

# MaKey MaKey Scratch Operation Game by Josh Burkner

Use a MaKey MaKey, Scratch, and some recycled materials to create your own Operation game! Remove the patient's bones and organs without touching the sides!

**Difficulty:** Though involved, this is a simple project. The photos for this tutorial show fifth graders building the games. They had some help from an adult with the X-Acto knife.

## Materials: MaKey MaKey

- Alligator Clips

- A computer running Scratch

- Chopsticks

- Electrical wire (I used telephone wire)

- Cardboard box, like an upcycled cereal box or laptop box

- A sheet of cardboard cut from a different cardboard box

- Acrylic paint

- Sharpee pen

- Ruler

- Scissors

- X-Acto knife

- Copper tape with conductive adhesive or aluminum foil and a glue stick

- Hot glue gun and glue

- Sugru or modeling clay that cures and hardens

**Time Needed:** You ought to be able to complete this project in about four hours.

## Cost: The cost of the MaKey MaKey

- A recycled box can be found around your home or office

- Half inch copper tape is about \$15 a roll

- If you ask nicely you ought to be able to get a set of chopsticks for less than the cost of a meal at a Chinese restaurant

- Acrylic paint sets cost about \$15

- Eight mini packs of Sugru are about \$20

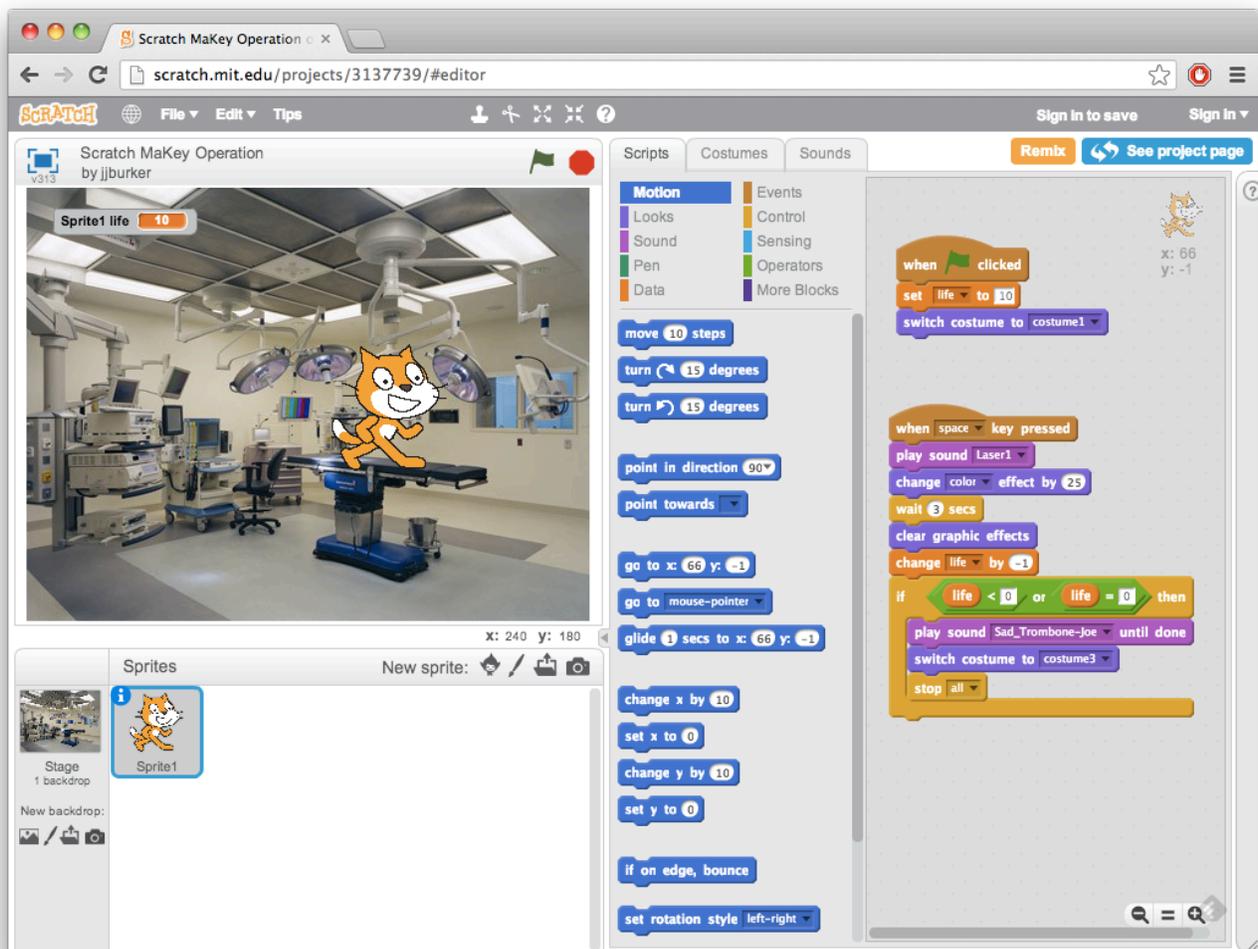
- Modeling clay should cost less than \$15

Scratch is free to run on the computer you already have

Software: You can use Scratch to work with your custom Operation board and the MaKey MaKey. Depending on how you lay out your motherboard you can map the “cups” that hold the patient’s organs or bones to a single key or to multiple keys.

I suggest building your Scratch project so when Scratch detects a key press through the MaKey MaKey the program provides the game player with both audio and visual feedback that they have completed the circuit and are “hurting” the patient. You can use variables in Scratch to track the patient’s “life” and remove a point for every time the player touches the sides while trying to remove the organs or bones.

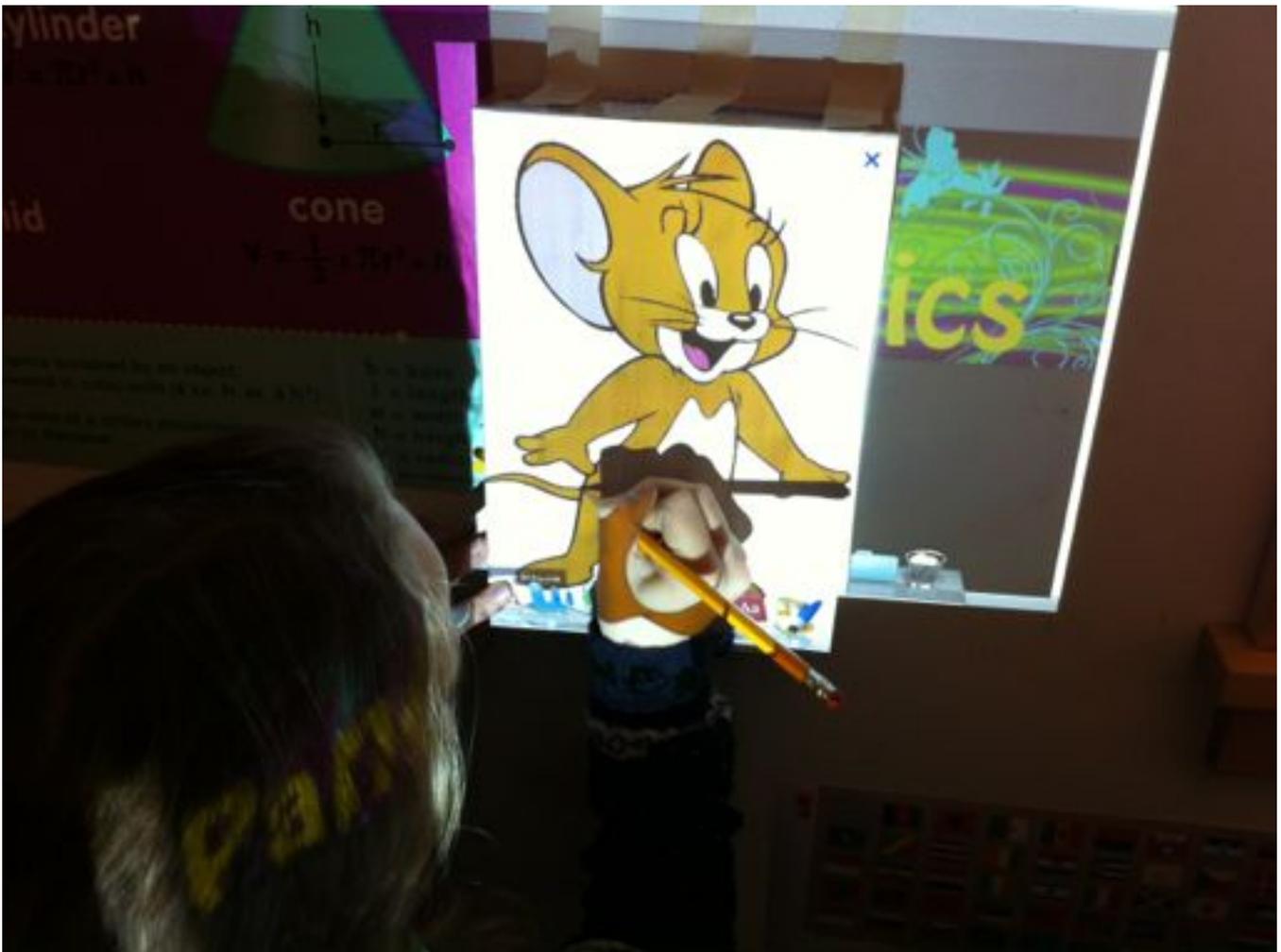
An example Scratch project that you can examine or remix is available at <http://scratch.mit.edu/projects/3137739/>



## Building your MaKey MaKey Scratch Operation Game Board

**Box Construction:** Start with your box. A cereal box works great. Paint at least one side with white acrylic paint and let the paint dry.

After the paint is completely dry you can draw the character on whom you will operate. You can freehand the drawing or, if you have access to an LCD projector, you can find a graphic you like on the Internet, project it on the box, and trace the character as a guide.



Use acrylic paints to color in your character. Colored Sharpie pens also work to

color your character. Use a black Sharpie pen to trace the outline of your character and any lines to make the box look awesome.



When you finish painting your character let the paint or ink dry. Use a pencil to gently outline where you are going to cut holes in the character from which you remove the bones or organs. It is difficult to cut holes in your nicely painted box but you need the holes to play the game!

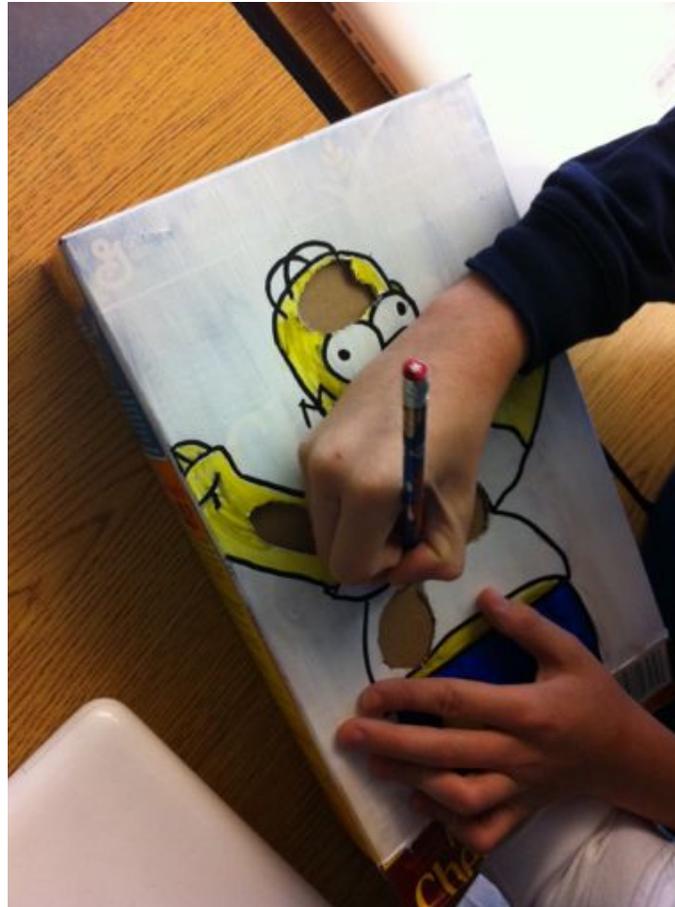
You can use the X-Acto knife to carefully cut a slit on one of the holes you outlined then use your scissors to cut the rest of the hole. Get an adult to help you with the X-Acto knife since it is very sharp.



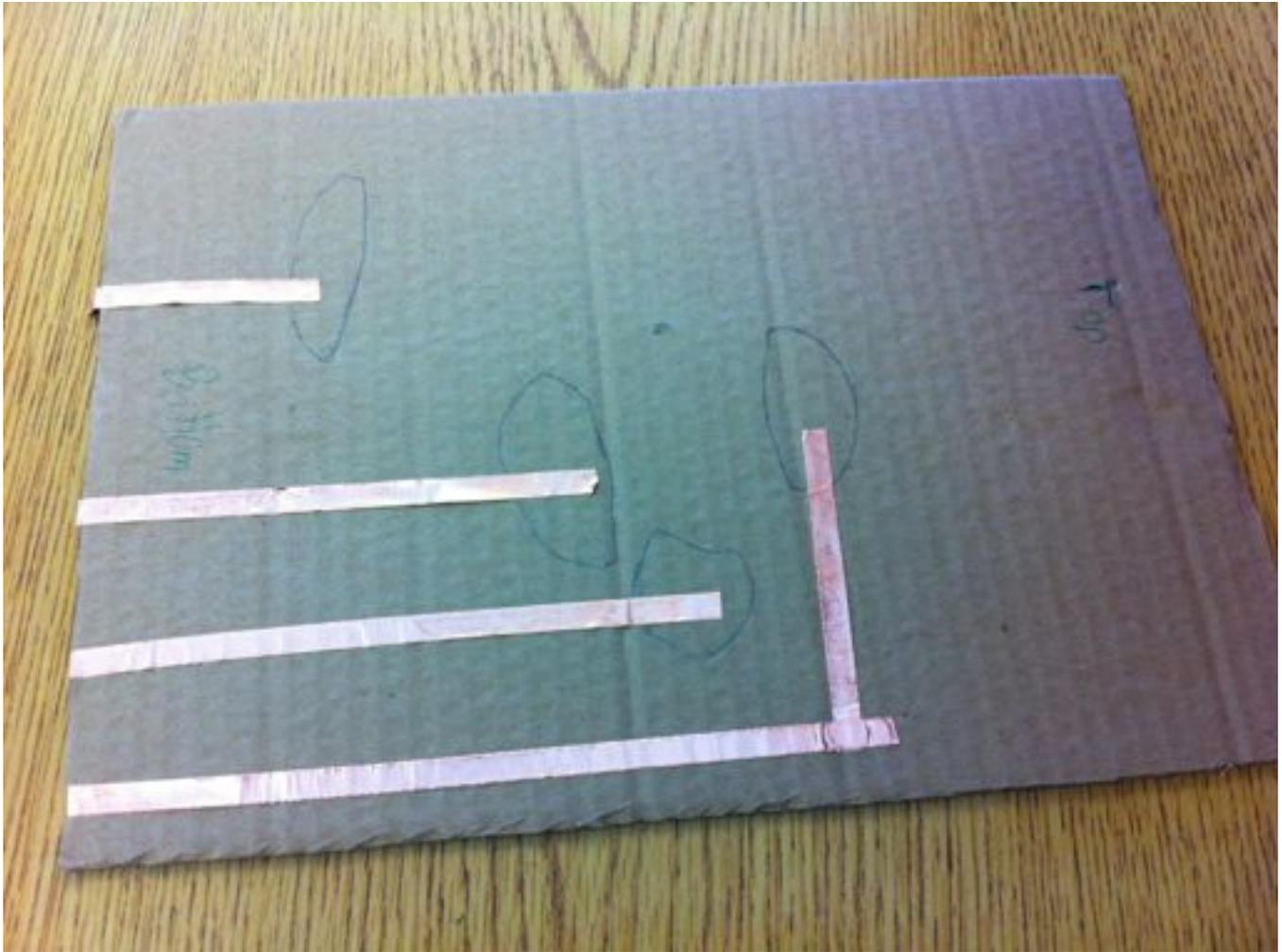
When you finish cutting the holes you will be ready to design your motherboard.

**Motherboard Construction:** Measure the interior of the cardboard box you painted in the previous step. Carefully use the scissors to cut a piece of cardboard just slightly smaller than the width and depth of the box. This will serve as the motherboard to which you connect the MaKey MaKey.

Place the motherboard inside the box and hold it so it is flush with the top of the box. Have a friend help you trace the holes cut in the box onto the motherboard.



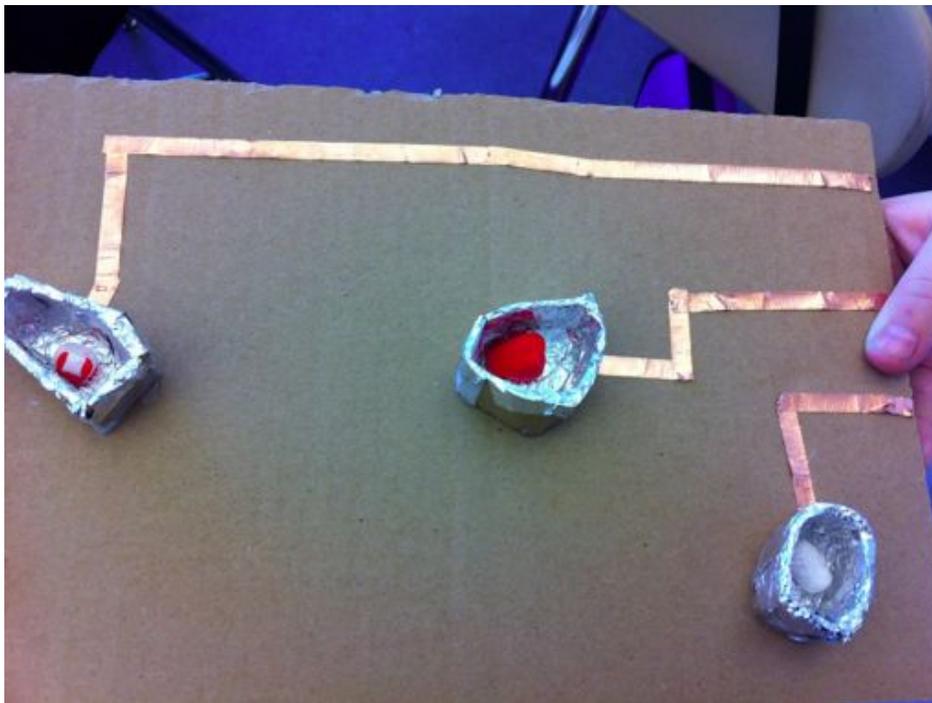
Run the copper tape from the bottom edge of the motherboard to the holes you traced on the motherboard. These strips will be the leads to which you attach the alligator clips. Make sure none of the strips of copper tape (or aluminum foil) touch one another if you plan to map to multiple keys on the MaKey MaKey. For troubleshooting purposes it is best to have each lead distinct and separated from the rest. It is helpful to label the top and the bottom of the motherboard. Make sure the tape extends to the edge of the motherboard so it is easy to clip to with the alligator clips.



Next, cut out circles of aluminum foil that are roughly the size of the holes from the box that you traced. You can run the copper tape over the aluminum foil or under the foil, but make sure the tape is in contact with the foil. Use a glue stick to glue the foil to the motherboard.

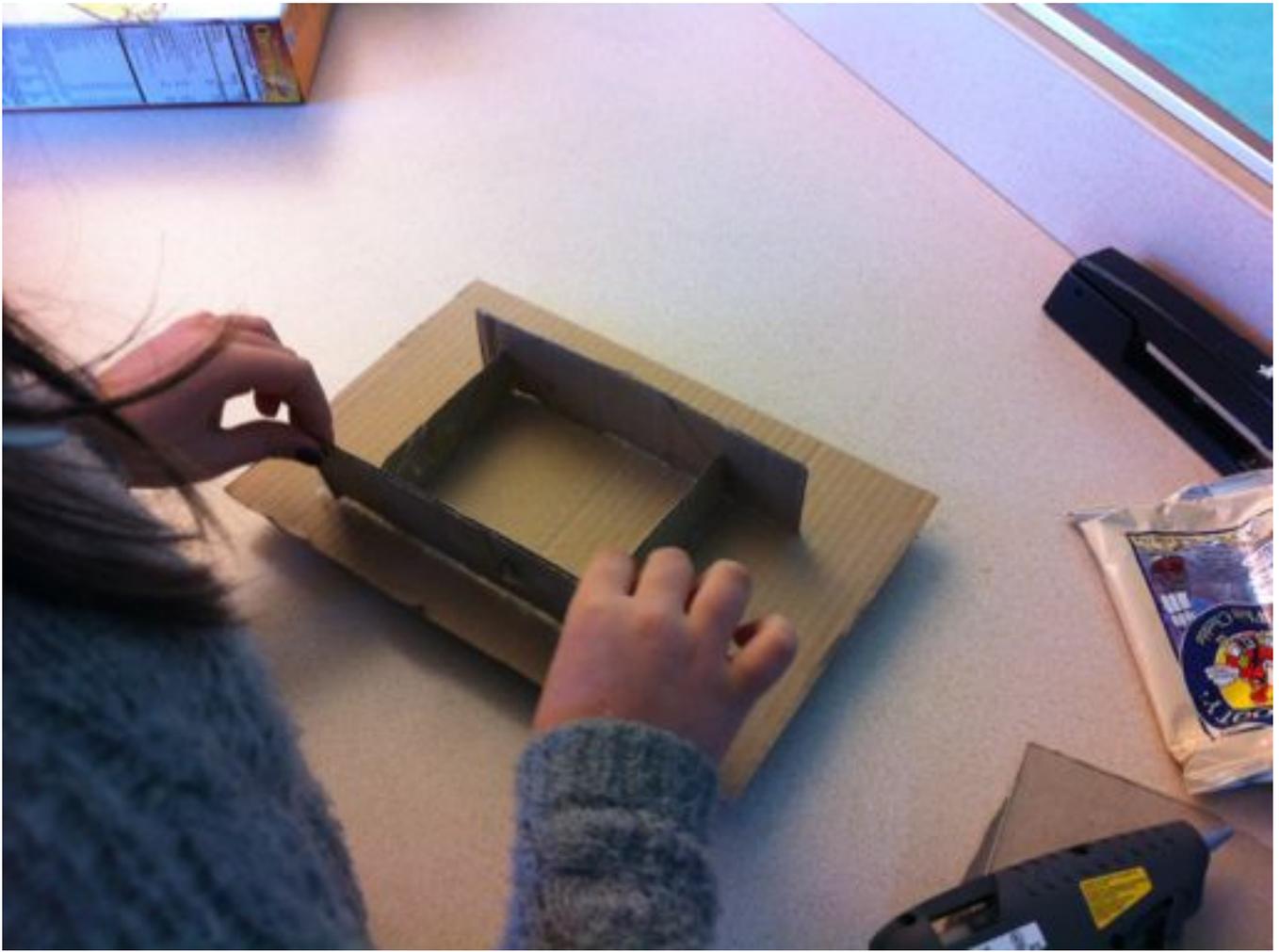


Measure as many strips of cardboard as you have holes in your box. You want the strips of cardboard to be equal in width so the motherboard sits flat against the inside top of the box. Use a glue stick to glue aluminum foil to these cardboard strips. Bend the cardboard into the shape of the hole you traced on the motherboard. Use a hot glue gun and hot glue to attach the "cups" to your motherboard.



If you want to map all the "cups" to a single key on the MaKey MaKey use a strip of copper tape at the bottom of the motherboard that crosses all the other leads.

Insert the motherboard with the cups attached into the box and measure the distance from the bottom of the motherboard to the inside of the box. You will need to cut strips of cardboard this width to elevate the motherboard so it sits flush against the inside top of the box.



**Build Your Organs and Bones:** Use Sugru or modeling clay that hardens to make your organs and bones. Take care not to make the pieces so big that you cannot fit your tweezers or chopsticks into the holes. Allow the Sugru or clay to cure and harden. Make sure the hardened Sugru or clay fits nicely in the hole but allows room to grab the piece with tweezers or chopsticks.

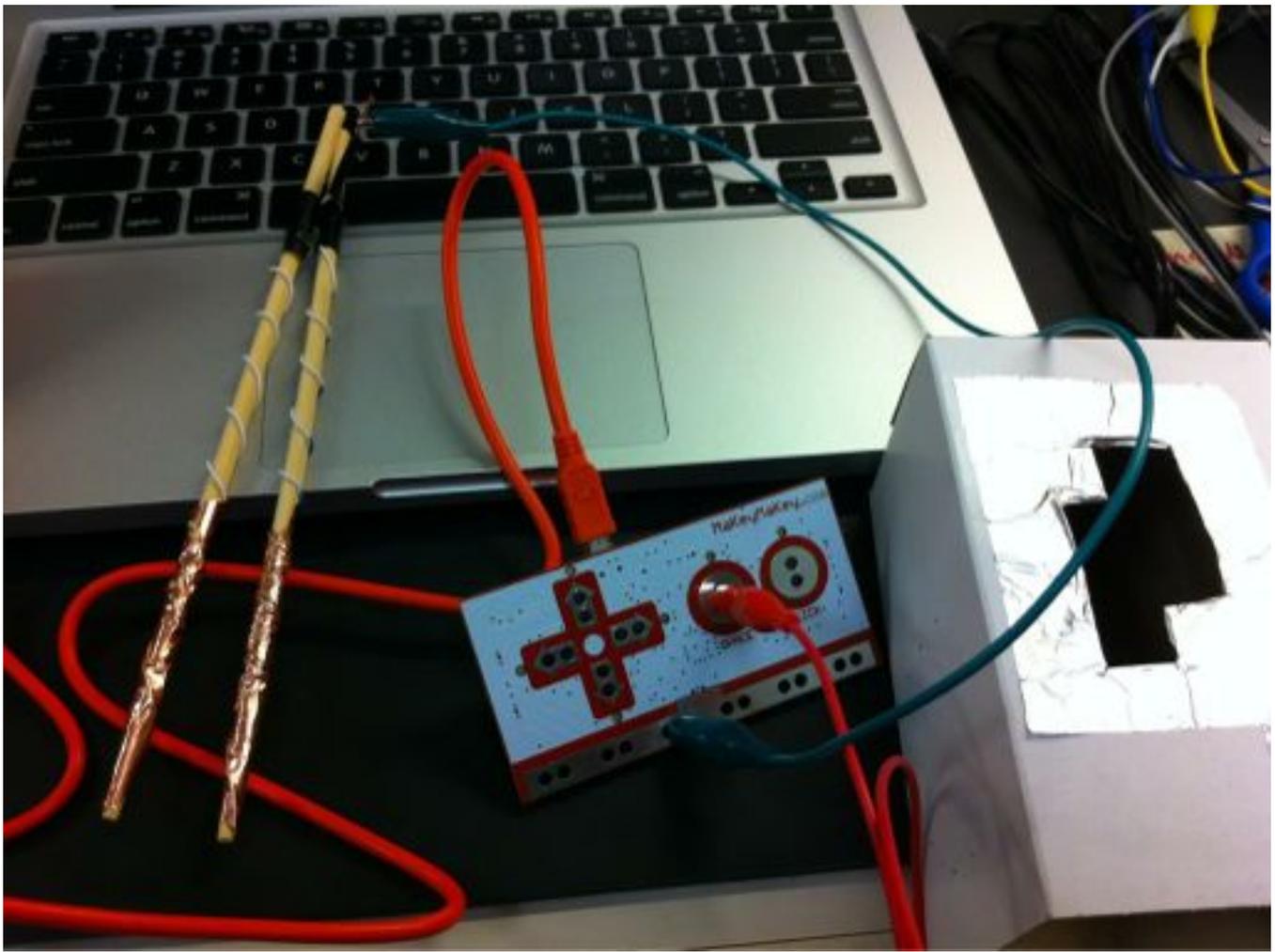


### Building Your Chopsticks:

You can use a rubber band to turn your chopsticks into tweezers. Roll the paper in which the chopsticks are packaged and place the roll between the chopsticks. Use a rubber band to secure the chopsticks with the paper between them.



Strip the plastic insulation from both ends of your telephone wire with a pair of wire strippers. Wind the wire around the chopsticks, starting at the base of chopstick all the way up to where your hand is. Use a piece of copper tape for each end to secure the wire and to create a larger conductive surface at the end of your chopstick.



A dollop of hot glue or electrician's tape secures the wire at the top of the chopsticks.

**Using Your MaKey MaKey Scratch Operation Board:** Attach the alligator clips to the copper tape leads on the motherboard. If you are mapping all the "cups" to a single key on the MaKey MaKey, just connect one alligator clip to the long strip of copper tape covering all the leads at the bottom of the motherboard. Attach the other end of the alligator clip to the appropriate key on the MaKey MaKey. Make sure your Scratch project uses the same key to trigger the audio and visual feedback.

Attach an alligator clip to the wire from your chopsticks to one of the Earth, or ground, ports on the MaKey MaKey.

Plug the MaKey MaKey into your computer's USB port.

Open your MaKey MaKey Scratch Operation project and press Start. Can you remove the patient's organs and bones without closing the circuit and subtracting points?! It takes a very steady hand. Have fun!

**Things to Try:** Experiment with different chopstick or tweezer designs. If you have access to a 3D printer try designing "cheaters" into which you can put the chopsticks to change them into more of a tong design. Print a set of tweezers out of ABS or PLA plastic and use conductive paint and telephone wire on them.

Use Scratch 2.0's cloud capabilities to create a running high score for your MaKey MaKey Scratch Operation Game project. The "highest" score in this case would be a low score, where you make the fewest amount of mistakes when operating on your patient.