

Make a Mechanical Hand

Student Instructions



Introduction

Engineers start by identifying the problem they are trying to solve and any constraints they need to consider.

Your challenge: How can you design and build a mechanical hand with fingers that bend and straighten like a human hand?

Success Criteria

- The fingers and thumb must bend at joints located in the same places as on a human hand.
- The fingers and thumb can both bend and straighten.

Engineering Constraint

An engineering constraint is a limitation on your design. There is one constraint for this challenge:

- The hand has to have four fingers and a thumb (but it does not need to be the same size as a human hand).

Brainstorm Designs

- Take a minute to watch your hand as you make a fist and straighten your fingers and thumb out. Note where the joints are and how the thumb joint is different. Notice that your fingers have three joints that only bend and stretch in one direction, and your thumb has two joints. Which materials would make fingers with joints and a sturdy palm?
- To move a finger, muscles in our hands or forearms pull a tendon, which is like a long strong string. It pulls on a bone in our finger. When the muscle pulls, the finger bends at the joints. There are no muscles in our fingers and thumb!

Kit Materials

For the Hands & Fingers:

- Chipboard
- Cardstock
- Jumbo straws (5)

For the Tendons (cords that connect muscle to bone):

- String

For the Design & Assembly of the Hand:

- Duct tape
- Glue dots
- Glue gun
- Paper hole punch
- Scissors
- Ruler
- Pencils

Bonus Materials:

- Cardboard tubes – *Add an arm to your design or use them as fingers to make a large hand.*

How can your materials work in the same way?

- As you're designing your fingers, consider how you will create joints that only bend in one direction. Explore how cutting little notches in your straws or cutting the straws into sections might help the fingers bend and straighten.
- What about making the tendons work? Since a tendon's job is to help your fingers bend and straighten, how might you use a piece of string to bend the fingers on your mechanical hand? And how will you attach the tendon—in this case, the string—to one end of your joint?

Build and Test

- Build your hand after doing some experimenting.
- To test it, pull on the tendons and see if the fingers and thumb bend. Will the fingers and thumb straighten out again when you release the tendons?
- If your tendons popped or your hand doesn't open and close properly, no worries. Engineers learn from what isn't working all the time.

Evaluate and Redesign

- What design elements worked the way you wanted them to? Think about the changes you'd like to make. Ask yourself:
 - What's the best way to attach the tendon after you've threaded it through the straw you're using—making a knot on one end, or wrapping it over the end and taping it?
 - What works better to make the finger bend and straighten, cutting little notches in the straw or cutting the straw into sections?

Make Changes and Try Again!

- See if you can improve your mechanical hand by making any weak points stronger.
- If this design challenge was easy, ramp it up. Can you make a hand that can pick up an object?
- Use the bonus materials (cardboard tubes) and:
 - Design and attach an arm.
 - Or use the tubes as fingers and make a large hand.

Share Your Results with a Teacher, Parent/Guardian, or DiscoverE!

You can share photos and videos on social media and tag @DiscoverEorg.