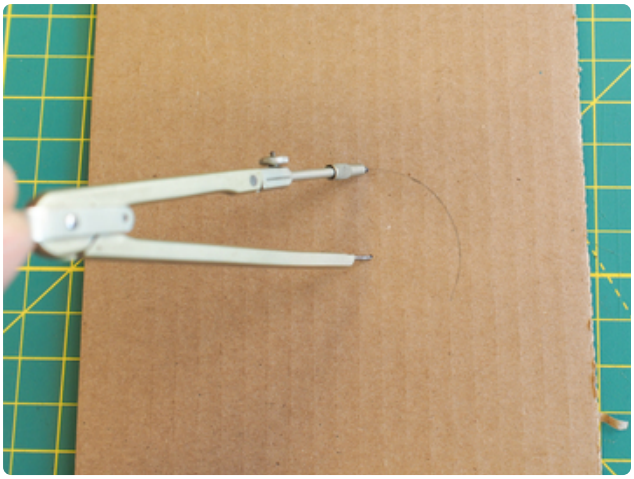


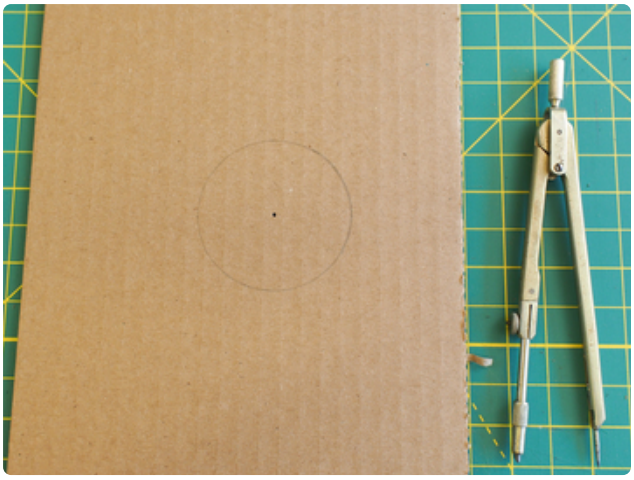
Circle Cutting

Use a small, thin blade

Go slowly

Take multiple shallow passes rather then trying to cut it all in one go

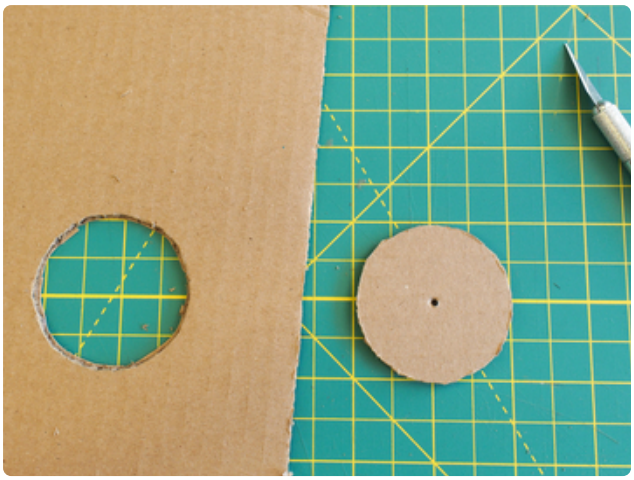


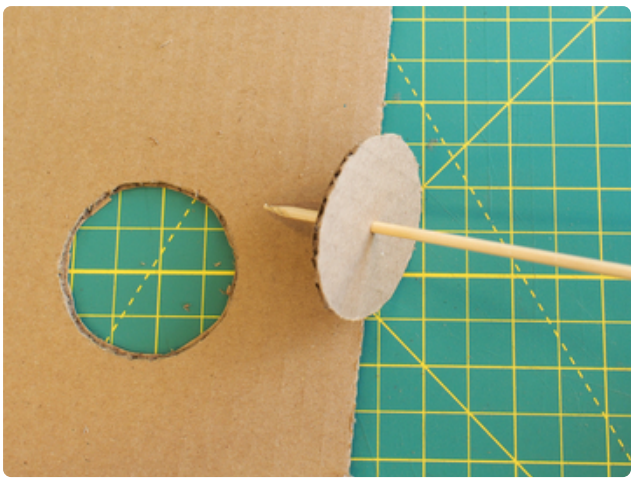


Circle Center

One advantage of using a compass or the pushpin and string method for drawing your circle is automatic center hole!

You can then use the center hole for an axle, such as a bamboo skewer.

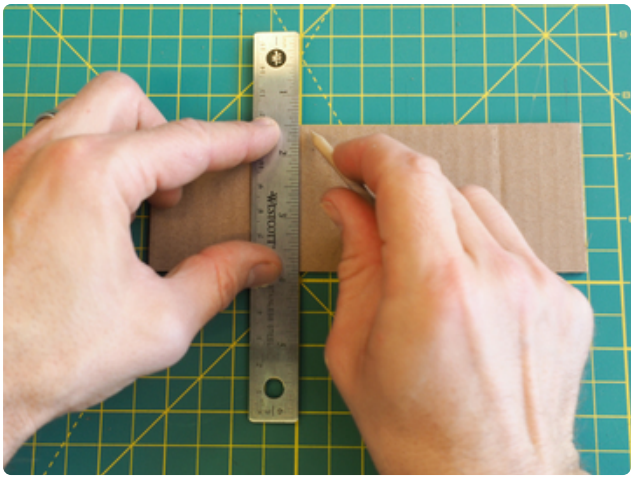


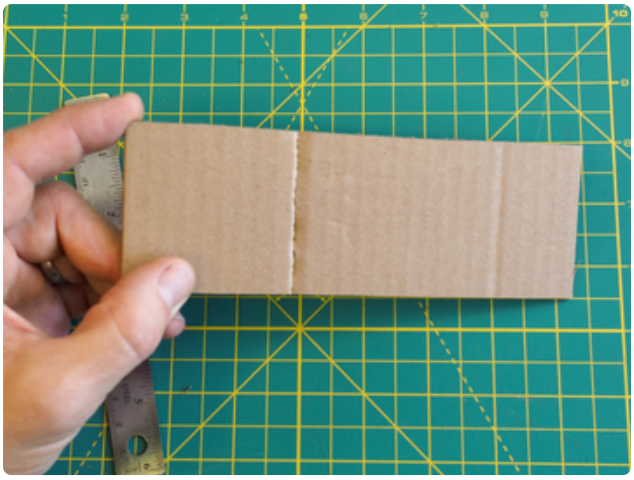


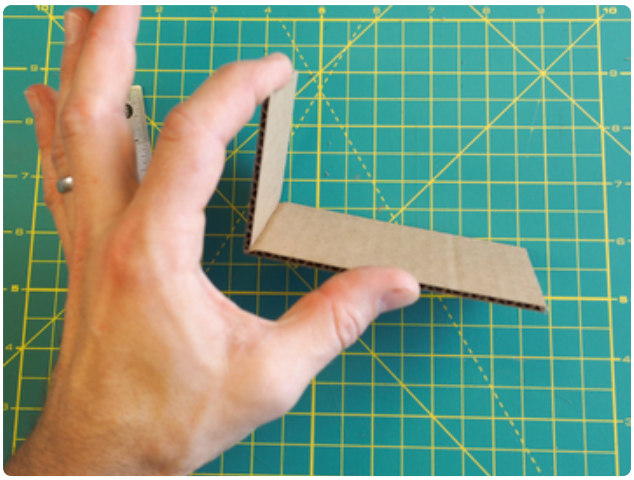
Creasing, Scoring, and Poking

To help you make bends in cardboard, you may want to crease or score, one side of the material. For this, you can use a variety of tools. A dried out pen, a knitting needle, or a pointed dowel (not too sharp) all work well.

You will also want some tools for poking holes in cardboard. For this, an awl works very well, but you can substitute a bamboo skewer, toothpick, or small Philips screwdriver.







Crease to Bend

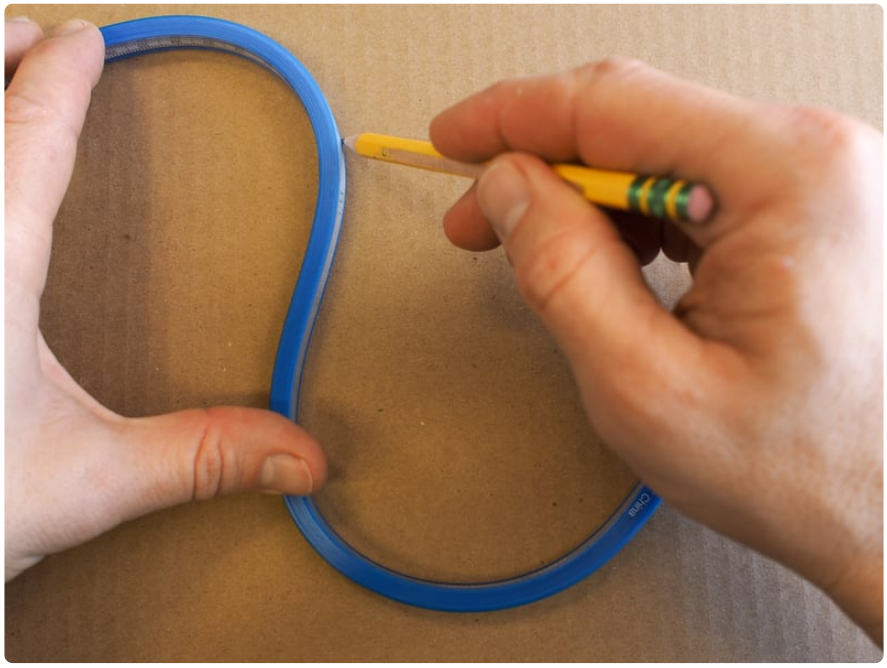
Run a creasing tool across the cardboard a few times in order to create a better bend.

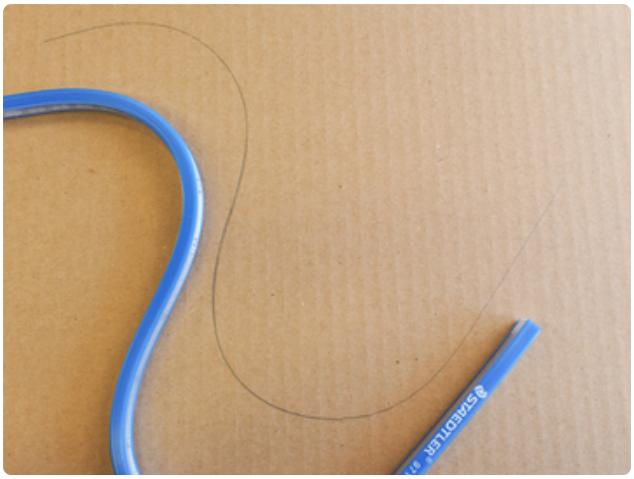
Hole Punch

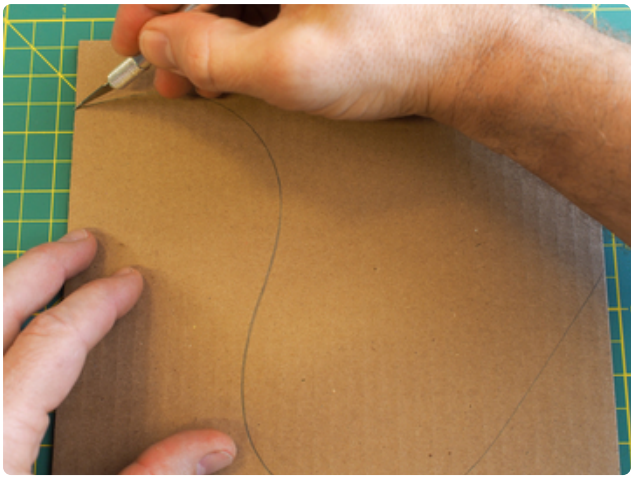
A single hole punch is great for making holes in cardboard. You'll be limited by the "throat" of the tool by how far in from any edge you can punch. If you have very specific needs, there are specialized hole punches available at craft/hobby stores that have farther reaches, a variety of diameters, and different shapes of punch.

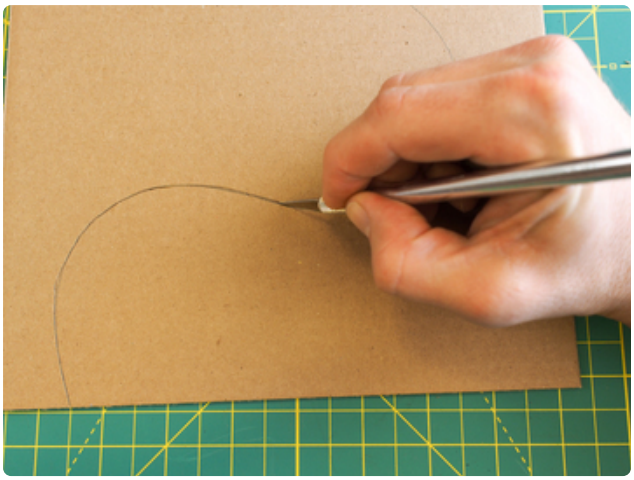
Curved Lines

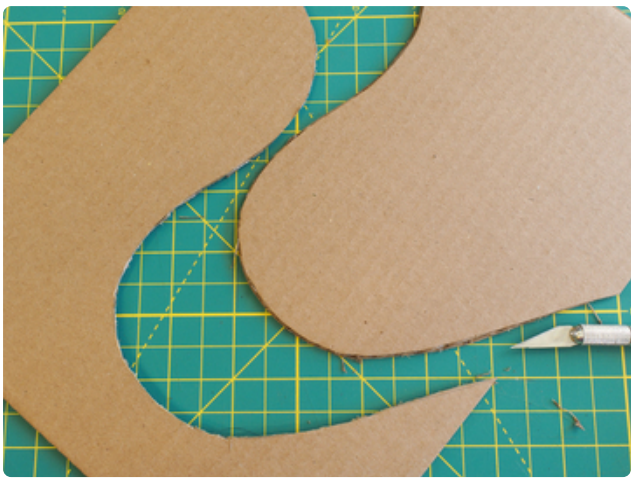
You can create freehand curves, trace objects, or use a flexible curve ruler. This is especially useful if you need to create multiple instances of the same curved shape.











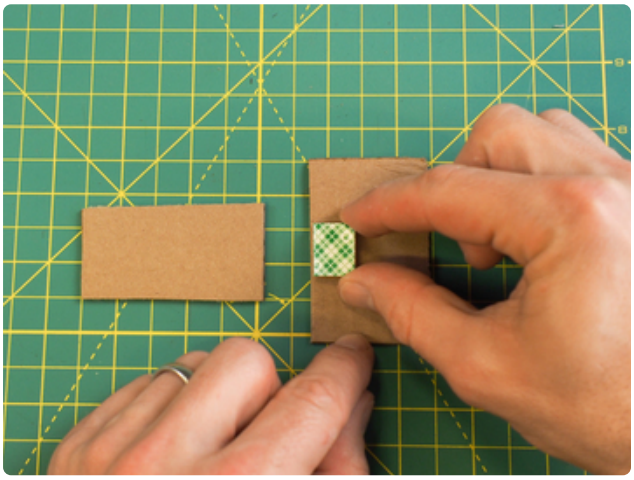
Curve Cutting

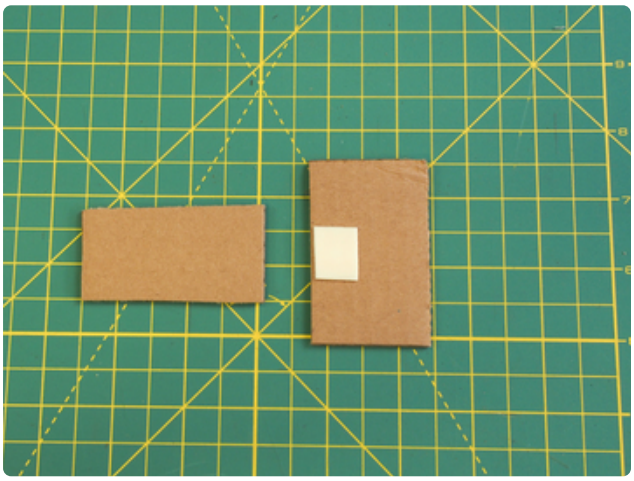
Lay out your curve with a pencil

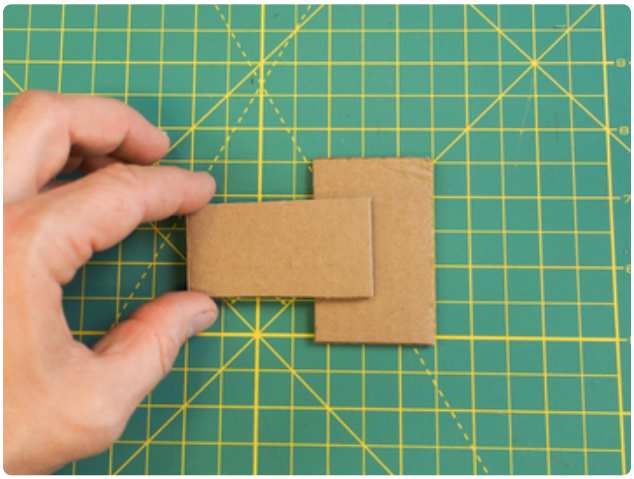
Make multiple light cuts using a small, thin blade

Adhesives and Joinery

Once you've cut up your cardboard to size you'll often want to join it together. Here are some ways to do just that!

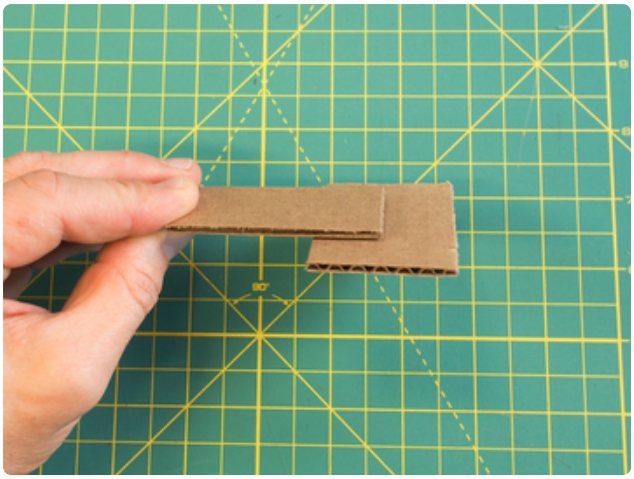


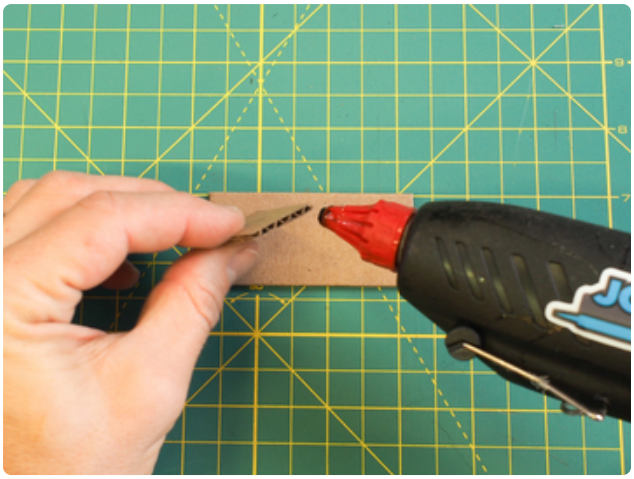


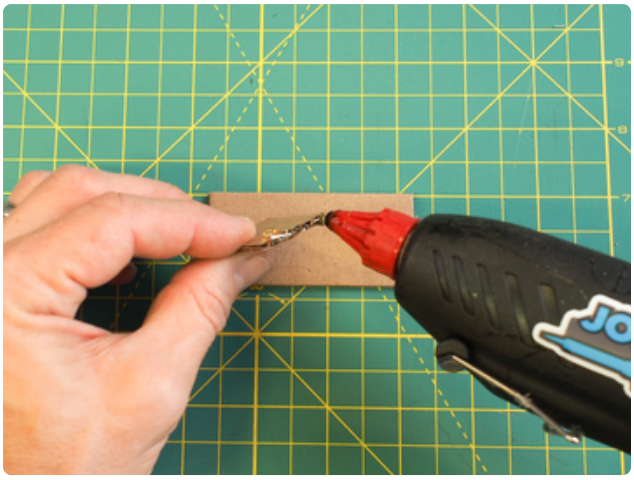


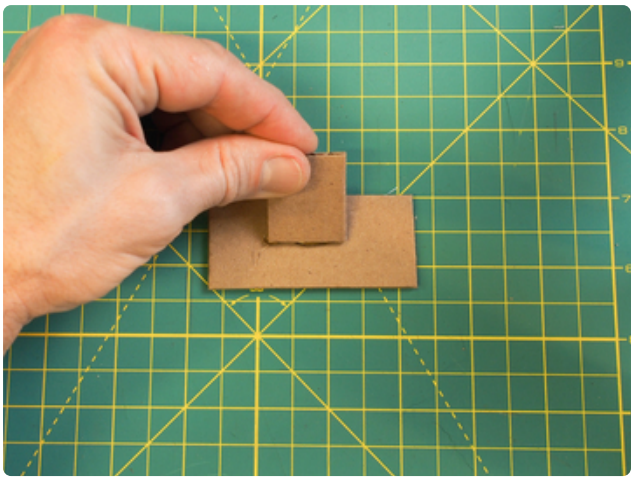
Double Sided Foam Tape

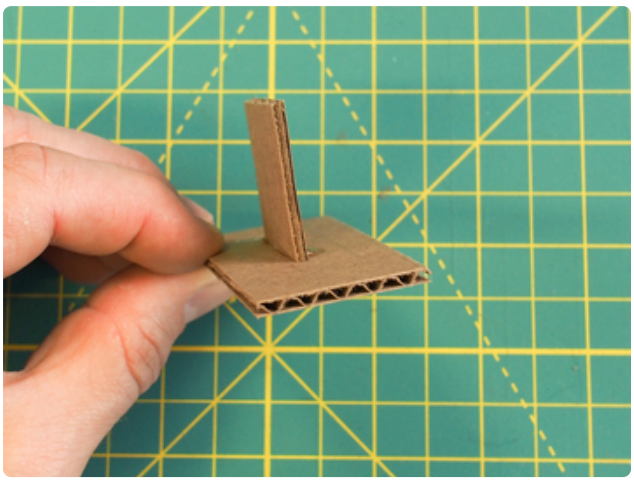
Foam tape with double sided adhesive is a quick way to join cardboard.











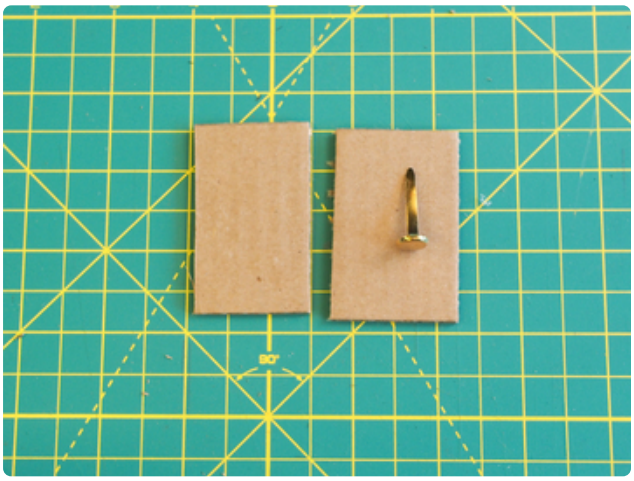
Hot Melt Glue

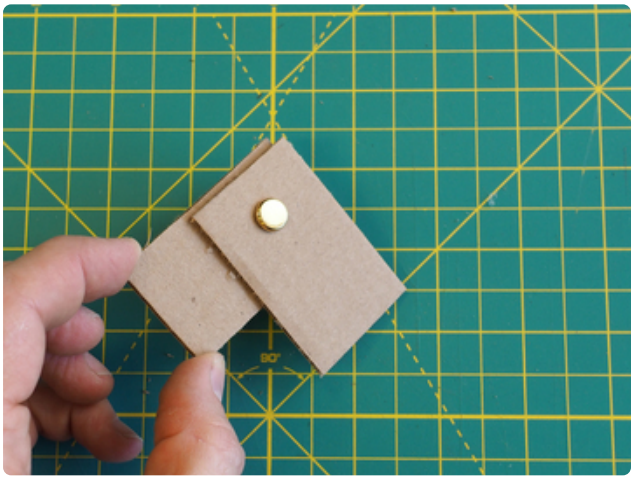
Hot melt glue is one of the best ways to join cardboard. It is fast to cure, strong, and can fill in gaps in uneven surfaces.

PVA White Glue

White glue works very well on cardboard. It's a bit slower to dry than hot melt glue, but requires no special tools, and is cheap and ubiquitous.

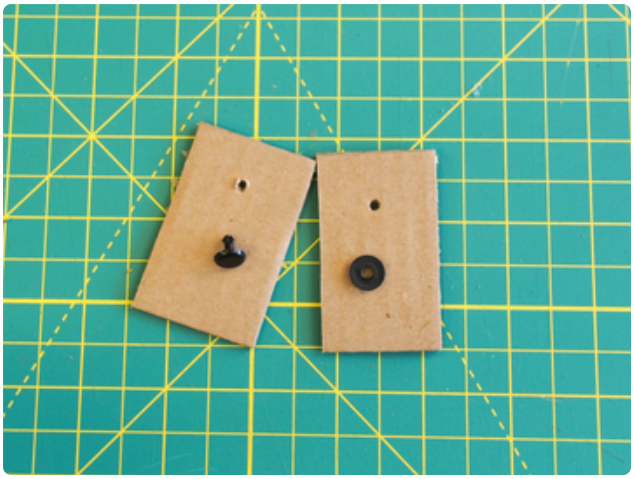
Mechanical Fasteners

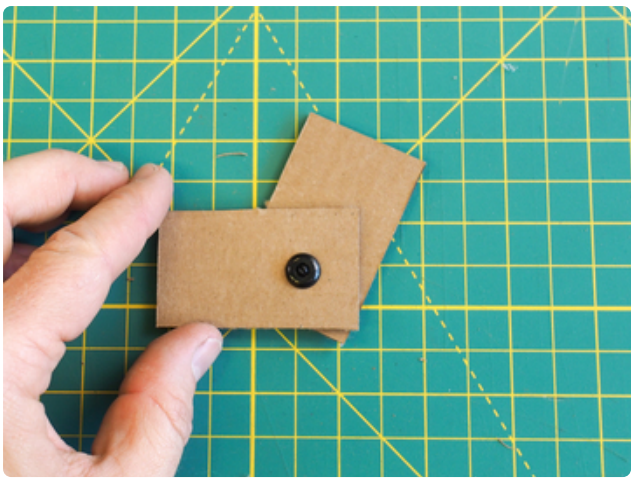


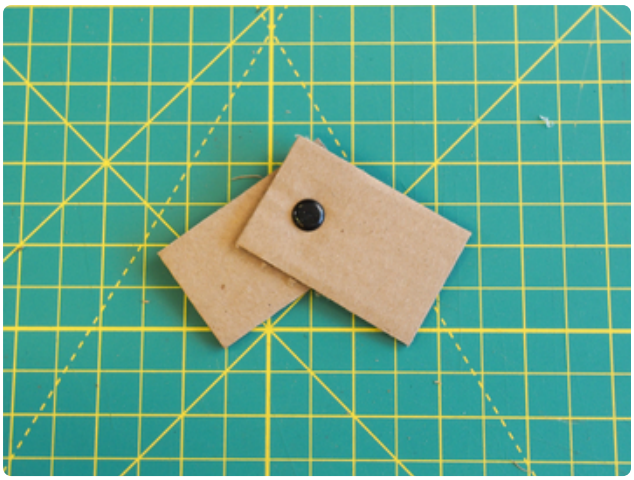


Brass Paper Fasteners

Punch a couple of holes in your cardboard, push a paper fastener through, and fold out the legs. Instant connection!

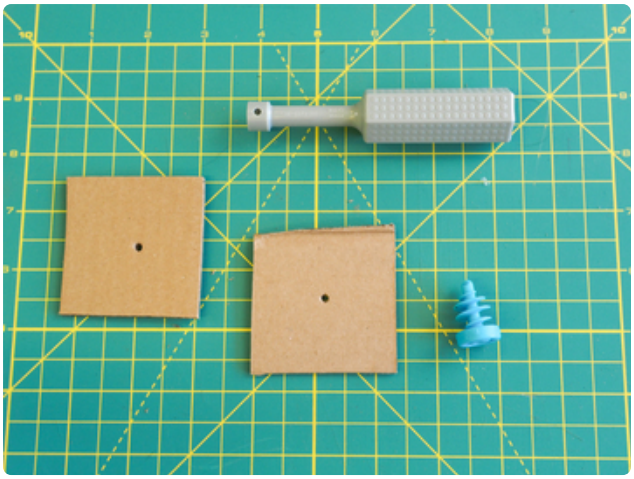


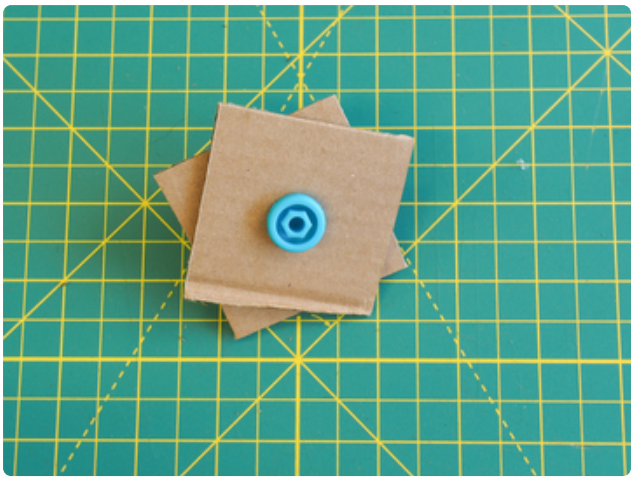




Rivets

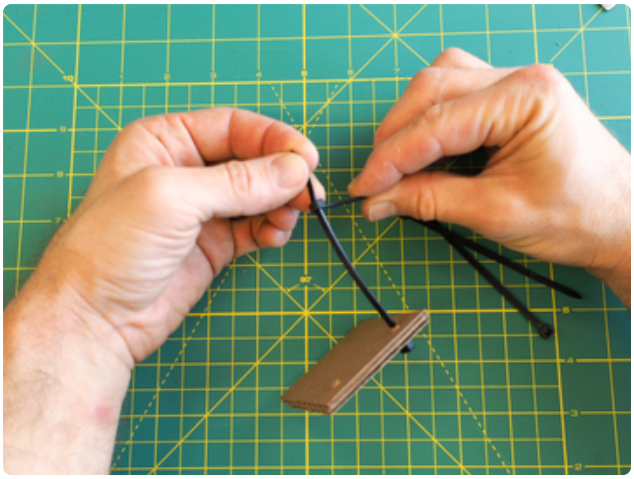
Rivets make for excellent fasteners, and since they have a smooth shaft, they can be used for rotating pivot points and joints.

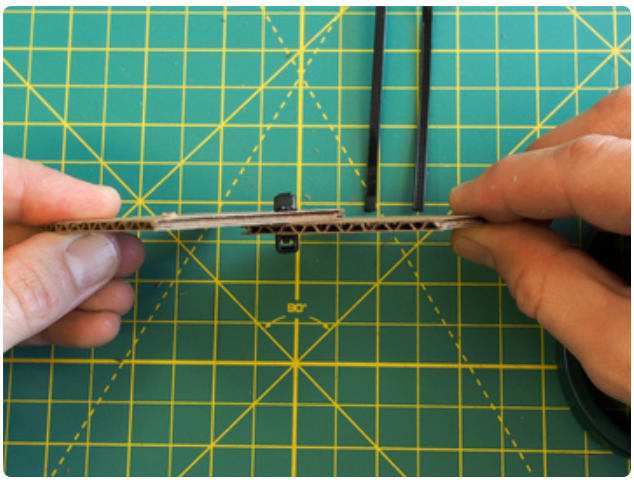


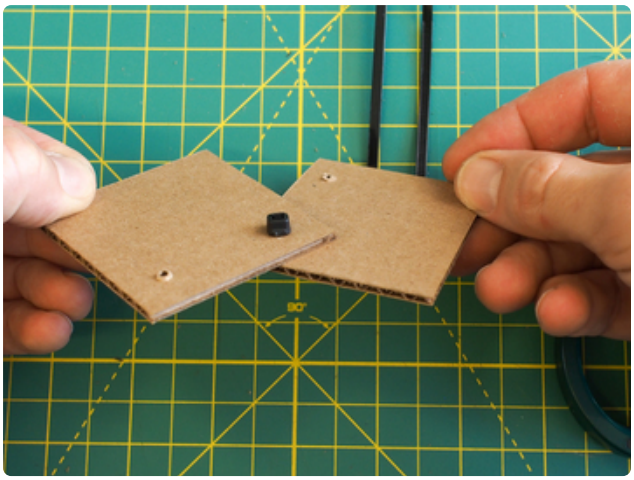


Screws

Makedo Scrus are specialized screws designed specifically for joining cardboard. They come in two lengths -- the short ones work great for two or three layers of cardboard, the long one can handle even more, particularly the thick, 5-ply cardboard from heavy-duty shipping boxes.





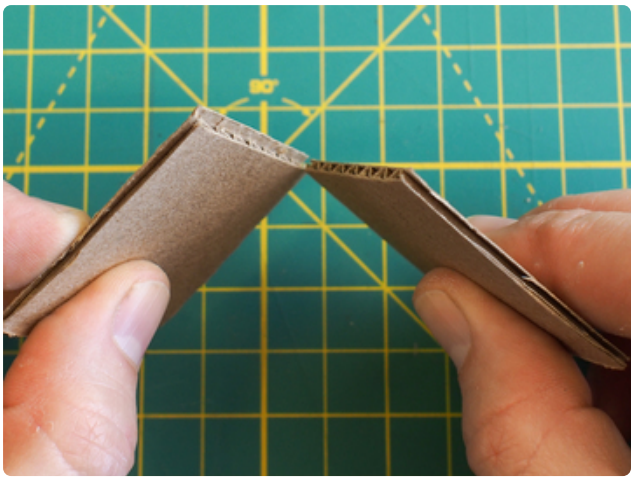


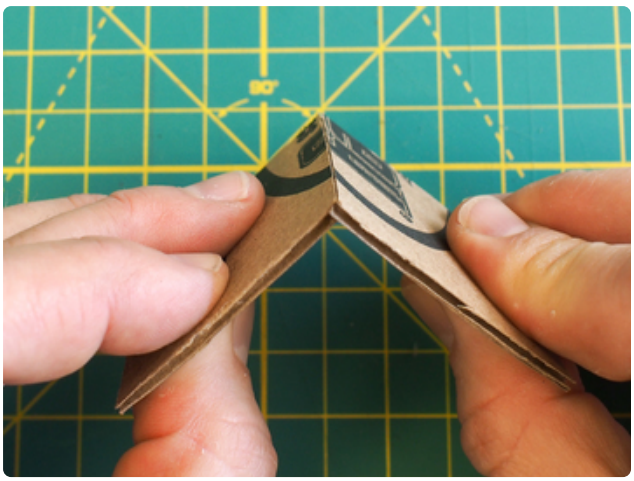
Zip Ties

Zip ties are incredibly versatile. Here's a trick for using them to create rivets of greatly varying lengths. Push one zip tie through the cardboard to be joined, then slip a second zip tie onto it. Trim the excess length.

Lap Joints

Looking for a nice, clean 90° joint between cardboard sections? Here's a great way to do that -- it's similar to a lap joint in woodworking.

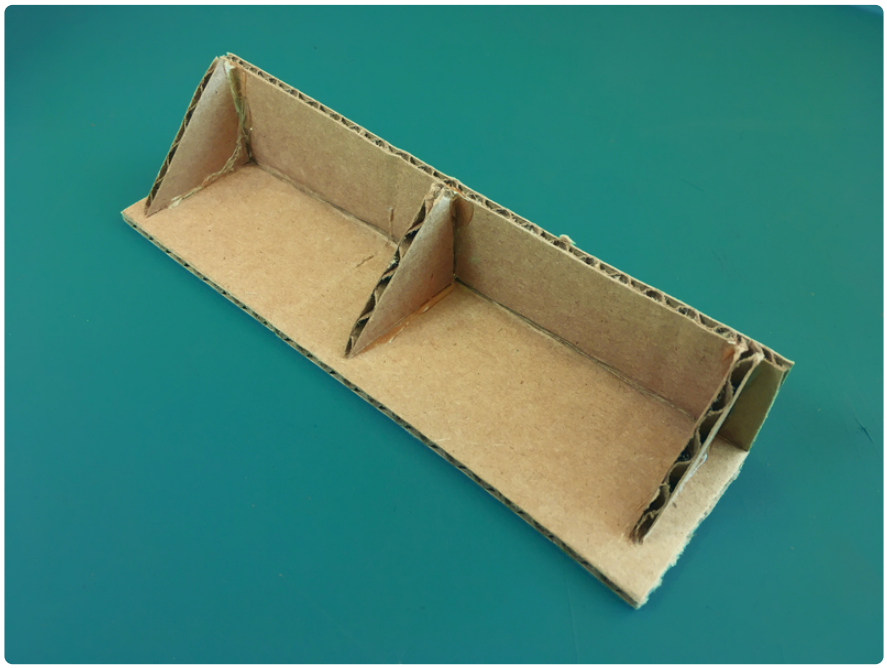




On one piece of cardboard, measure in from the edge the same distance as the thickness of the piece to be joined
Trim away one face layer and the corrugation flutes from this section, making sure to leave the outer face intact
Glue and fit the two pieces together, holding them in place as the glue cures
Admire the perfect edge!

Support

Depending on your project, you may need a bit of extra strength and support where your walls are joined. There's a simple, yet effective way: cut a few triangular support braces and glue them into place!



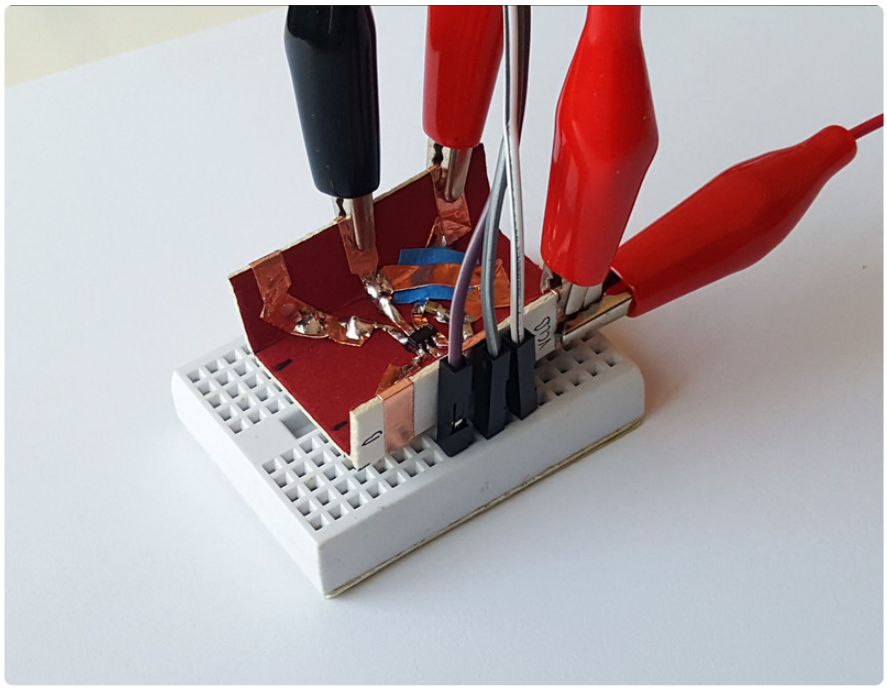
Links and References

Cardboard Skills

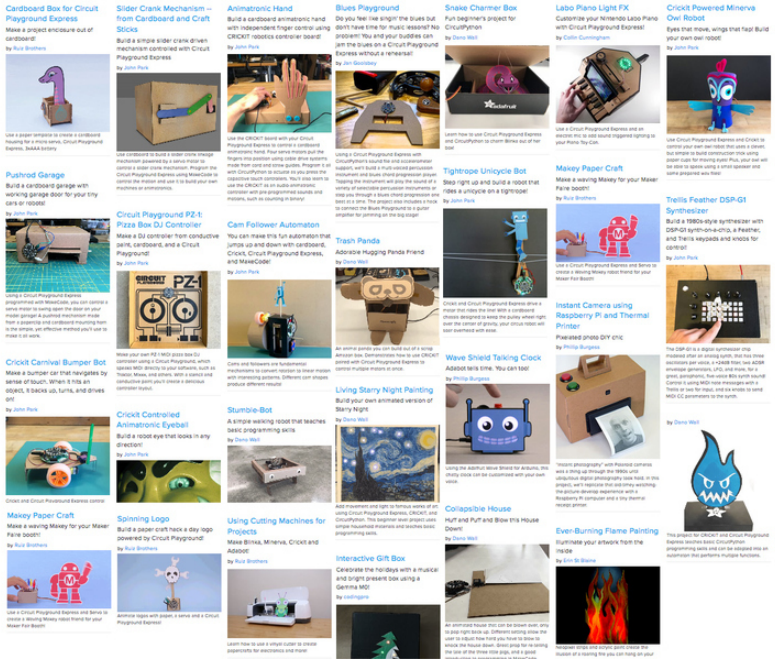
There are many excellent resources out there that dive into greater detail and more specific or esoteric areas of cardboard construction. Here's a collection of some great ones to visit:

- Bay Area Maker Educators Cardboard Night (https://adafru.it/BIU)
- Pro Tips for Using Cardboard (https://adafru.it/BIV)
- Design Modeling with Jude Pullen (https://adafru.it/BIW)

- Bunnie's Cardboard with Electronics Post (https://adafru.it/BgS)



- Paper Weights Crashcourse (https://adafru.it/BIY)
- Paper Types and Thicknesses video (https://adafru.it/BIZ)



Cardboard Projects

There are a number of great cardboard (https://adafru.it/BI-) and papercraft (https://adafru.it/BJ0) project tutorials in the Adafruit Learn Guide system. Click those links and have a look!