

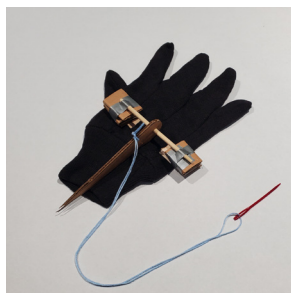
# TAKE & MAKE KIT

## Pulley System Glove

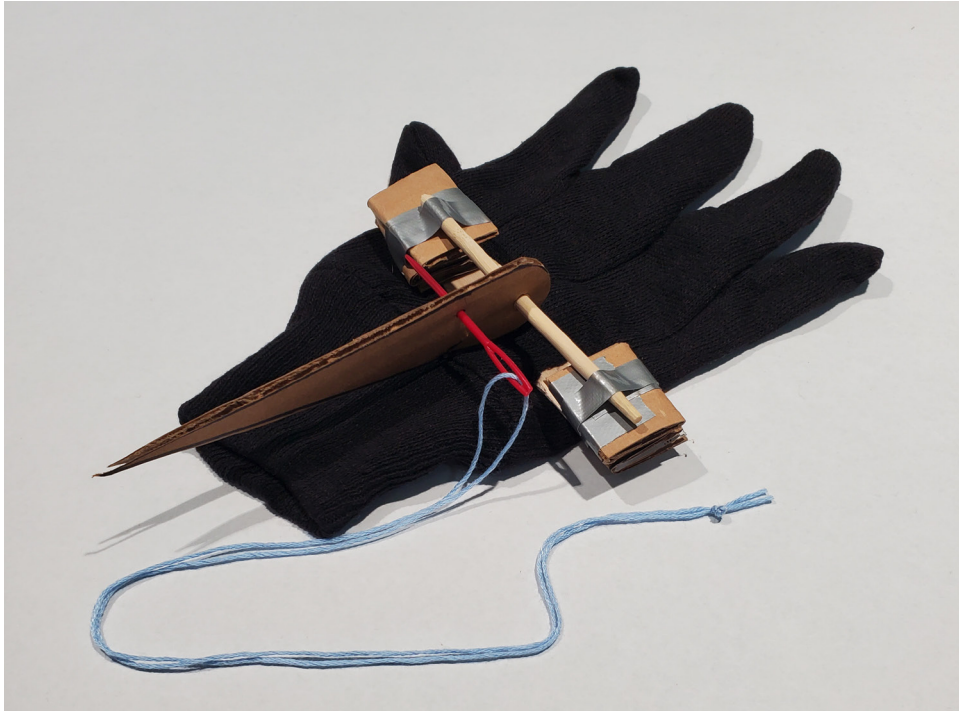
TIME: 45 min

ADULT SUPERVISION ADVISED | CONTAINS SMALL PIECES

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## What's in this kit?

In this kit you will learn how to design with the human hand in mind. Build a mechanism that works with the movements of your hand and learn about tensioning, pulley mechanisms, and ergonomics.

### You will learn:

- How to thread a needle
- How to design for the human body
- How tensioning systems work
- How pulley systems work

## Let's Get Started!

### Materials

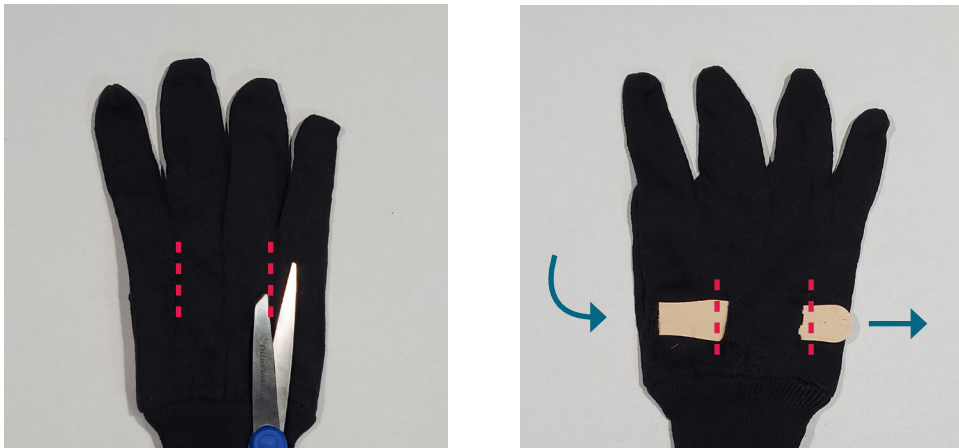
- 2 gloves
- 1 sewing needle
- 1 piece of thread
- 2 chopstick halves
- 2 popsicle stick halves
- 2 pieces of cardboard
- 1 template to cut out (two pages)
- 1 piece of tape

### Tools

- Scissors
- Pen or pencil

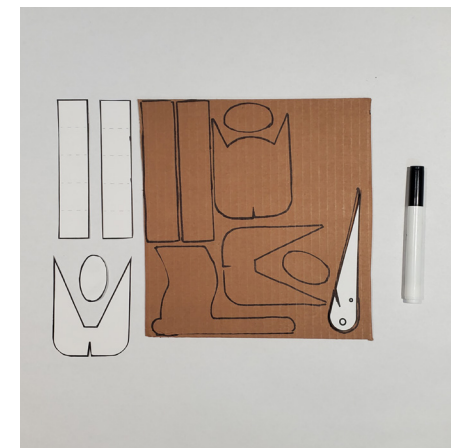
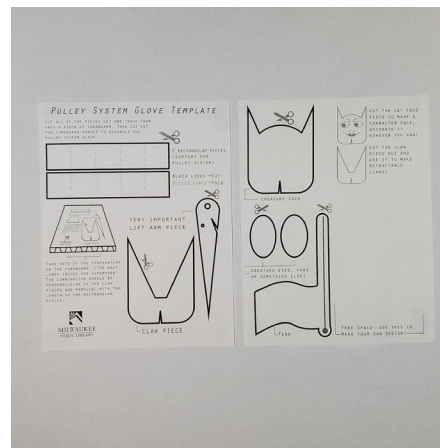
## Step 1 Cut the glove and slide in the popsicle stick.

Cut two slits in the gloves as shown in the picture. The cuts should be roughly  $\frac{1}{2}$  inch long - just enough to stick your popsicle sticks through - and about 1 -  $1\frac{1}{2}$  inches away from each other. Slide the popsicle stick through one of the holes and out the other.



## Step 2 Cut the template and trace onto cardboard.

Using a pair of scissors, cut out all the shapes on the paper template on both pages. Then trace the shapes onto the piece of cardboard that came with your kit. All the shapes can fit onto the cardboard, so take a moment to rearrange the pieces before tracing them if you need to.



## Vocabulary

**Ergonomics:** The process of designing or arranging products, workplaces, and systems that best fit the people using them. Think of designing a chair that fits a sitting body, or a tool handle that fits a hand.

**Tension:** Is a state of stress in which material is being pulled apart. Think of a cable that is attached to a ceiling with a weight fixed to its lower end.

**Pulley:** Is a collection of one or more wheels and a loop or handle to pull with. Pulleys make it easier to lift and pull things. They are examples of what scientists call simple machines. Simple machines help us multiply the force from our bodies to make work easier.

## Did You Know?

If you have a single pulley and an object that weighs one pound, a pulley will reverse the needed force to lift the object. The result is that you will need one pound of force pulling down to lift the object.

If you add more wheels to this pulley system, you can further reduce the needed force. If you add a second wheel, you can lift this item with half a pound of force

If you add four wheels to the pulley system, you can pick up the object with a fourth of the original force needed!



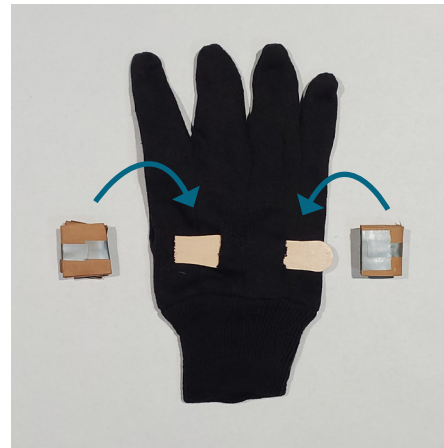
### Step 3 Cut out the shapes.

After you trace the shapes onto the cardboard, cut them out. Make sure you cut the slits into the two pointy pieces. Use a sharp pencil to poke a hole in the skinny pointed piece.



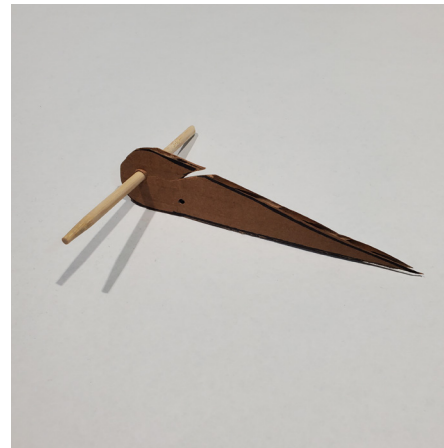
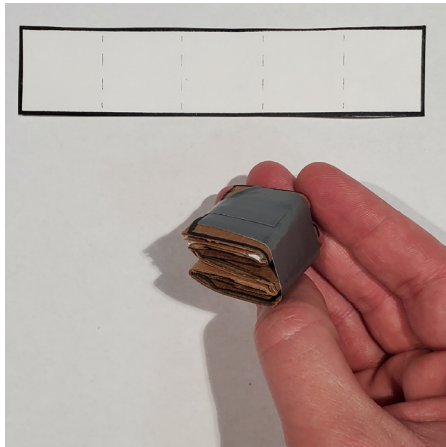
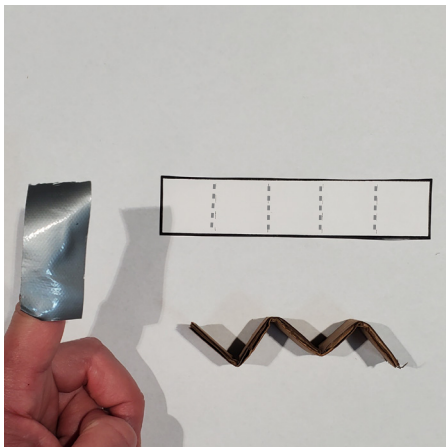
### Step 5: Poke chop stick through the hole.

Poke one of your chopstick halves through the hole in the skinny pointy piece. Place this and the two cardboard pieces on top of the popsicle stick. Tape the chopstick to the cardboard pieces.



### Step 4: Zig-Zag fold the rectangles.

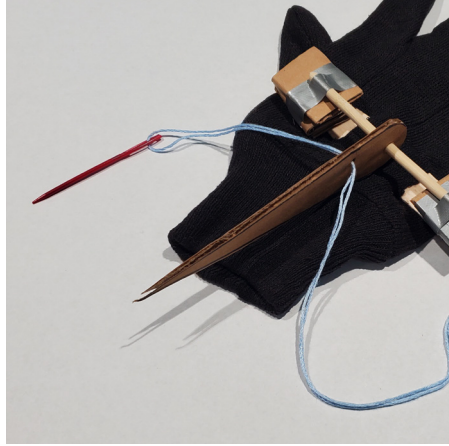
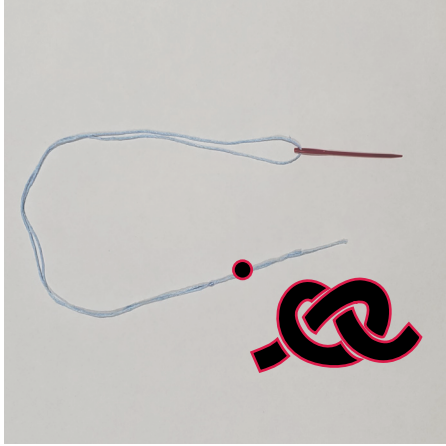
Cut a piece of tape about 2 inches X 1/2 inch in length and set it aside. Take your cardboard rectangular pieces and fold them in a zig-zag fashion along the grey lines in the template. Your shapes should look like a folded up cube. Tape these to either side of the popsicle sticks.



**IMPORTANT:** When attaching the skinny pointed piece, the cut out slice has to be facing the wearer when the piece is upright. This means the hole without a chopstick is facing the wearer's fingertips.

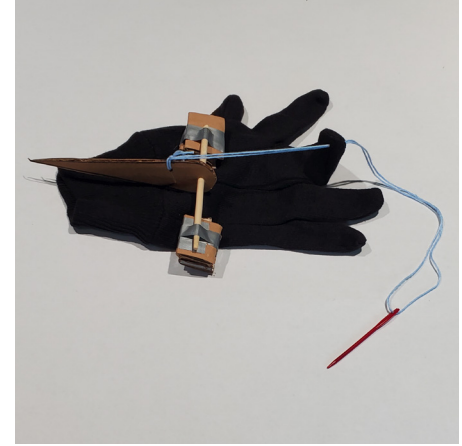
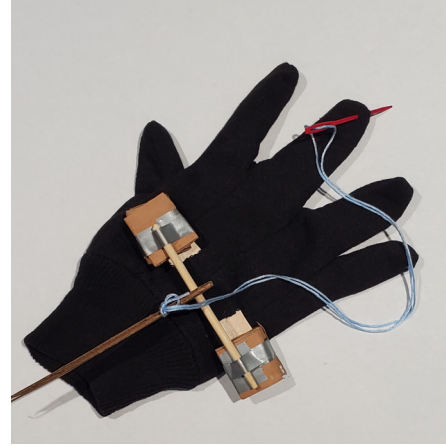
## Step 6 Threading the needle.

Poke the thread through the eye of the needle. Make both ends of the string even. Tie the two ends of the string together. Poke the needle through the hole of the skinny pointed cardboard piece. Pull the string almost all the way through.



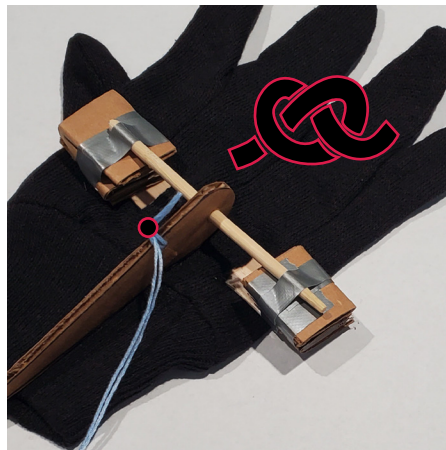
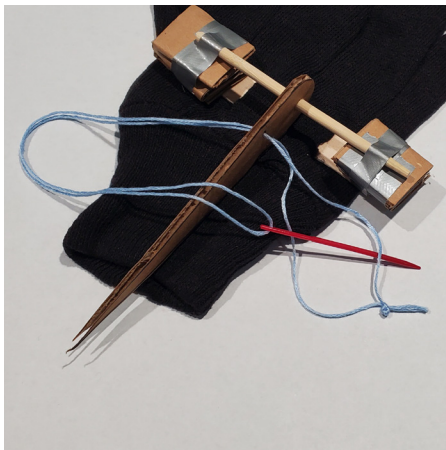
## Step 7 Make a fist.

Once the needle is tied to the hole in the cardboard, very carefully poke the needle through the tip of the glove's middle finger and out again. Extend your fingers straight and pull the string with just enough force that the cardboard piece starts lifting.

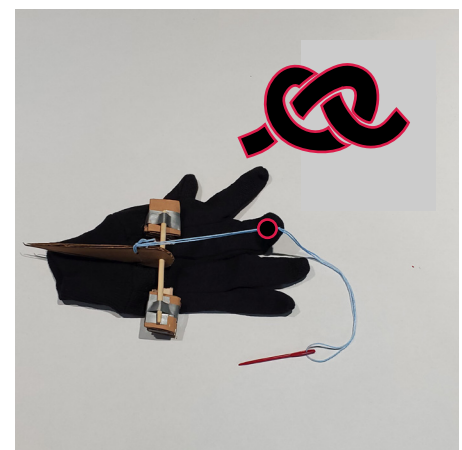
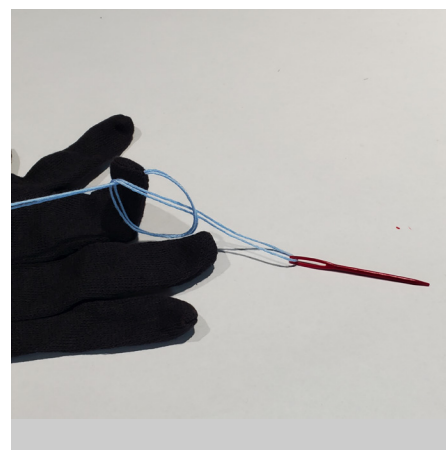


Bring the needle back around and over the cardboard, then pull the needle all the way through the string loop. Pull to secure a knot.

At this point you should be able to pull on the string to make the pointed cardboard piece pivot upwards.



Use the needle to tie a knot on the end of the middle finger. When you make a fist, you should be able to make your cardboard piece lift if the mechanism is functioning properly. Cut the excess thread after testing the tension. (See next step.)





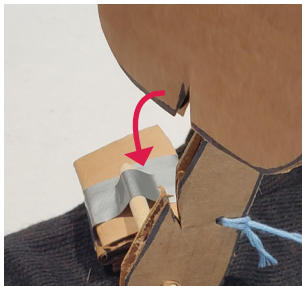
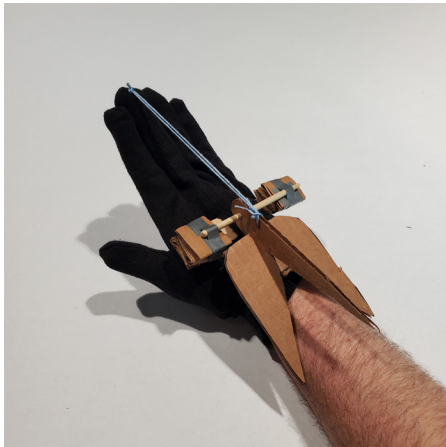
## Step 8: Troubleshooting.

If your thread isn't tight enough to pull up your cardboard piece, don't cut the thread yet. You can wrap the needle around the thread and tie another knot at the tip of the middle finger. Keep doing this until your string is the desired length.

## Step 9: Claws, Creature, Action!

Once you have completed the pulley mechanism you can choose what you want to do with this project. Use the remaining shapes in the template to give this pulley mechanism some character. Make it into wolverine claws, a pop up creature, or use the flag template.

To make the wolverine claws or the creature face, intersect the tiny slits from the point cardboard piece with the creature or claw pieces. To make a raising flag, simply tape the flag to the skinny pointed piece of cardboard.



## Go Beyond

The kit included instructions to make your own wolverine claws, creature face, or a raising flag. What else can you make? Take note of the blank space on the template, what can you create with this? Get Creative! Can you make a thumbs up? A high five hand? A sign? What else?

## Challenge

Construct a mechanism to achieve a task. Can you make your pulley system throw a small item? You have two gloves...can you use the second glove to make another pulley project with a friend? How can your pulley projects interact with each other?

Try walking around your house. What tasks do you do often? Can you make your pulley glove perform a task around the house? Flip a light switch? Close a door? What else?

HANG OUT,  
MESS  
AROUND,  
GEEK OUT.



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