creativity lab

Lighthouse Community Public Schools

in collaboration with

Maker Ed

MakerPromise

CARDBOARD GRABBERS

A Guide from the Creativity Lab

Author
Tobie Irvine

Contributor
Anna Milada Grossi

Lighthouse Community Public Schools
444 Hegenberger Road
Oakland, CA 94621

www.lighthousecreativitylab.org

www.makered.org

About This Project

How does a human hand work? How do tendons and joints work together to manipulate fingers? What are the design strengths of a human hand? What are the weaknesses?

Building cardboard grabbers challenges students to think critically about mechanical design. Using simple materials, students will design and build their own visions of what a hand should be, and test the functionality of their machines by lifting an assortment of objects.

This project is designed to give students ownership of their learning by offering minimal instruction. Students should learn through the iterative process of design, test, and redesign. This is a crucial element of this project, and should not be viewed as merely supplemental. We encourage you to customize this project to the needs of your class, but maintain the ideal of students' learning through exploring.

Our Story

This project was introduced to the Creativity Lab by Jeremiah Jenkins. Amy Dobras, the Middle School Making Teacher, piloted a "Grabber Challenge", in which the 7th graders competed in making a grabber that could pick up the most objects.

This activity can be completed within one class (or, depending on the desired level of complexity, can be extended), is low cost and is overall a low floor, high ceiling activity that allows a certain amount of iteration and design. We use cardboard for this project because it is cheap and plentiful. However, students who show the initiative and enthusiasm to use other materials should be encouraged to go forward with their plans (see Cardboard Grabbers with Older Students).

Materials & Tools

MATERIALS

- Cardboard (recycled)
- String / Yarn
- Straws
- Beads
- Masking Tape
- Popsicle Sticks

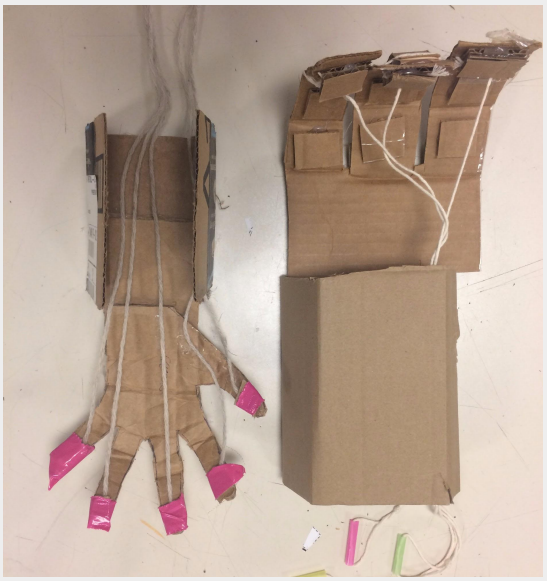
TOOLS

- Hot Glue Guns
- Scissors
- Cardboard Cutters
- Exacto Knives

TIME: 50 minutes

Learning Targets

- I can look closely at my hand.
- I can explore complexity.
- I can learn from mistakes and follow unintended paths.
- I can test designed solutions to defined problems and take next steps on the basis of my testing.
- I can create a functioning "grabber" from cardboard and other materials

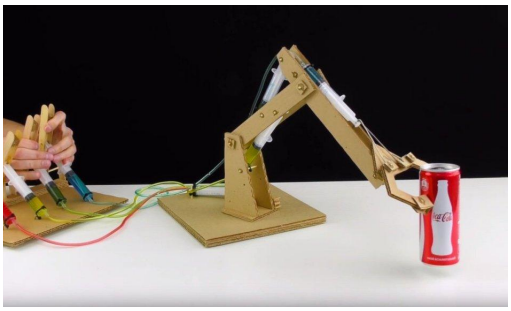


Context: Before we make...

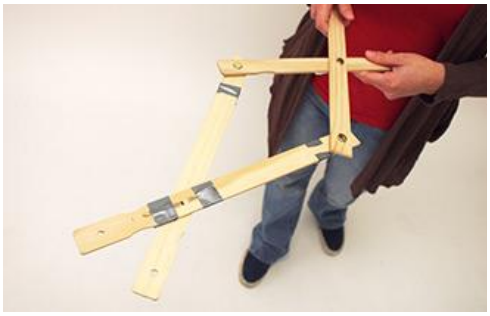
Challenge students to spend 5–10 minutes examining their hands, and imagining their inner workings. What is going on beneath the skin that lets their fingers move? Let them work in groups, or start a single class discussion. At this point, there are no wrong ideas. After they have had time to ideate, have them journal their thoughts, using a combination of sketches and descriptions.

Broaden the definition of "hand" to include any sort of prehensile machine: talons, prosthetic hooks, pincers, etc. Show students a variety of these alternatives to human hands, either with physical objects, or projections on the screen. How is each of these hands effective or ineffective? Working in groups or as a class, have students identify the strengths and weaknesses of each design.

Robotic Hand



Hydraulic Arm



Extending Grabber

Material Management

- Bandage scissors are great for cutting cardboard, and are safer than utility knives. You can order them from Amazon.
- Students may want/need extra materials for their designs. We accommodate them as much possible, so as not to stifle their creativity. Rubber bands and pipe cleaners are common items that students ask for.
- If space allows it, keep an ongoing supply of recycled cardboard in your class, with different sizes readily available for the students

How to Introduce New Tools & Tech SAFELY

- Students should work together to overcome setbacks by sharing design ideas. They should only turn to the teacher for help after they have sought each other for advice.
- Exercise caution when handling hot glue guns, scissors, cardboard cutters and exacto knives. Always provide mats for cutting on tables.

Step-By-Step Guide

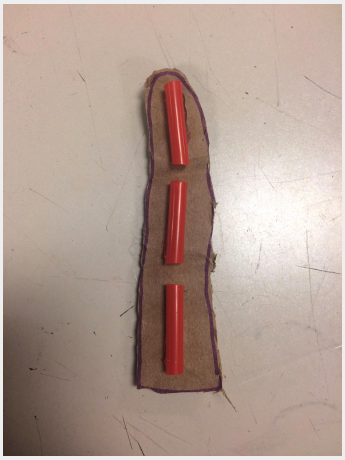
If students had unlimited time and resources, we would let them go about their designing and planning without any intrusion.

Because we are constrained by pragmatic issues, like class-time, we offer students this basic design as a jumping off point, which they may or may not use as they go forward:

1. Cut a finger shape out of cardboard.
2. Hot glue one-inch pieces of straw along the finger, leaving small gaps between each piece. The pieces of straw act as bones, and the gaps between the straws are joints.
3. Run a piece of string or yarn through the pieces of straw.
4. Tie it off or hot glue it at the tip. This will act as a tendon.
5. Crease the finger at the joints, then pull the tendon to create a gripping motion.
6. Combine several fingers to create a complete hand.

Construction may require several class periods dedicated to independent work time.

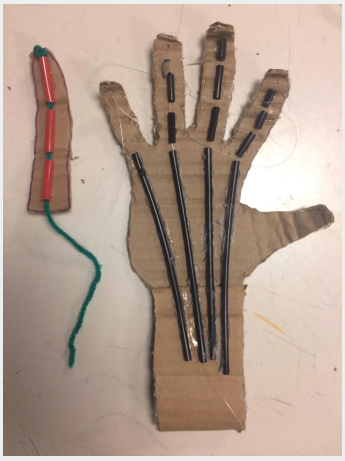

1.


2.


3.


4.


5


6.

Notes

Challenge students to design their own mechanical hand capable of lifting objects of varying weights, shapes, and sizes, and tell them the materials they will have to work with. Give them the remainder of class to create a design and work plan. Do not show them the objects they will be challenged to grab.

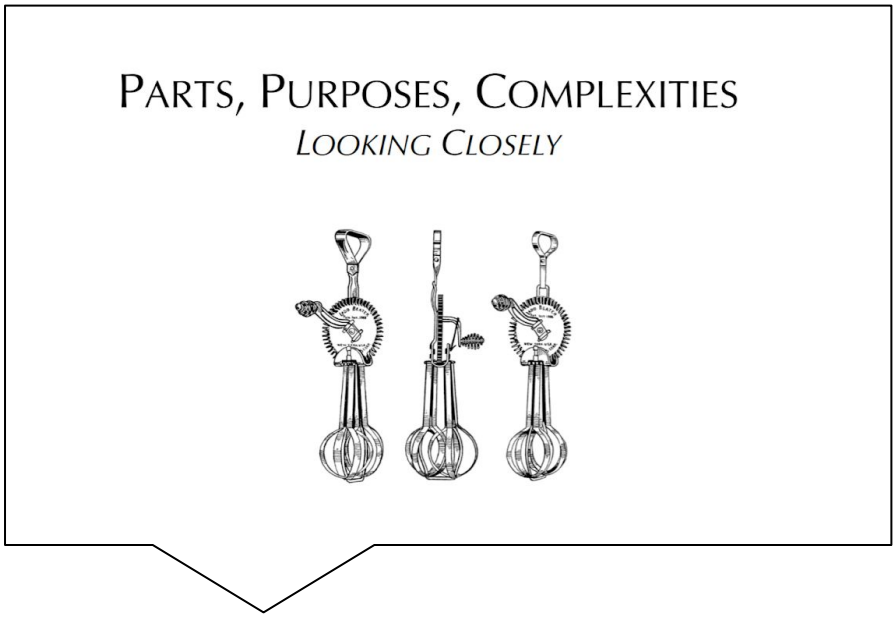
Cardboard Grabbers with Older Students

To further develop this project into a student-driven learning opportunity, have students break into groups and plan a several-month-long unit based around hands. Perhaps students want to build a Claw Machine arcade game, incorporating mechanics, circuitry, and programming. Students should plan budgets and work schedules, and strive for a professional level project. This is a good opportunity to introduce students to more advanced tools, like 3D printers and laser cutters.

Inquiry Model

Break students into groups, where each group with a different hand to examine. Challenge students to look closely at their hands' parts, purposes, and complexities, and think critically about its design. This thinking routine is from Agency by Design, a multiyear research initiative at Harvard's Project Zero group.

For a complete guide on Parts, Purposes, Complexities, visit Agency By Design.



Looking Closely

Have students refine their designs as necessary, then test them again. As students discover their design flaws, have them return to their journals/blogs to plan how they can improve upon them.

Reflection & Community Connection

Display students' work for everyone to see. This serves to both inspire future projects, as well as showcase students' learning and accomplishments.

Ask students how they could improve upon their projects. Could they make them function better? Could they improve the aesthetics? What about the production efficiency? Have students reflect and document together how they could improve their designs, and what skills/tools they would need to do so.

Give students ten minutes to make any final adjustments to their hands. Then gather everyone together. One at a time, have students talk about their designs, and the challenges they faced. Then have them test their designs.

If a design fails to lift an object, ask how they could continue to improve upon their design. Ask the class for feedback, and celebrate the student's successes and efforts. Then have the next student present her or his machine.

Standards Assessed in Cardboard Grabbers

As students continue working, show them the objects they will test their machines on. We recommend using at least three objects that are a range of weights, shapes, and sizes. Give students the chance to test their designs to discover their strengths and weaknesses.

Grading should reflect students' efforts more than the final functionality of their designs. We use a Does Not Meet, Meets, and Exceeds Expectations system. A student whose design lifts at least one object automatically meets expectations. However, if a student does not lift a single object, they could still potentially receive an Exceed Expectations. When grading a project, consider the creativity, diligence, critical thinking, and perseverance that the student demonstrated, and reward her or him accordingly.

Learning Targets

- I can describe how hands work.
- I can design a prehensile machine.
- I can create a work plan.
- I can test and refine my original design.
- I can understand & utilize simple mechanics.
- I can reflect on how to improve upon my work.