



## Curiosity Guide #306

### Skeletal System

Accompanies Curious Crew, Season 3, Episode 6 (#306)

#### Model Hand

Investigation #5

#### Description

Make a movable model of a hand to learn more about how tendons work with the other parts of the hand.

#### Materials

- "Robot Hand" pattern from online. Go to [sciencetoymaker.org](http://sciencetoymaker.org).
- White piece of paper
- 5 thin, flexible drinking straws
- Braided mason twine
- Measuring tape
- Marker
- Candle
- Match
- Scissors
- Cereal box
- Liquid soap
- 1 to 2 tubes of 100% silicone
- Caulk dispenser
- Small, flat screwdriver
- Paper towels
- Razor blade or sharp knife. Use only with adult help.

### Procedure 1: Getting ready

- 1) Print out the "robot hand" template found online.
- 2) Cut out the template.
- 3) Cut out the front or back panel of the cereal box. Lay the panel flat on the table.
- 4) Smear liquid soap on the printed side of the box panel. The soap will allow the pattern to peel away in Procedure 4.
- 5) On the mason twine, measure and mark 5 lengths of 20 inches each. You will use a flame to "cut" the lengths. Using a flame rather than scissors prevents fraying.
- 6) With adult supervision, light a candle. Hold the mason twine in the flame for a moment to "cut it" at each mark.
- 7) Set the 5 pieces of string aside.

### Procedure 2: Preparing the back of the hand

- 1) Lay the white piece of paper on the table. Place the hand template on the paper with the back of the hand facing up.
- 2) You should be able to see the black lines through the template.
- 3) Using the silicone and dispenser, lay centered beads down the length of each finger. These should be about the size of a pen.
- 4) Immediately lay a length of twine centered in each bead so that the end starts where the wrist would be and the additional length is above each finger.
- 5) Using a small flat screwdriver, press the twine into the silicone and smear the silicone over the twine so that the twine is completely covered.
- 6) Repeat for each finger.
- 7) Carefully lift and place the pattern on the soapy cereal box, silicone side down.
- 8) Gently press on the pattern so that the silicone makes good contact with the cereal box.

### Procedure 3: Preparing the front of the hand

- 1) Stretch each drinking straw so the flexible part spreads out.
- 2) Bend and lay each straw on the palm side of the template, being careful to place the bendy parts of the straw where suggested in the pattern.
- 3) The straws will hang over at the tip of the finger and at the wrist.
- 4) Start at the tip of one finger and lay a thick crisscross bead of silicone on each finger so that the straw is completely covered in silicone, especially where the straw touches the paper.
- 5) Repeat with the other fingers.
- 6) When covering the thumb straw, apply extra beads of silicone where the squiggly lines are on the pattern.

### Procedure 4: Finishing the hand

- 1) Let the pattern dry for at least one day.
- 2) Peel the pattern off the cereal box. The soap should allow the pattern to peel away.
- 3) Carefully trim the straw so that there is no overhang at the fingertip or wrist. Be careful not to cut the string by mistake.
- 4) Use the razor blade or knife to cut a small wedge over each knuckle where the lines are on the pattern, but do not cut into the straw. There should be three cuts on each finger and two cuts on the thumb.
- 5) To make sure the lowest finger joints bend, trim between each finger by cutting the silicone and template down to the palm line
- 6) Feed each piece of twine down the straw toward the wrist.

### Procedure 5: Testing the hand

- 7) Pull each string and make each finger move.
- 8) What else can you make the hand do?

## My Results

### Explanation

Tendons are part of the skeletal system. They attach the muscles in the body to bones. Since there are few muscles in the hand, tendons run from each finger up into the muscles in the forearm and control moving the hand. When the forearm muscles fire, the tendon is either pulled or straightened, moving individual fingers or parts of the fingers.

The tendons are visible under the skin of your wrist. Try wiggling your fingers or making a fist and notice the tendons moving in your wrist. You can also see the tendons on the top side of your hand when you flex your fingers up. You can also find tendons above your heel, going up the back of your leg.

In the Model Hand example, the straws provide some support like the bones in the finger would. Rather than a single straw or "bone," as in the model, the finger is made of separate bones connected at each joint. In the model hand, the silicone bead forces the finger to straighten. In reality, we have different tendons that pull our fingers back the other way.

**Explore further:** Muscles and bones work together, making it possible for us to move, but the tendons are what keep the muscles connected to the bones, pulling them one way or another. The tendon is like a rope or cord made of bundled fibers that grows out of the muscles and connects to the bone.

Try looking at the backs of your hands and wiggling your fingers. Do you see lines moving around? Those are your tendons! You can even feel your big Achilles tendon just above your heel, going up the back of your leg. Tendons are terrific!

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