

WEEK 6

CARDBOARD ENGINEERING & PROTOTYPES

**INTRODUCTION**

This week makers are introduced to cardboard engineering and cardboard prototyping.

**ESSENTIAL QUESTIONS**

- What is a cardboard prototype?
- How do artists, engineers, and makers solve problems when they're working?

**LEARNING OUTCOMES**

1. Explore how to build and prototype with cardboard.
2. Engage in project-based learning through brainstorming and developing a prototype.



VOCABULARY

Engineering: Applying science and math to solve problems and design machines, structures, and technology

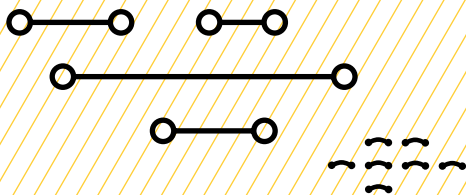
Prototype: Early sample, model, or release of a product built to test a concept or process

User: People using the game or device

User interface (UI): Design of how the user interacts with the game or device

User experience (UX): How natural and enjoyable the experience of using a game or device is

Troubleshooting: Using resources to solve issues as they arise





MATERIALS LIST

EACH PAIR OF MAKERS NEEDS:

- Scissors
- Cardboard scissors
- Tape (masking, duct, etc.)
- Notebook
- [Planning Your Prototype worksheet](#)

ALL MAKERS NEED ACCESS TO:

- Cardboard (corrugated and flat)
- Assorted paper
- Zip ties, rubber bands, popsicle sticks
- Paper fasteners, binder clips, paper clips
- Pipe cleaners, googly eyes, pom-poms, etc.
- Markers or colored pencils
- Bottle caps/recycling (optional)
- Straws (optional)
- Hot glue ([See Facilitation Tips.](#))
- Box cutter and mat ([Teacher use only. See Facilitation Tips.](#))

Items can be portioned out per table or set up in an area where students can access them freely.





TEACHER PREP WORK

1. Ensure the internet connection is working and connect your laptop to a projector or screen.
2. Preload videos and slideshow to save time.
3. Arrange maker materials in an area where makers can easily access them.
4. Prepare a few examples of the cardboard-joining techniques shown in the slides (optional).
5. Print and post [Safety Agreement](#) and [Troubleshooting Tips](#) (Edit to include your own modifications.)
6. Set up a hot glue station and a box cutter station, covered with newspaper or butcher paper.
7. Print copies of the [Planning Your Prototype worksheet](#) for each pair of makers.

FACILITATION TIPS

Inspiring creativity: If makers have trouble generating ideas, try brainstorming with them, or ask them, “What devices do you use often? What might those devices look like in 30 years?” It can be helpful to ask them to create a list of “problems” and then brainstorm ideas for devices that could help solve those problems.

Materials management: It’s up to you as the educator to decide what works best for your class. You can portion out maker materials into paper trays

for each table or have a dedicated area where makers can access materials freely as needed.

Safety: Using hands-on tools is an empowering part of this curriculum. However, practicing safety when working is crucial when using hot glue and sharp tools. You know your makers best, so make adjustments and adaptations as necessary. **If makers misuse any tools, have them take a break from the tool and return at your discretion.**

Note: If you don’t feel comfortable letting makers use hot glue on their own, you can set up an area where you help them hot glue connections they can’t achieve in other ways.

Box Cutter (Teacher Use Only): If you’re comfortable using a box cutter, you can help makers with cardboard cuts they can’t do on their own with scissors. Ask them to draw a visible line with a marker where they want the cut. Encourage them to use the regular and cardboard scissors for most of their other cuts.

Guidelines for using the box cutter:

- Extend the blade of your box cutter out to the minimum needed to cut your material.
- Be sure that the pathway of the knife is not in line with any part of your body, including your other hand and your legs.
- Don’t push down hard—instead, take multiple passes to make a cut.
- Retract the knife fully when not in use.
- Pass the knife only when retracted.
- Change dull or dirty blades.

CARDBOARD ENGINEERING AND PROTOTYPES

STEP 1



Revisit UI/UX.

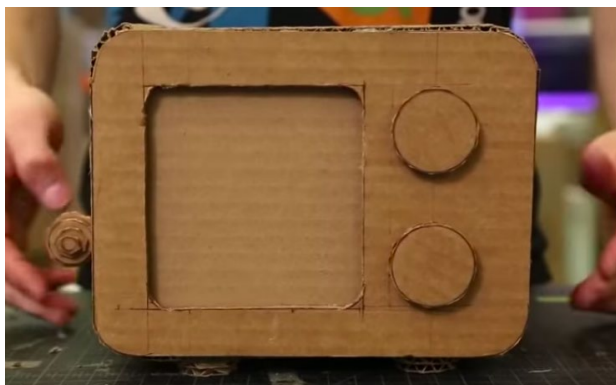
Review the following concepts from the past weeks:

- **User:** Person using the game or device
- **User interface (UI):** Design of how the user interacts with the game or device
- **User experience (UX):** How natural and enjoyable the experience of using a game or device is

EXPLAIN



UI/UX designers and engineers think through the design of devices such as game controllers, phones, and appliances to make them easy and fun to use. In order to explore ideas, they **prototype** with simple materials, like cardboard and paper.



[“How to make a cardboard prototype”](#) on YouTube, uploaded by Quirky, 12/11/2014

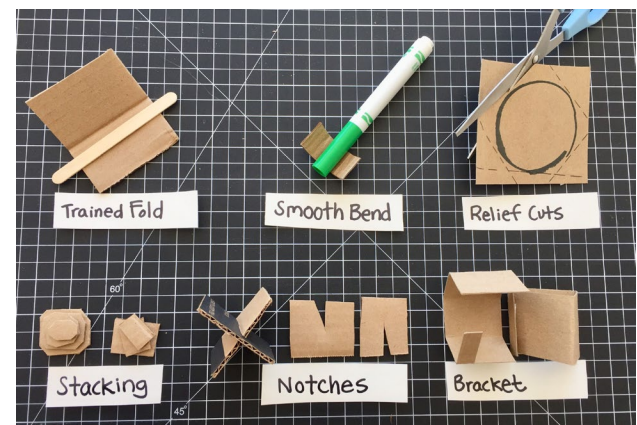
On a projector, show this [video](#), which explains the purpose of cardboard prototyping. While watching, ask makers to answer the following questions in their journals and then share the answers out loud:

1. What’s the first step of prototyping before using cardboard?
(A: *Draw out your ideas to get an estimate of size and scale.*)
2. What’s the purpose of prototyping?
(A: *To get the idea out of your head and in a form that people can see and experience.*)

STEP 2



Introduce cardboard engineering and safety.



First, go through the slideshow of cardboard **engineering** techniques

(trained folds, smooth bend, relief cuts, stacking, notches, bracket, etc.), emphasizing how they could be useful.

EXPLAIN



Now that we've programmed and connected buttons and switches to the Micro:bit, we'll explore prototyping devices with cardboard. Prototyping is all about exploring new ideas, so don't be afraid to try something and learn from any "mistakes." Even the most experienced engineers build off of "failed" prototypes.

Next, introduce the safety agreements of working in an active "make space." Review the safety agreements with makers. Add and modify as needed for your class, and then print out and post up where they can be clearly seen.

SAFETY AGREEMENT

1. Take care when walking with scissors or sharp things (hold with point facing down).
2. One maker at a time per tool prevents accidents.
3. Be mindful of space from others when using tools.

GLUE GUN SAFETY

- Only 1–2 makers at the hot glue station at a time.
- Don't touch the tip of the glue gun.
- Don't point the glue gun at another person.
- Work at the protected glue gun station.
- Keep the glue gun close to your work.
- If the glue gun jams, ask an adult for support.

EXPLAIN



Before we get started, we need to cover some important safety agreements. This will help everyone stay safe and do their best work while sharing space, tools, and materials. After reviewing these, if anyone isn't following the agreements, they will need to take a break from using the tool, not as "punishment" but as a way of creating safe habits.

STEP 3



Introduce the Prototype for the Future project.

Go through the slides, emphasizing how cardboard prototypes are a way of exploring an idea for a device and not necessarily intended to be fully functional.

Explain to makers that their prototype designs must:

1. Use 3 or more cardboard engineering techniques.
2. Explain how the user would interact with the device.
3. Include ideas for how to add a Micro:bit to their prototype.

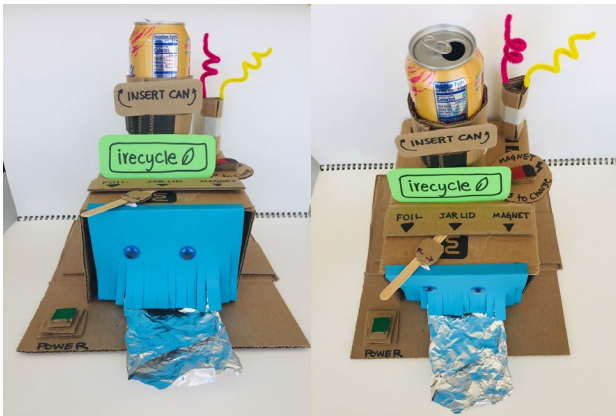
EXPLAIN



In the year 2050, what kinds of inventions do you think would be useful that don't exist now? You and

your partner will brainstorm ideas of devices for everyday life in the future.

Today, you and your partner will design and make a prototype using cardboard building techniques. In the next session, you'll add a Micro:bit and maybe even buttons or switches!



An example of an invention is “iRecycle,” an at-home recycler that turns aluminum cans into foil, jar lids, or magnets.



Another example is this [robotic helping hand](#) with a remote that can be programmed. This device could be helpful for situations where using human hands would be dangerous or not strong enough.

Makers will:

- Brainstorm with their partner about

what they want to design/make and take notes using this worksheet.

- Determine who will do what to start and then gather materials.

STEP 4

Make cardboard prototypes.



Makers use this time to build with cardboard engineering techniques.

- Circulate throughout the room and watch for safe working habits. Take note and verbally point out when safety agreements are being followed. If any maker misuses a tool, have them take a break or remove the tool temporarily (2–3 minutes) to help reinforce a culture of safety.
- Circulate throughout the room noting and celebrating when makers are using the various building techniques. Offer suggestions of techniques that are

appropriate for what the makers are building.

- If you're assisting makers by making cuts with the box cutter, create a signup list on the board. Send makers to try again when you think they can handle the cut on their own using scissors. Be sure to keep the box cutter closed and in your possession.

STEP 5



Clean up.

Makers label and save their prototypes to continue working on the next session.

Makers will:

1. Put projects away in bins. Label parts they want to keep that don't fit in the bins.
2. Return tools and materials that can be used again to the right place.
3. Clear tables of garbage and recycling.

TROUBLESHOOTING TIPS

Cardboard is difficult to cut.

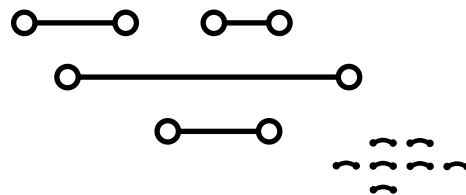
- Using the inside of the scissors instead of the tip can make cutting easier.
- Cutting pieces away from the edge of the cardboard is easier than cutting out a shape from the middle of the cardboard.
- If you're really having a hard time, ask a classmate or adult to help you with cuts.

Hot glue isn't holding stuff in place.

- Hot glue dries quickly, so try to apply the glue a little at a time instead of large amounts.
- After gluing, hold the pieces in place for at least 20 seconds before releasing.
- Support two pieces with an L-bracket, or bridge with glue or tape.

Cardboard won't hold the shape.

- Try experimenting with a different joining technique.
- Try different thicknesses of cardboard or layers of cardboard.



TROUBLESHOOTING TIPS

Print and use the empty rows to fill in with other problems and solutions that can be shared.

PLANNING YOUR PROTOTYPE

Title _____

Draw a picture of your **Prototype for the Future** below.

1. Describe what your prototype does and how the user interacts with it.
2. What are some of the cardboard building techniques you will use?
3. How could you use a Micro:bit in your project?

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