Snap Together Robohand

-Assembly Instructions-

TABLE OF CONTENTS

ROBOHAND, THE OPEN SOURCE MECHANICAL HAND

Look at your hands.

Hands are complex tools that grant humans a superpower, the power to transform imagination into reality. The power of our hands is unlimited. They can be used to throw a ball, climb a tree, or build a tool.

Not everyone is fortunate enough to have two hands.

Robohand is an open source tool created to help restore the super powers of humans who are missing the fingers from their hand. The original version was created by Richard Van As and Ivan Owen.

The Snap-Together edition of Robohand is a simplification of the original Robohand. It lacks the rugged durability of the original, but is much faster and easier to build. This snap-together version is primarily an experimental platform to help people understand the mechanics of Robohand. I hope it will serve as a catalyst for future development, and inspire others to pick up the project where I have left off.

These instructions are designed to give the builder an understanding of the Robohand and how it can be modified. I recommend that you build the Robohand exactly as described in these instructions before modifying it to your specific needs.

NOTES

- Parts in these plans are represented in two colors, red and black. These colors correspond to the colors used in printed examples. In general, red parts are movable or attachable parts, whereas black parts are static or structural.

- PLA is a material that wears quickly. During assembly, when you find parts that are too snug, forcing them through their motions several times will usually wear away enough excess material to ensure a good fit.

- Most of the parts for the Robohand have been designed to attach to one another with snap-pins.

- The durability of the Robohand can be enhanced by supplementing the snap joints with super glue. A gel-style super glue is recommended, as it is less likely to drip and run.

- A small tack hammer, a pair of pliers, and a hobby knife will be useful during assembly.

INSTRUCTIONS TO SCALE THE SIZE OF ROBOHAND TO THE INDIVIDUAL

1. Measure the length of the individual's knuckles across the back of the hand, from the index to pinky finger. (Example: 85mm)

2. Add 5mm to your measurement to account for the thickness of the gauntlet. (Example: if the individual's hand measures 85mm knuckle-to-knuckle, add 5mm for a total length of 90 mm).

3. The knuckle block in the files you downloaded is 65mm. Divide your result by 65. (Example: 90/65 = 1.38)

4. Multiply the answer times 100 to get a percentage.
(Example: 1.38 x100 = 138%)

5. Scale all the parts of Robohand by this percentage before printing. This can be done using the 'Scale' tool in Makerware.

There are five sets of components for the Robohand, all of which need to be printed at the same scale in order to be compatible.

SOURCES AND LICENSE INFORMATION

SOURCE

The Snap Together Robohand is a derivative of the original Robohand created by **RICHARD VAN AS** and **IVAN OWEN**.

The original files are available here:
WWW.THINGIVERSE.COM/THING:44150

**LICENSE:**

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QUESTIONS:

skimbal@makerbot.com

INVENTORY OF PRINTED PARTS
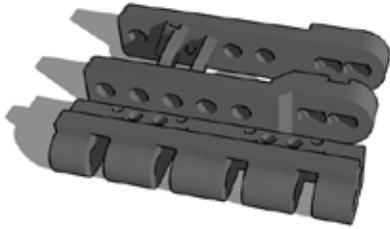
RIGHT KNUCKLE BLOCK.STL   Print Once
MakerWare - Medium
.270 mm layer height
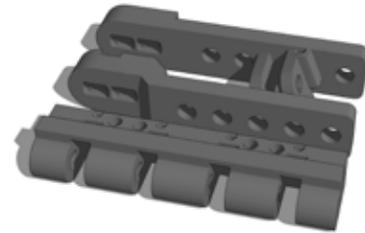
LEFT KNUCKLE BLOCK.STL   Print Once
MakerWare - Medium
.270 mm layer height
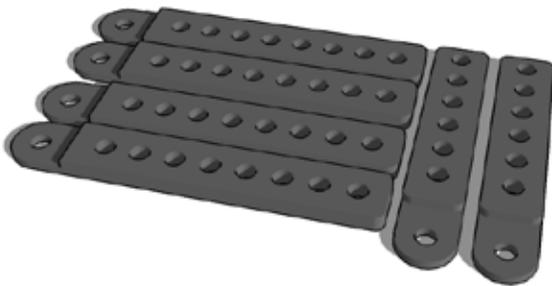
WRIST STRUCTURE.STL
MakerWare - Medium
.270 mm layer height

FINGERS.STL   Print Once
MakerWare - Medium
.270 mm layer height

SNAP PINS.STL   Print Once
MakerWare - Medium
.270 mm layer height
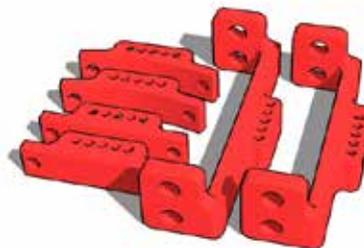
BRIDGES.STL   Print Once
MakerWare - Medium
.270 mm layer height

ELASTIC STRING
Approximately 1mm diameter
Can be found in most craft stores and online

NYLON STRING
Approximately 1mm or larger diameter
Can be found in most craft stores and online

5 SHORT SCREWS (OPTIONAL)
Short screws of an appropriate size for the
holes in the bridge

KNUCKLE BLOCK PINS

#2 SNAP PINS
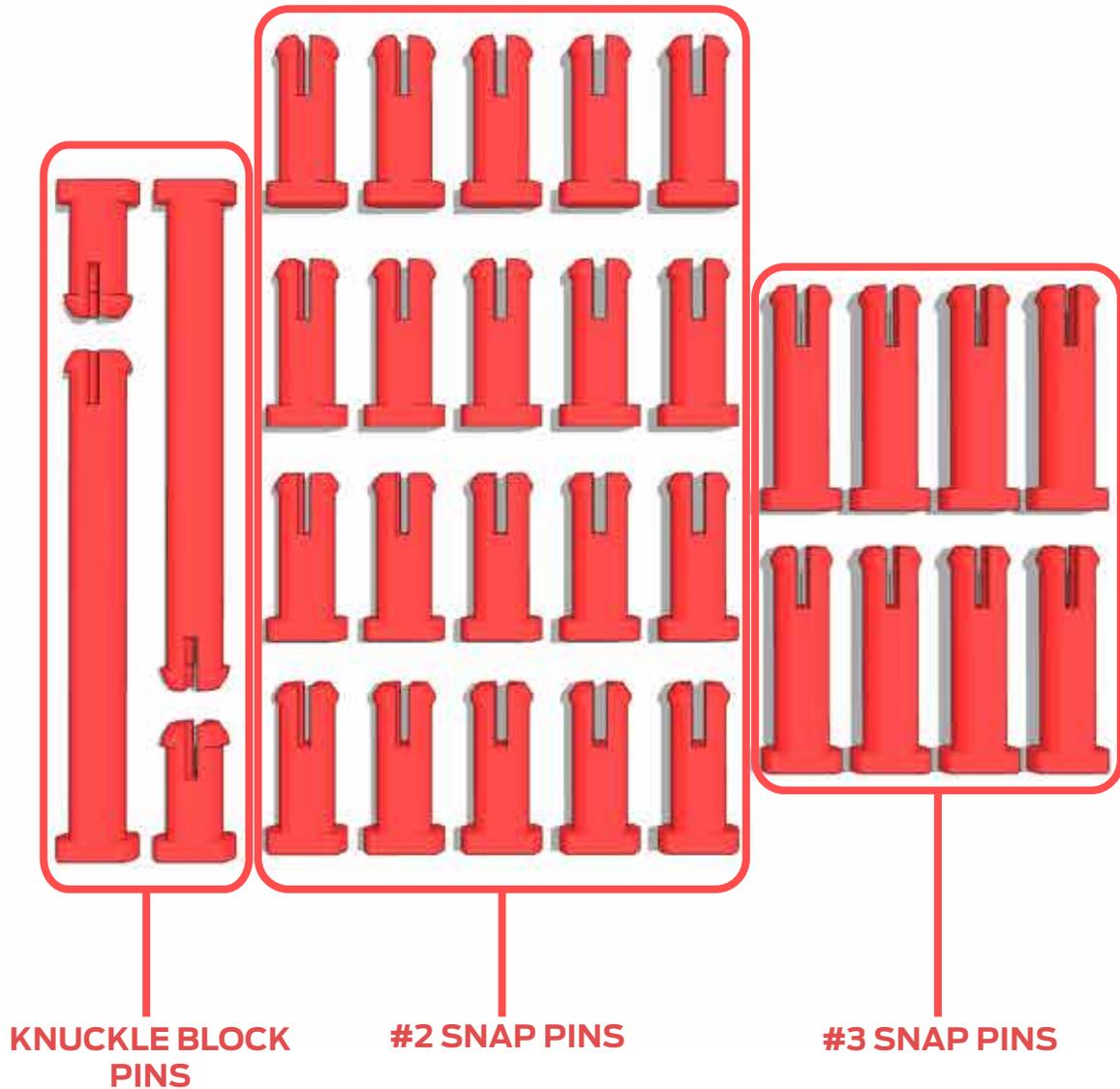
#3 SNAP PINS

THE SNAP PINS

There are four types of pins that print in the 'Snap Pins.stl' file. Two types of pins (long and short) are used to assemble the Knuckle Block. The remaining pins are divided into #2 and #3 pins. Generally, #2 pins are used when attaching two components and #3 pins are used when attaching three components.

The
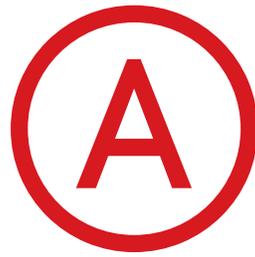
Fingers

PRINTED PARTS

Fingers.stl

PREPARATION

Put the Finger Tip on the table with the keyed side of the hole facing up
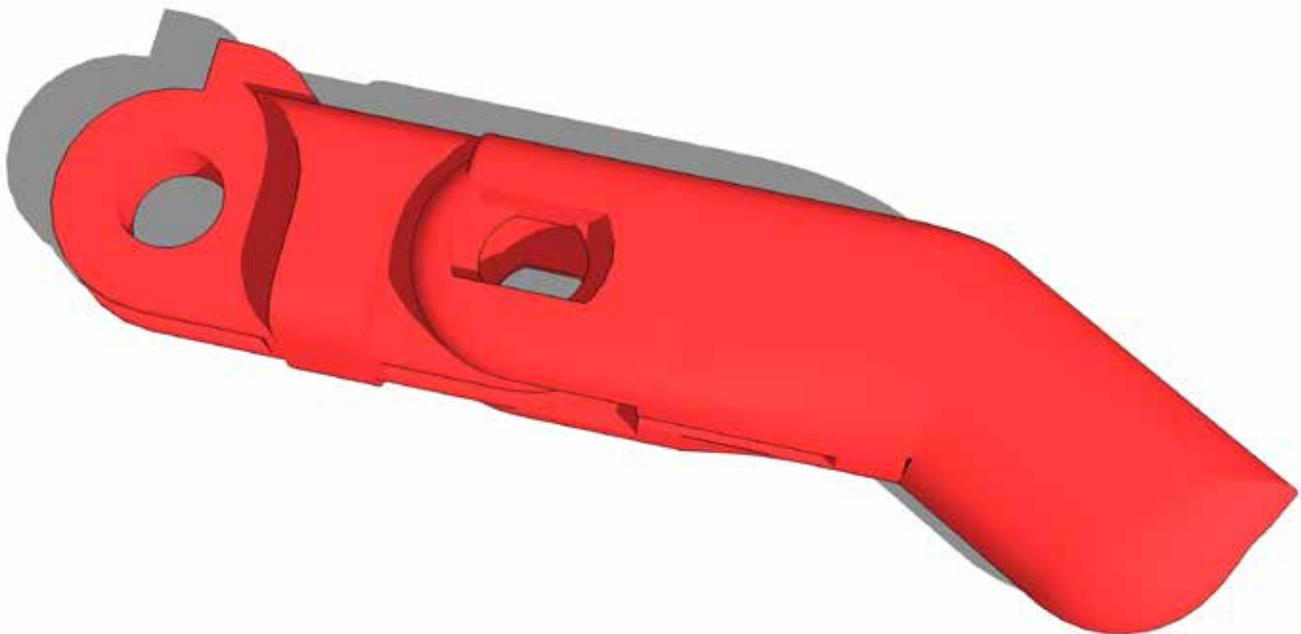
PRINTED PARTS

Fingers.stl

ADD THE FINGER SEGMENT

Slide the Finger Segment into the Finger Tip. Make sure the segment is oriented with the cable slot on the bottom and the endstop at the back of the assembled finger.
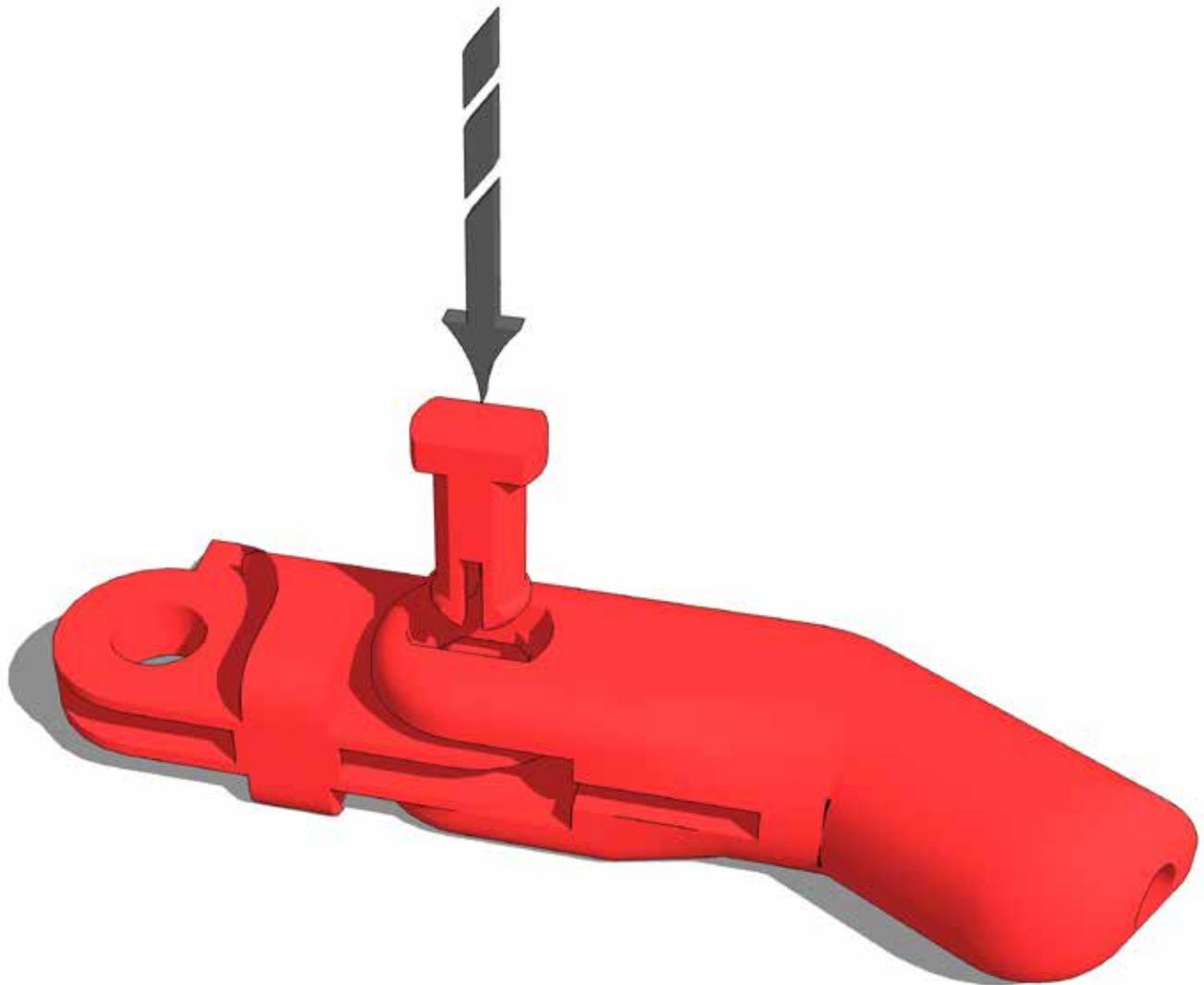
PRINTED PARTS
Fingers.stl

PIN THE FINGER JOINT
Use the small snap pin that prints with Fingers.stl to pin the joint.

Use a hammer to lock the pin into place.
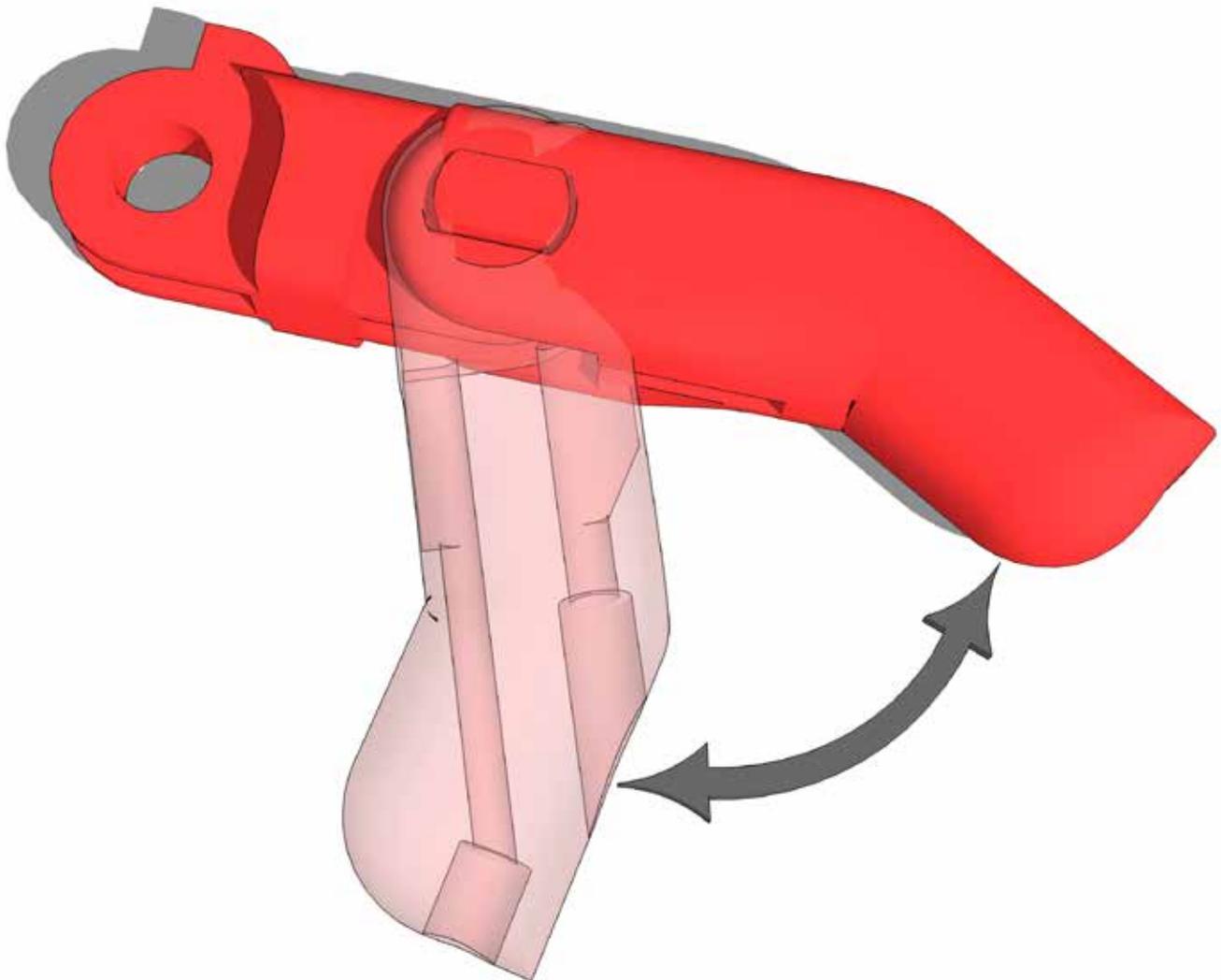
PRINTED PARTS

Fingers.stl

CHECK MOVEMENT

The Finger should move freely around its joint and the back of the snap pin should be flush with the side of the finger.

Repeat these steps to complete the other 4 fingers.

Building the

Hand

PRINTED PARTS
Right Knuckle Block.stl
or
Left Knuckle Block.stl

PREPARATION
Lay out the three parts of the knuckle block on the table.

These instructions show the assembly of the right knuckle block. The steps are the same for the left knuckle block, but the thumb will be on the opposite side.

ATTACH THE SIDES TO THE KNUCKLE BLOCK
Use the two shortest pins to lock the sides to the knuckle block. These pins go in the back two holes.

Use a hammer to lock the pins into place.
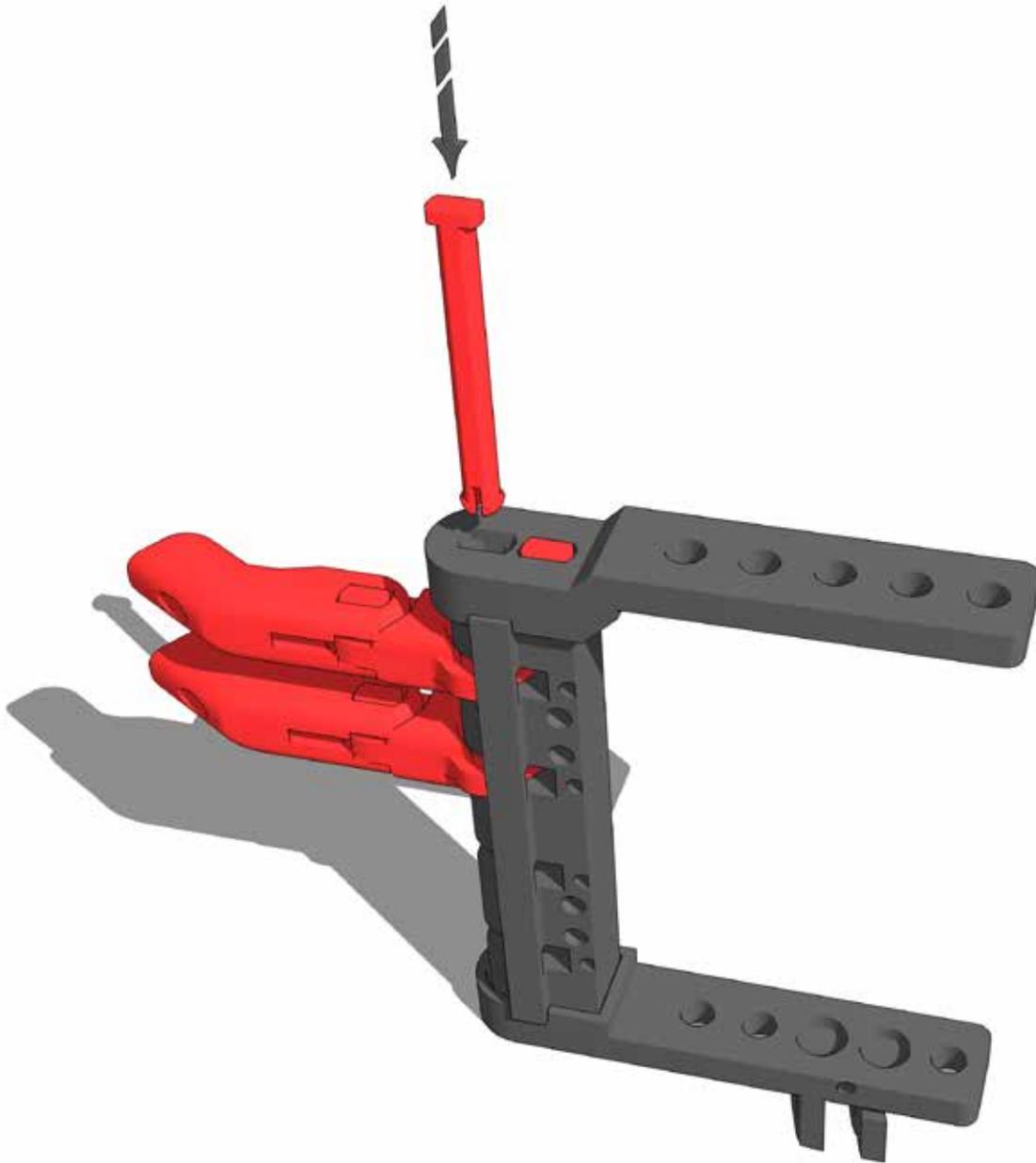
PRINTED PARTS
Snap Pins.stl

INSTALL THE FIRST TWO FINGERS
Put the first two fingers into their slots.

Use a hammer to tap one of the long snap pins into the hole, securing the fingers to the knuckle block.
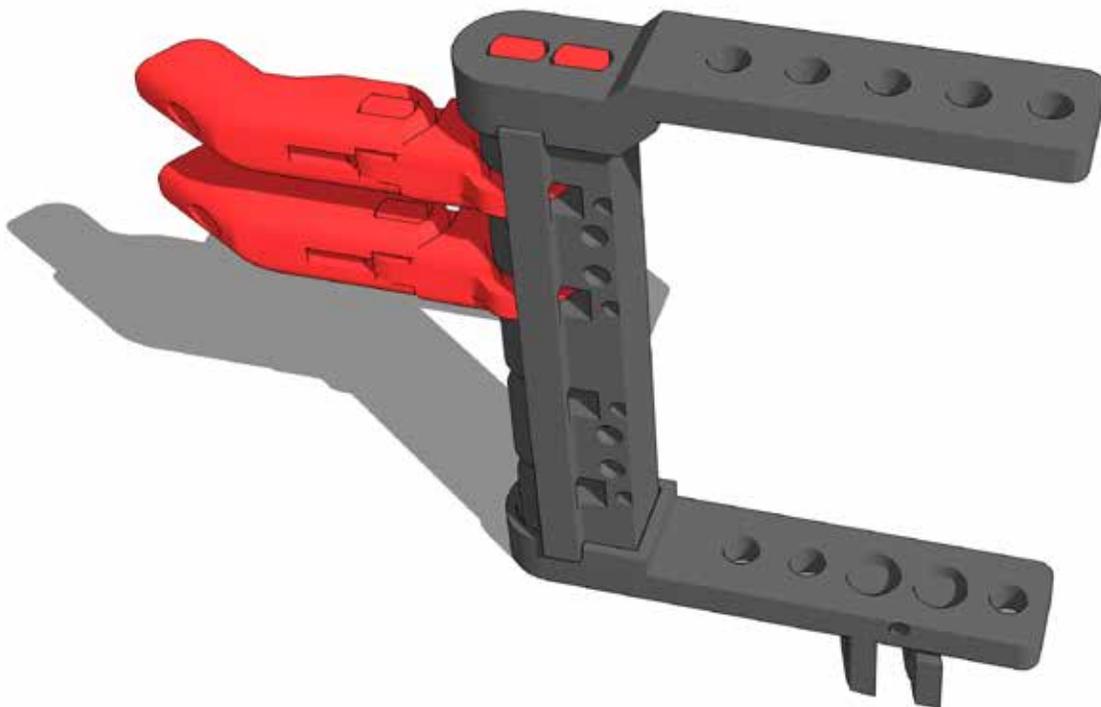
PRINTED PARTS

CHECK THE FIRST TWO FINGERS
Make sure the fingers move freely and the back end of the pin is flush with the surface.
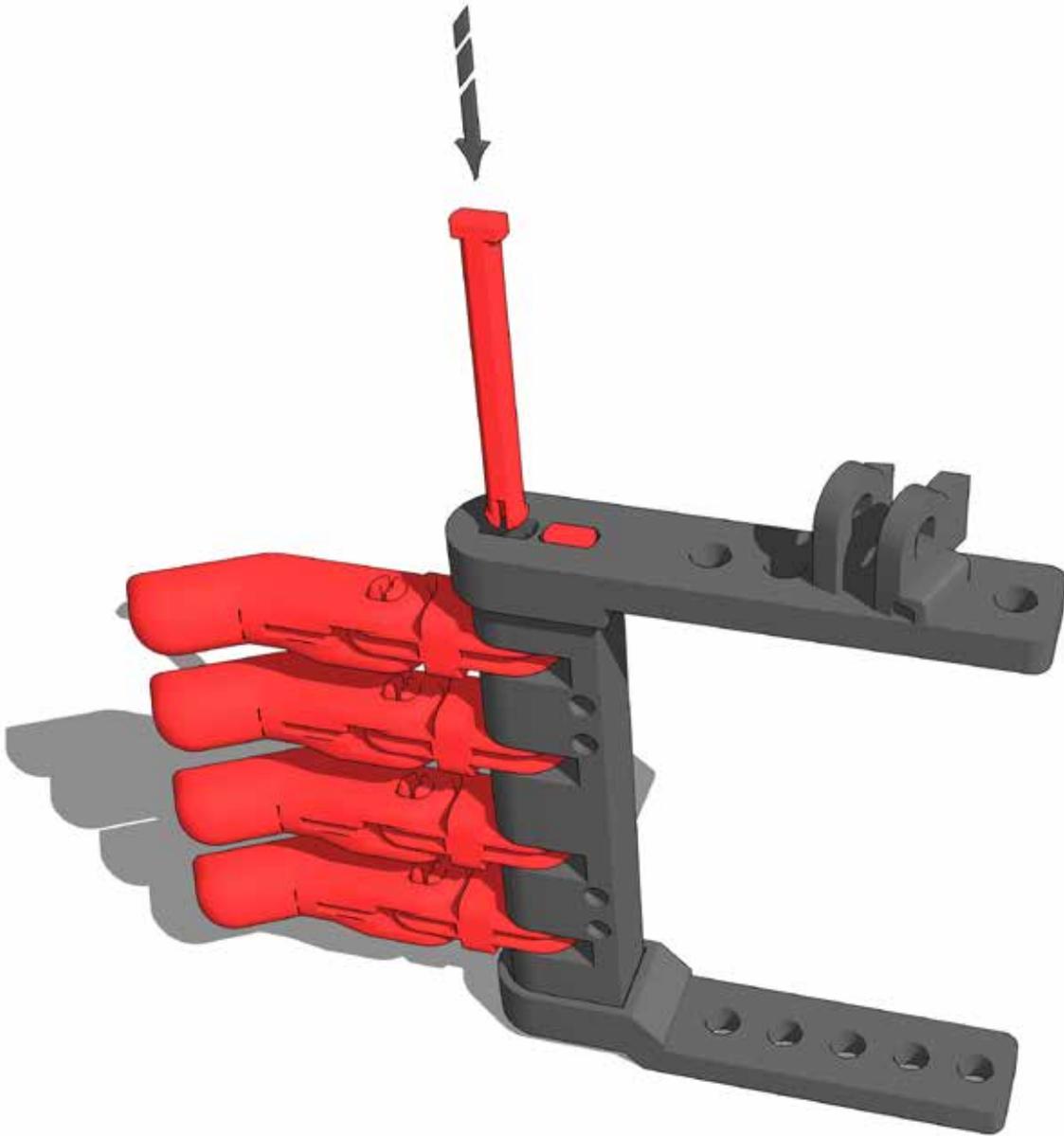
PRINTED PARTS
Snap Pins.stl

PREPARATION
Put the second two fingers into their slots.

Use a hammer to tap the other long snap pins into the hole, securing the fingers to the knuckle block.
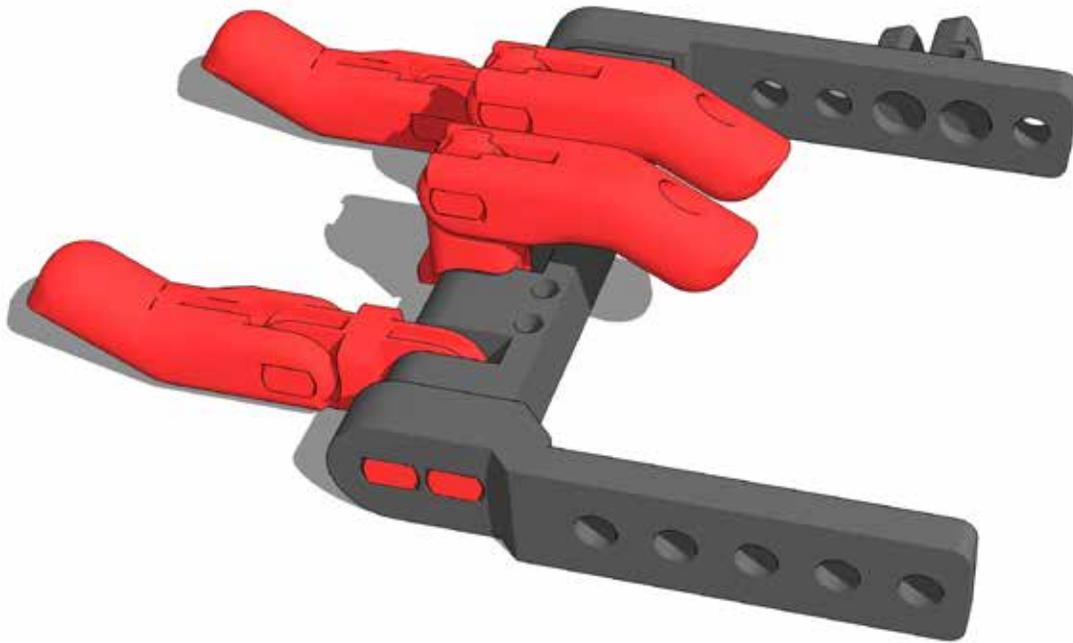
PRINTED PARTS

CHECK THE MOMENT OF THE FINGERS
The fingers should move freely with gravity. If they don't, force them back and forth a few times until they loosen up.
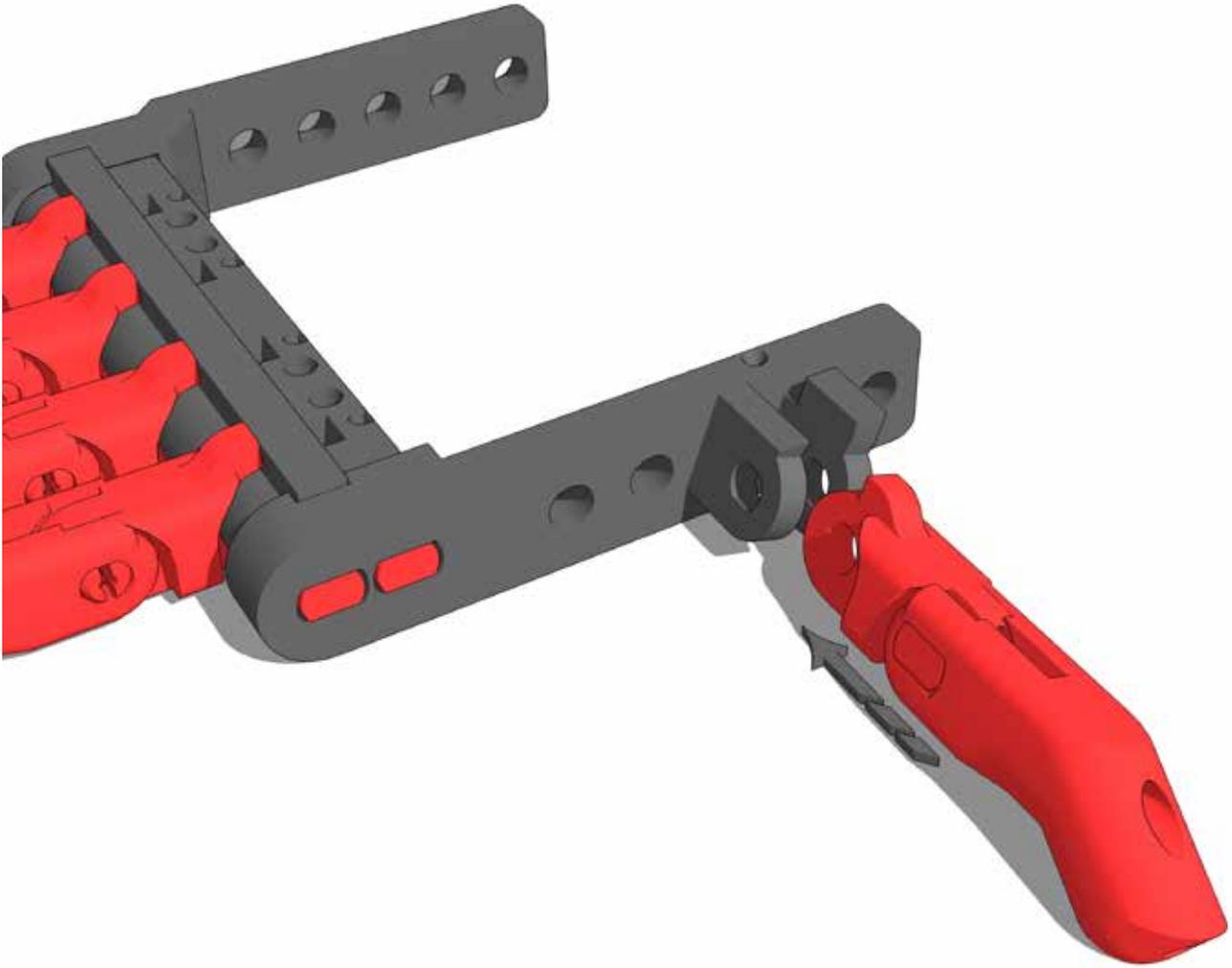
PRINTED PARTS
Fingers.stl

INSTALL THE THUMB
Slide the Thumb into place.
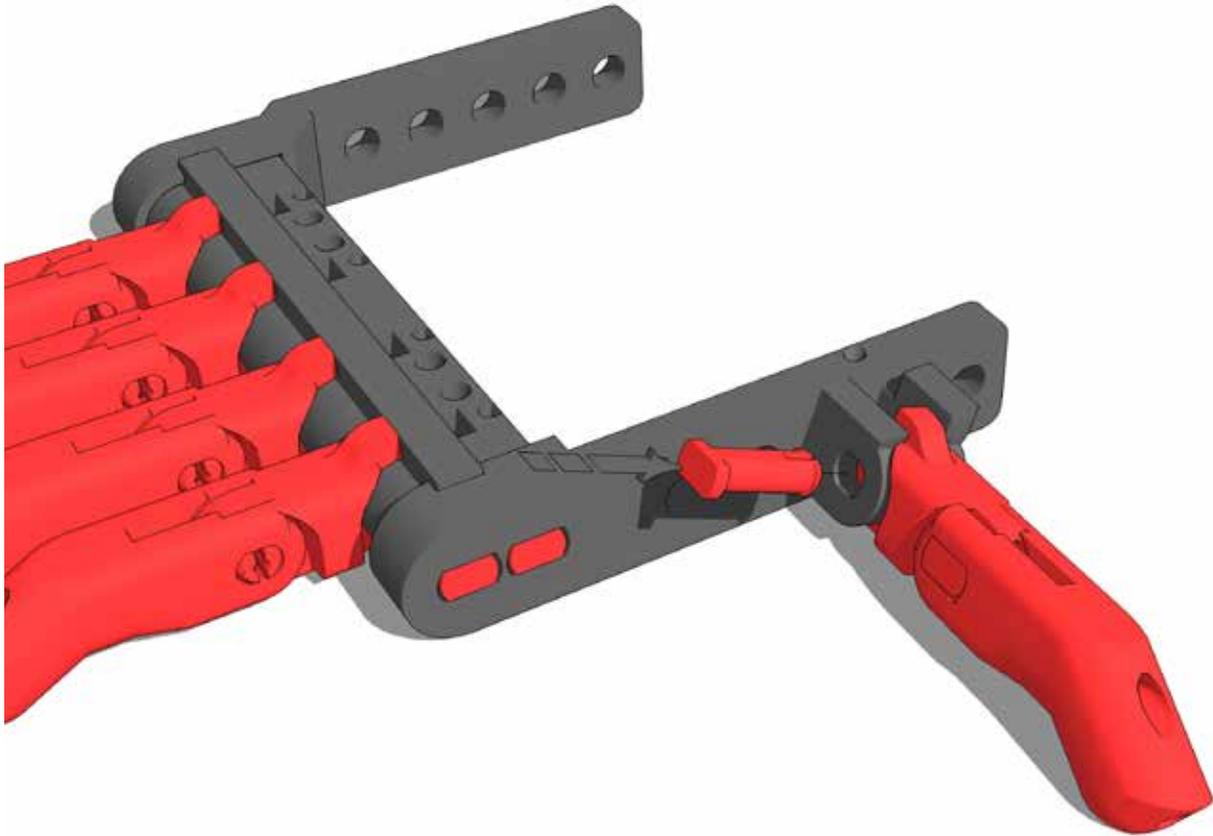
PRINTED PARTS
Snap Pins.stl

ATTACH THE THUMB
Use one of the 3 layer pins to attach the Thumb to the hand.

A large pair of pliers can be helpful for pushing the pin though the hole.
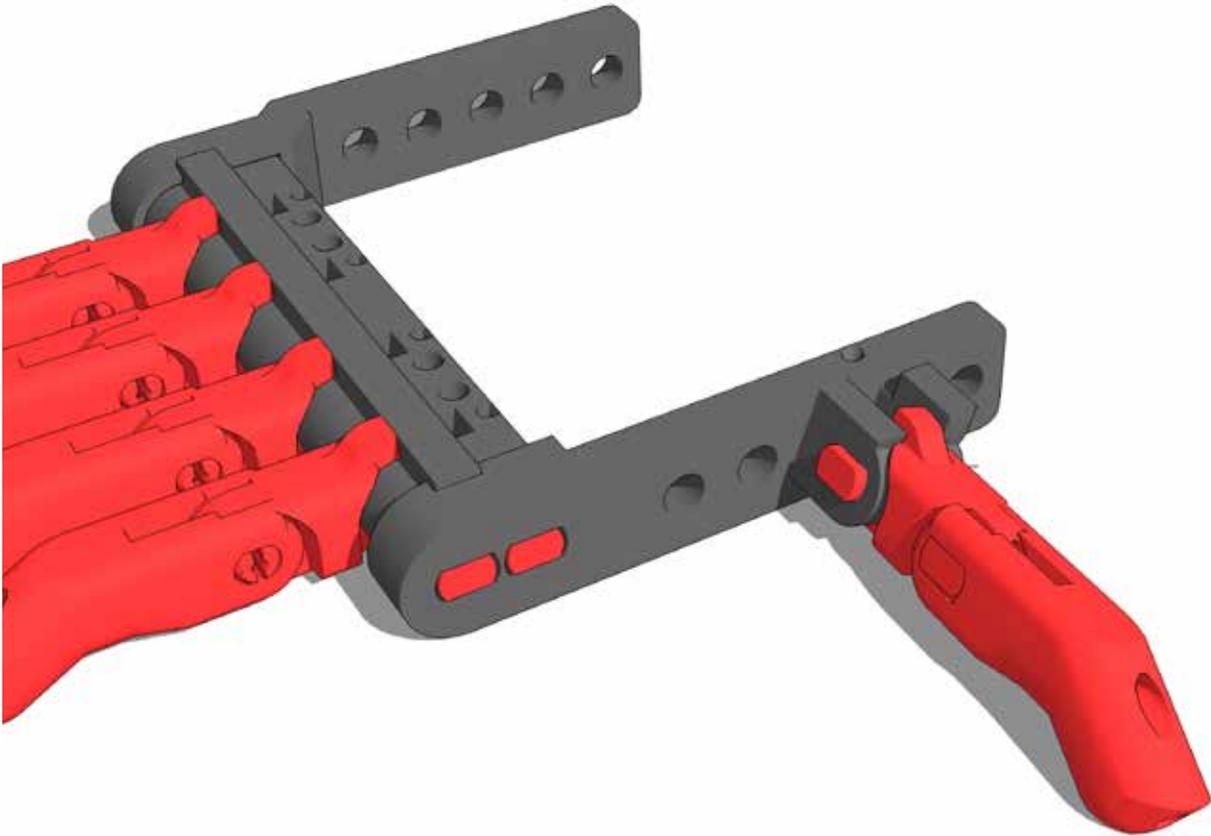
PRINTED PARTS

MOVE THE THUMB

The Thumb should move freely. If it doesn't, force it back and forth a few times until it loosens up.
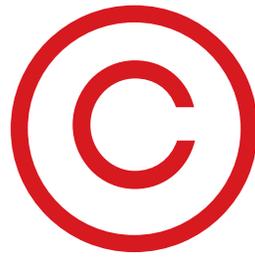
Building the Wrist

READ BEFORE PRECEDING

A mechanical hand is a highly individualized piece of equipment that needs to be custom fitted to its user. This document will not attempt to cover the process of creating a thermoplastic gauntlet that mates a Robohand to its user.

The following sections show how to build a functional example of the Robohand system.

These instructions are designed to give the builder an understanding of the Robohand and how it can be modified. I recommend that you build the Robohand exactly as described in these instructions before modifying it to your specific needs.

PRINTED PARTS
Wrist Beams.stl

THE FIRST BEAM
Place a 6 hole beam on the inside of the Hand Assembly, lining up the holes with across from one another.

PRINTED PARTS
Snap Pins.stl

ATTACH THE FIRST BEAM
Insert two #2 snap pins into the front two holes on opposing sides to attach the beam to the hand.

PRINTED PARTS

Wrist Beams.stl

Snap Pins.stl

THE SECOND BEAM

Attach the other 6 hole beam to the other side of the hand using two #2 snap pins in the front two holes.
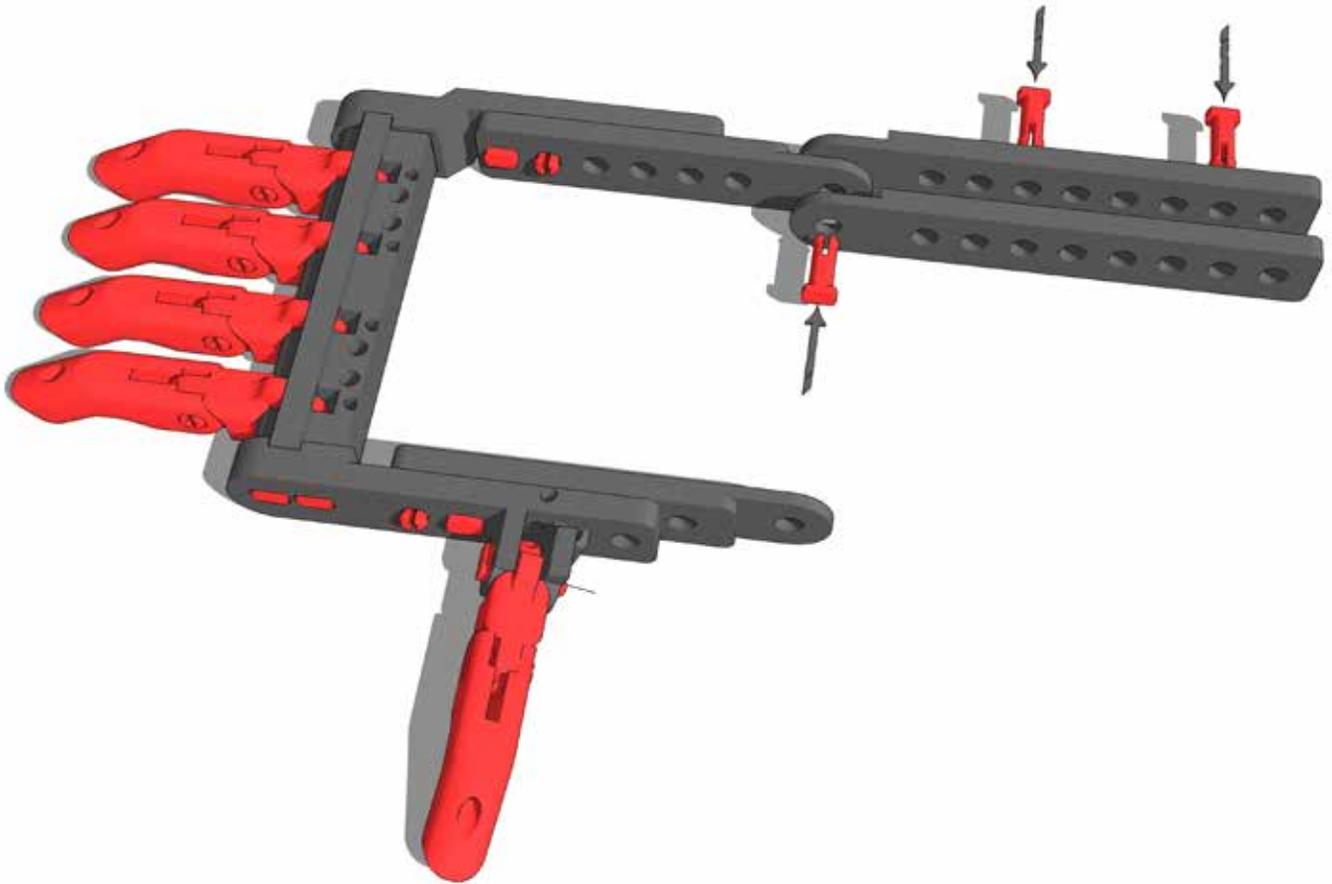
PRINTED PARTS
Wrist Beams.stl
Snap Pins.stl

THE FIRST HINGE

Use #2 snap pins to attach two 8 hole beams together. The flanges on these two beams create a slot. Slide the slot over the flange of one of the beams attached to the wrist, lining up the holes.

Use another #2 pin to attach the three flanges together, creating the hinge.

BUILDING THE WRIST - STEP 5
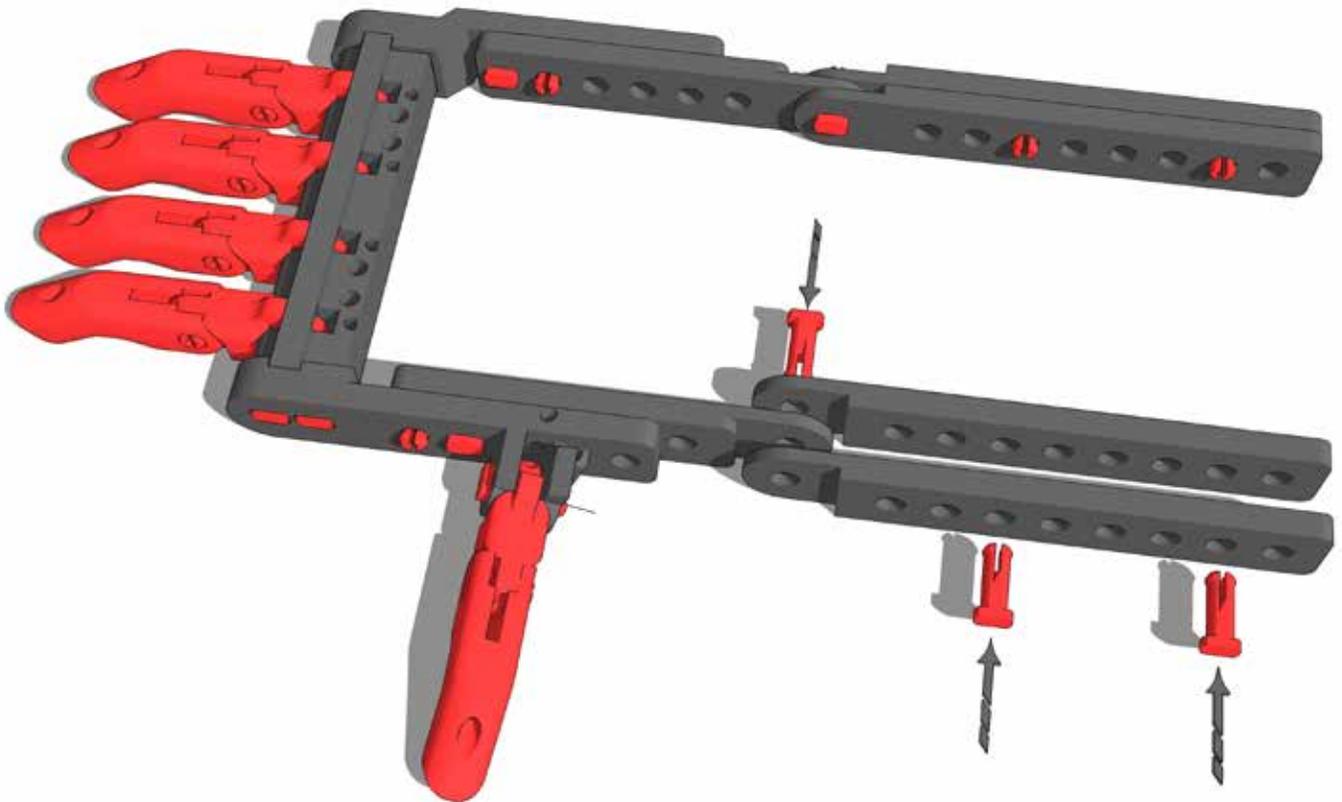
PRINTED PARTS
Wrist Beams.stl
Snap Pins.stl

THE SECOND HINGE

Use #2 snap pins to attach the other two 8 hole beams together. Slide the slot over the flange of the other beam attached to the wrist, lining up the holes.

Use another #2 pin to attach the three flanges together, creating a second hinge.

PRINTED PARTS

TEST THE HINGES

Move both of the hinges back and forth. The should move freely with gravity. If they don't, force them back and forth several times until they loosen up.
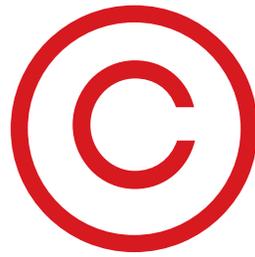
Attaching the

Bridges

ATTACHING THE BRIDGES - STEP 1
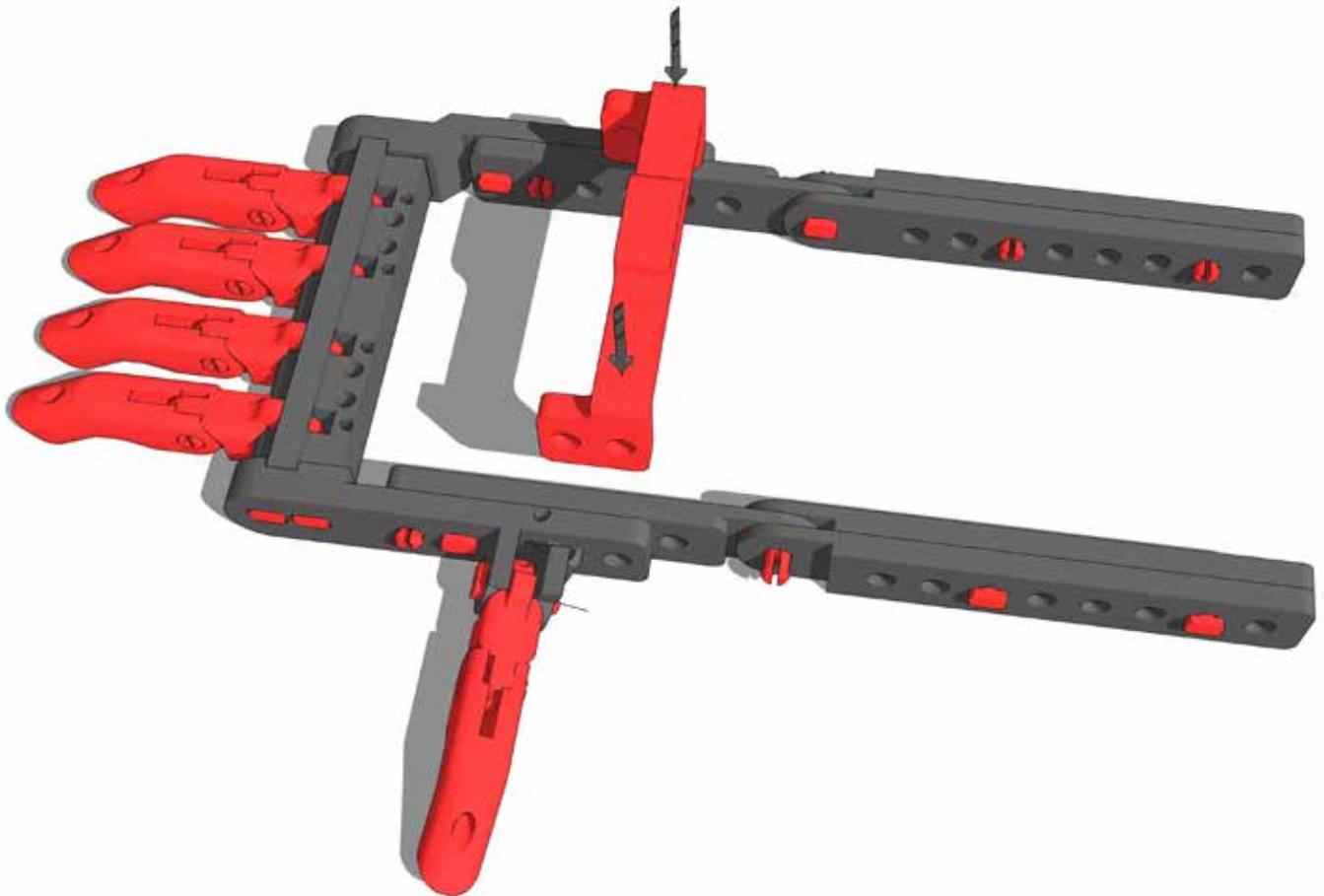
PRINTED PARTS
Bridges.stl

THE FRONT BRIDGE
Find the wider of the two bridges. Slide it between the front beams of the
Robohand, lining up the holes.
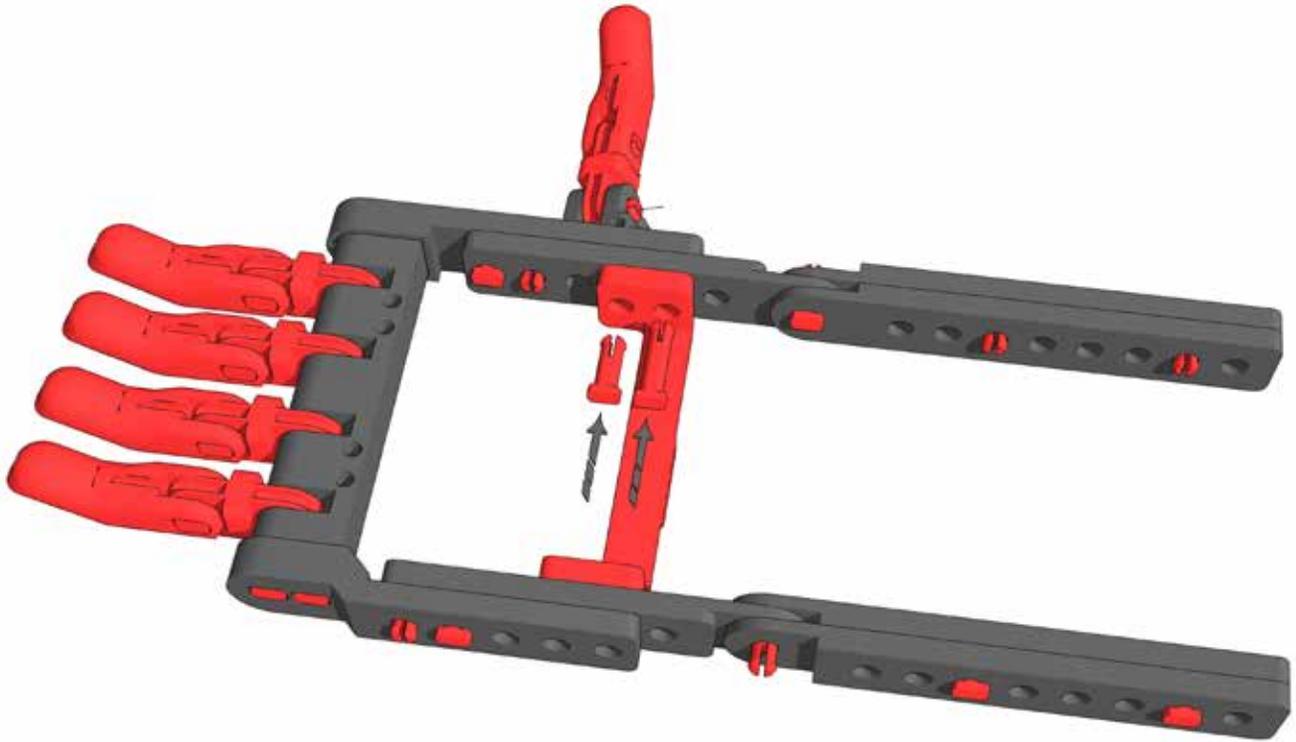
PRINTED PARTS
Snap Pins.stl

ATTACHED THE FRONT BRIDGE
Flip the Robohand over onto its back. Use snap pins to secure the thumb side of the front bridge. You will need to use a #3 pin in the hole that reaches through to the outside of the hand and a #2 pin in the hole behind the thumb.
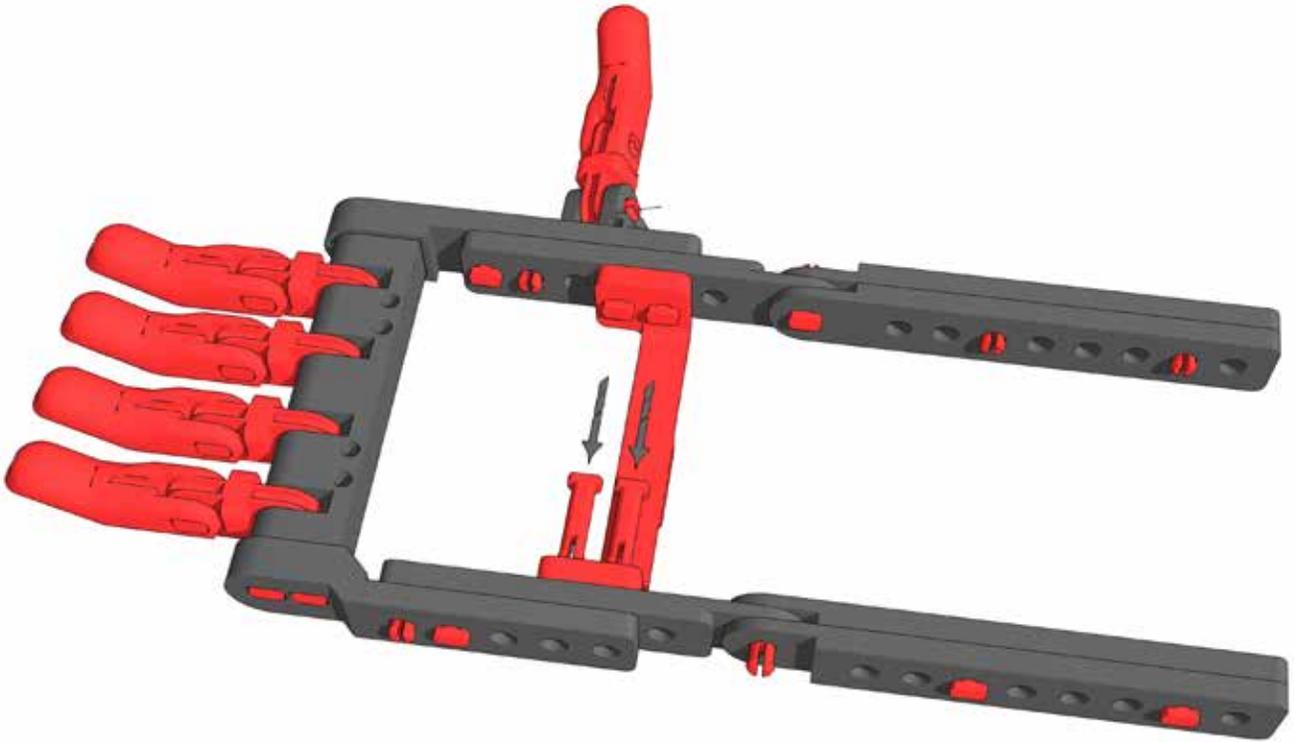
PRINTED PARTS
Snap pins.stl

ATTACHED THE FRONT BRIDGE
Secure the other side of the front bridge using two #3 snap pins.
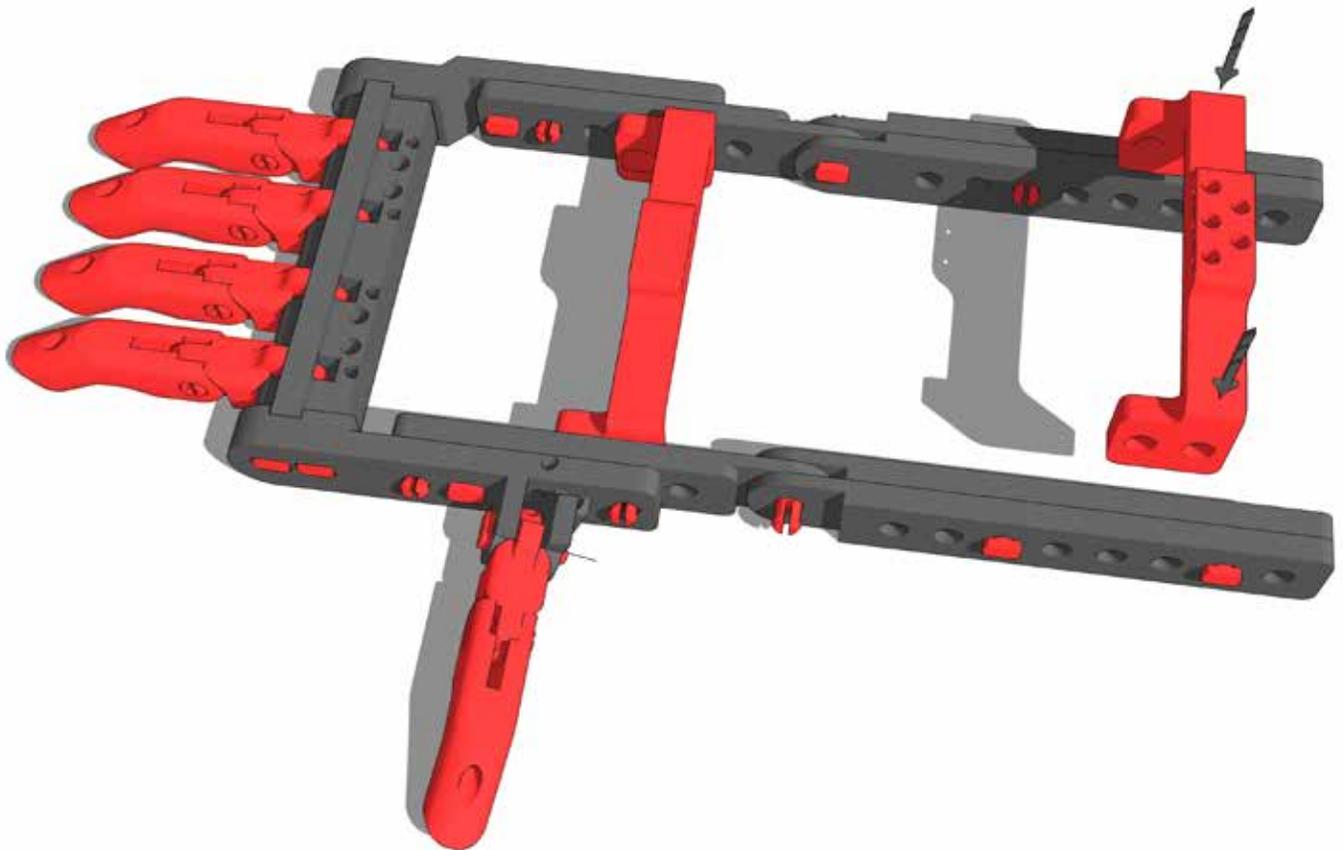
PRINTED PARTS
Bridges.stl

THE REAR BRIDGE
Flip the Robohand right side up again, and position the rear bridge between the rear beams.
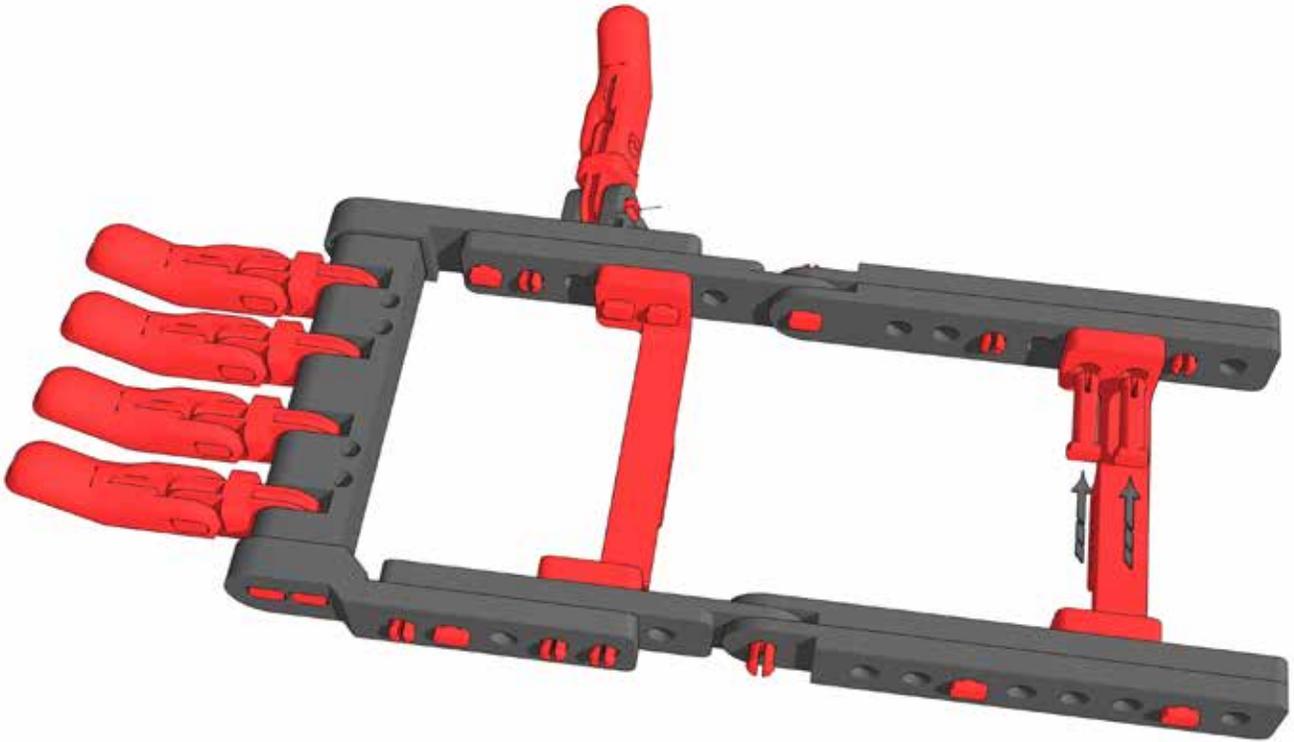
PRINTED PARTS
Snap Pins.stl

ATTACHED THE REAR BRIDGE
Use two #3 snap pins to attach the rear bridge to the beams.
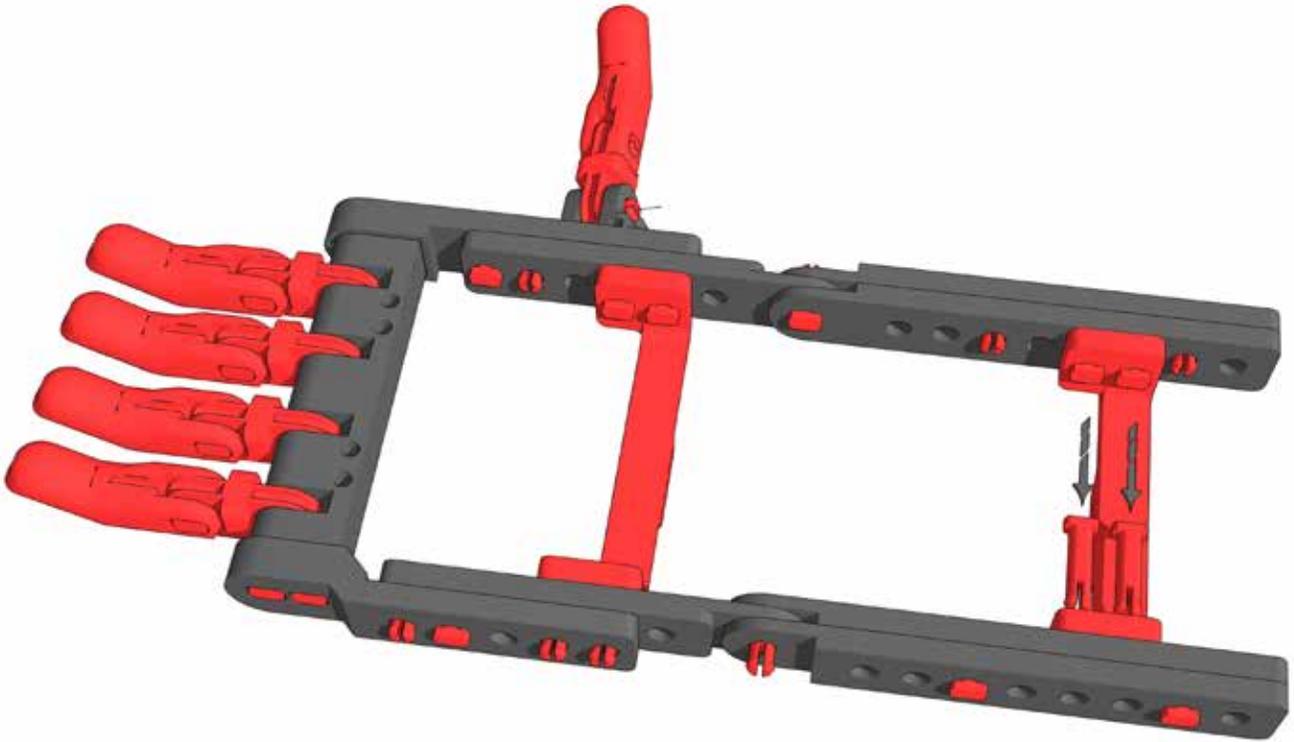
PRINTED PARTS
Snap pins.stl

ATTACHED THE REAR BRIDGE
Use two more #3 snap pins to finish attaching the rear bridge to the beams.
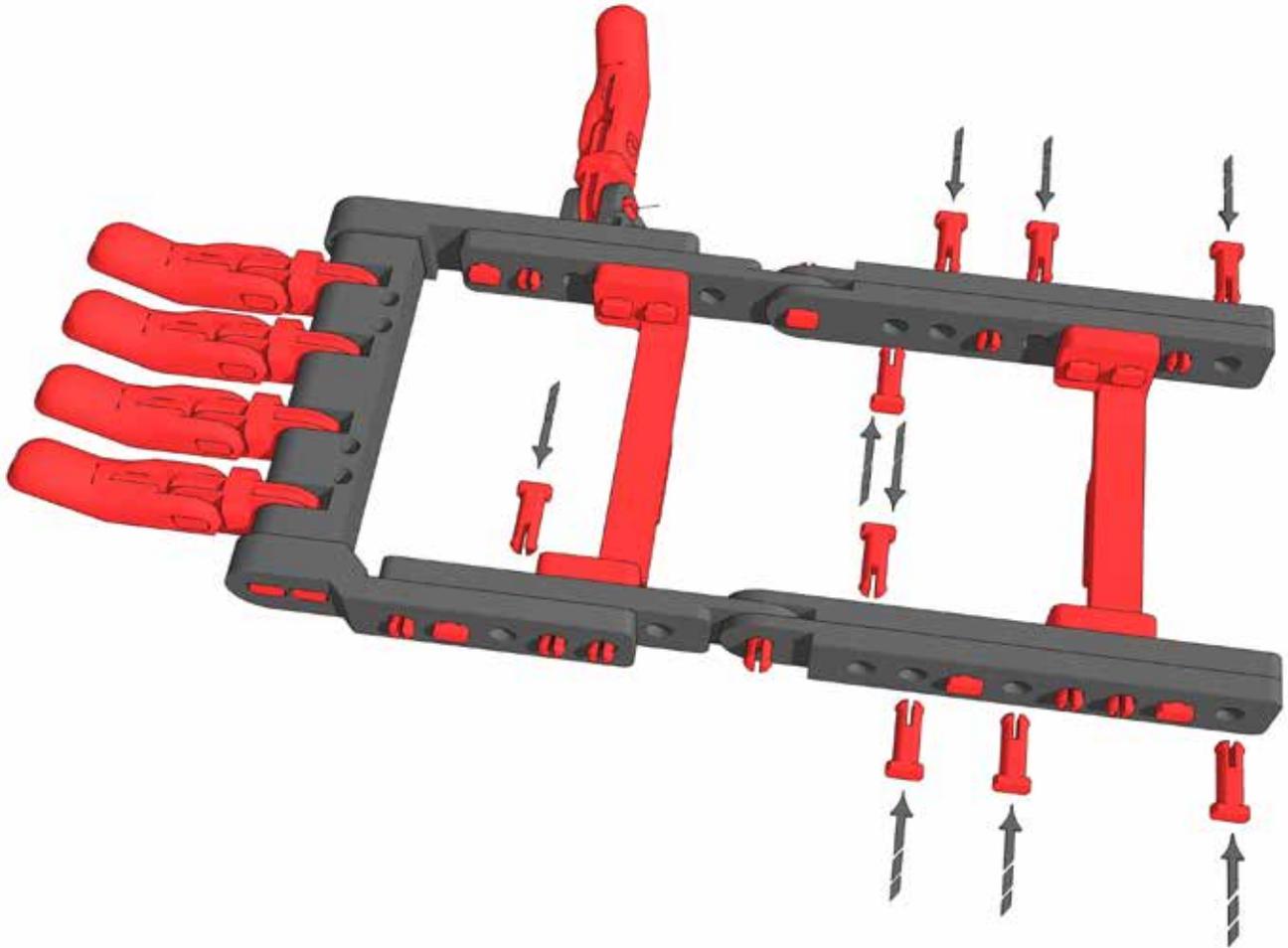
PRINTED PARTS
Snap Pins.stl

FILL IN THE HOLES
Use any remaining #2 snap pins to fill in the open holes in the beams. Alternate the placement of the pins so the top and bottom of the pins are staggered on opposite sides of the beam. This will increase the Robohand's strength, and give it a snazzy riveted look.
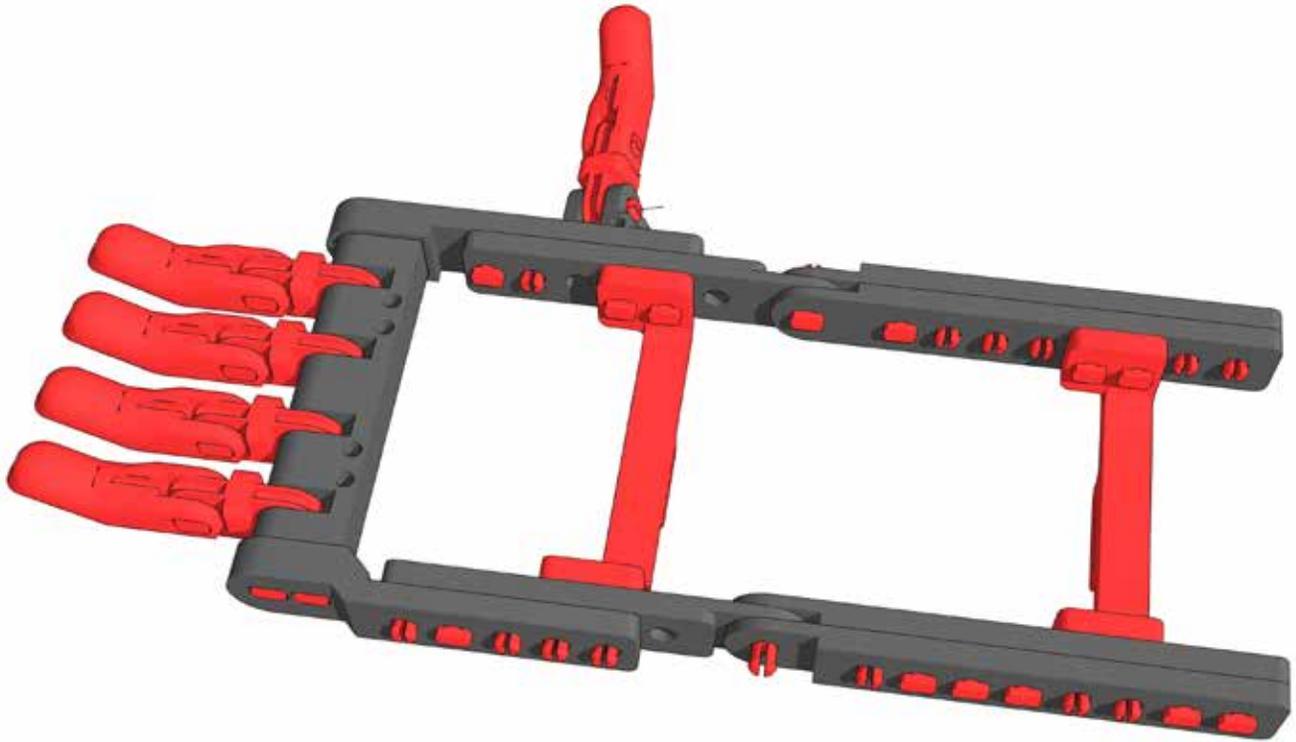
PRINTED PARTS

Fingers.stl

TEST THE MOVEMENT

Move the joints of the wrist back and forth. It should move freely. If it doesn't, force it back and forth several times until the joints loosen up.
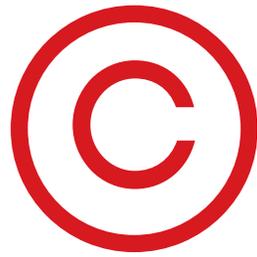
**MakerBot**

The

Elastic
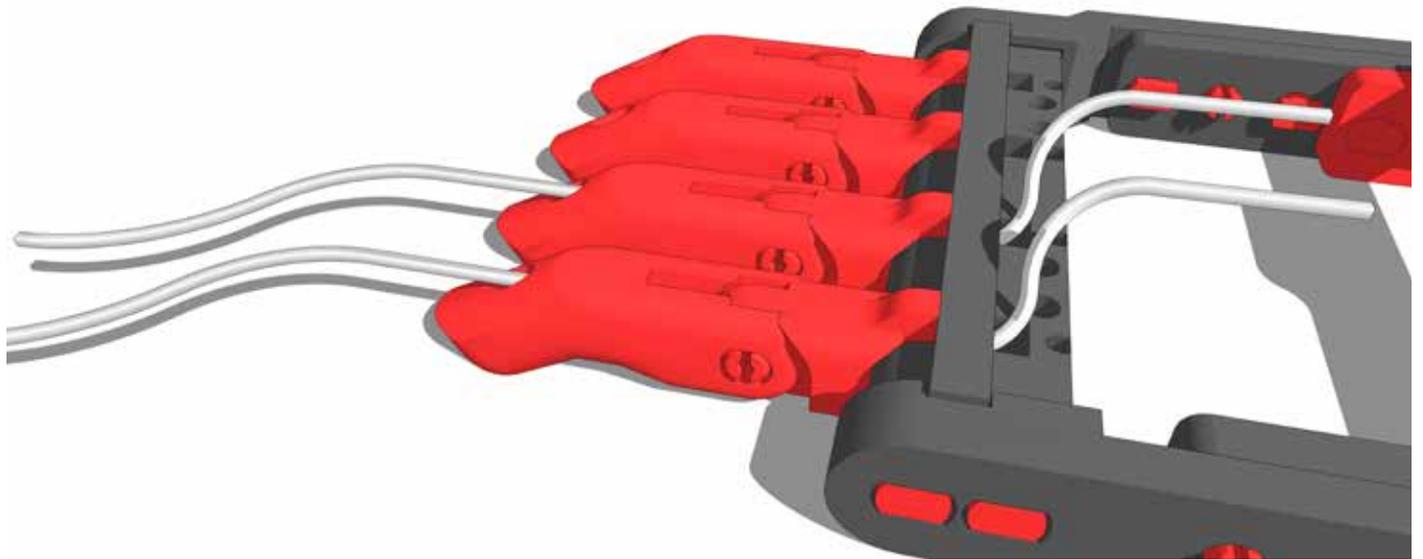
PRINTED PARTS

THREAD THE ELASTIC THROUGH THE FINGER
Thread your elastic through the holes on the upper side of the index and middle fingers and out the top of the knuckle block.
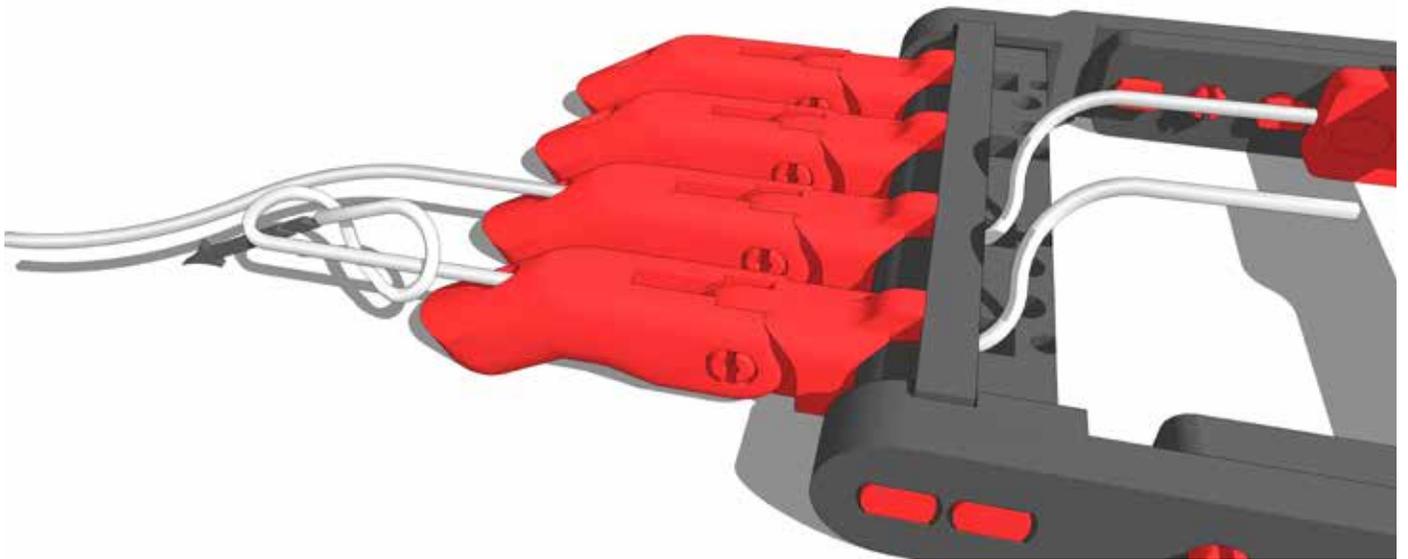
PRINTED PARTS

TIE THE END

Tie a Figure 8 Knot at the finger tip end of the elastic as shown.
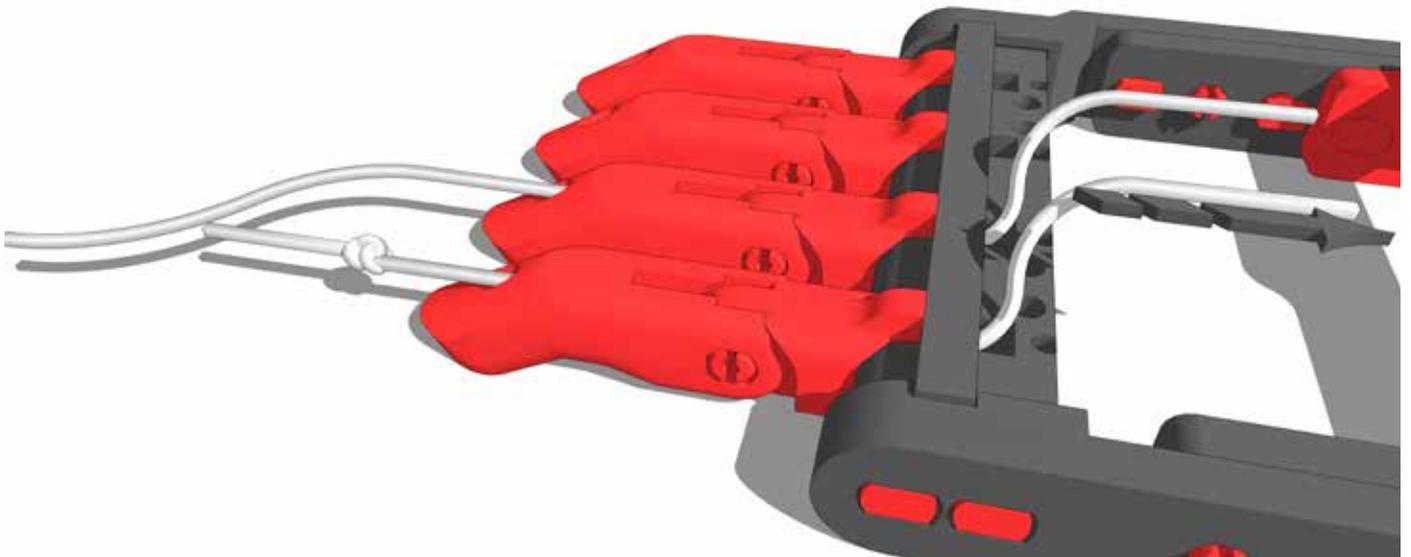
PRINTED PARTS

SEAT THE KNOT

Pull back on the knuckle block end of the elastic. The knot should slide
completely into the finger.

Cut off any excess elastic hanging from the finger tip.
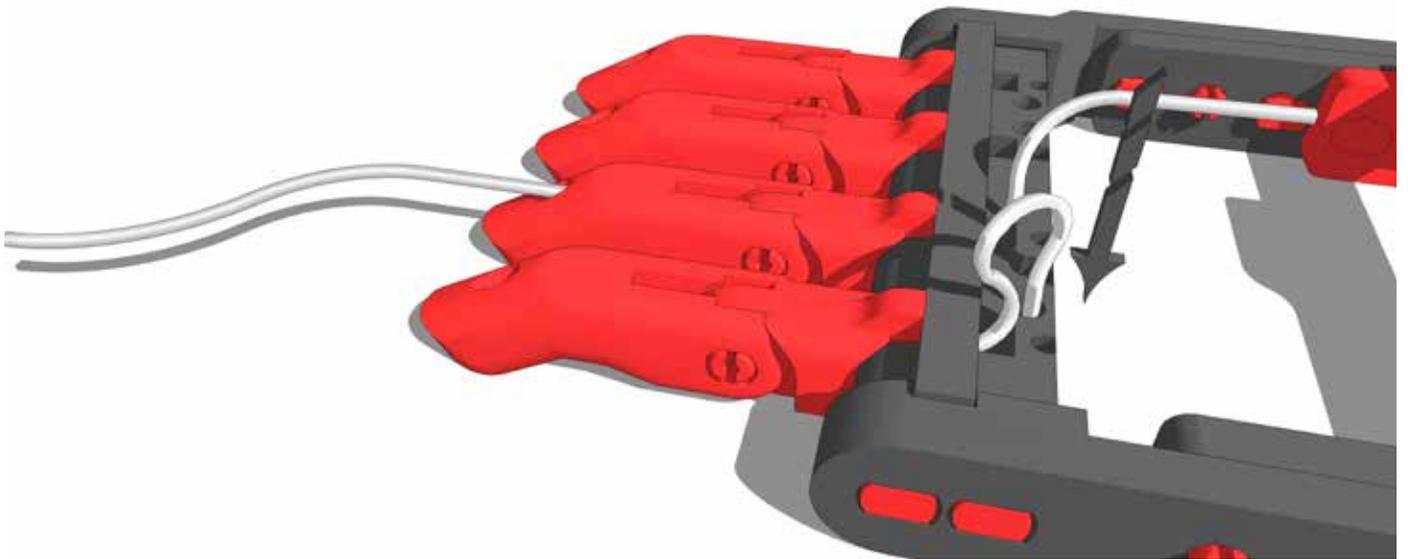
PRINTED PARTS

THREAD THE ELASTIC THROUGH THE KNUCKLE BLOCK
Run the elastic down through the hole in the knuckle block.

Repeat this step for the second finger.
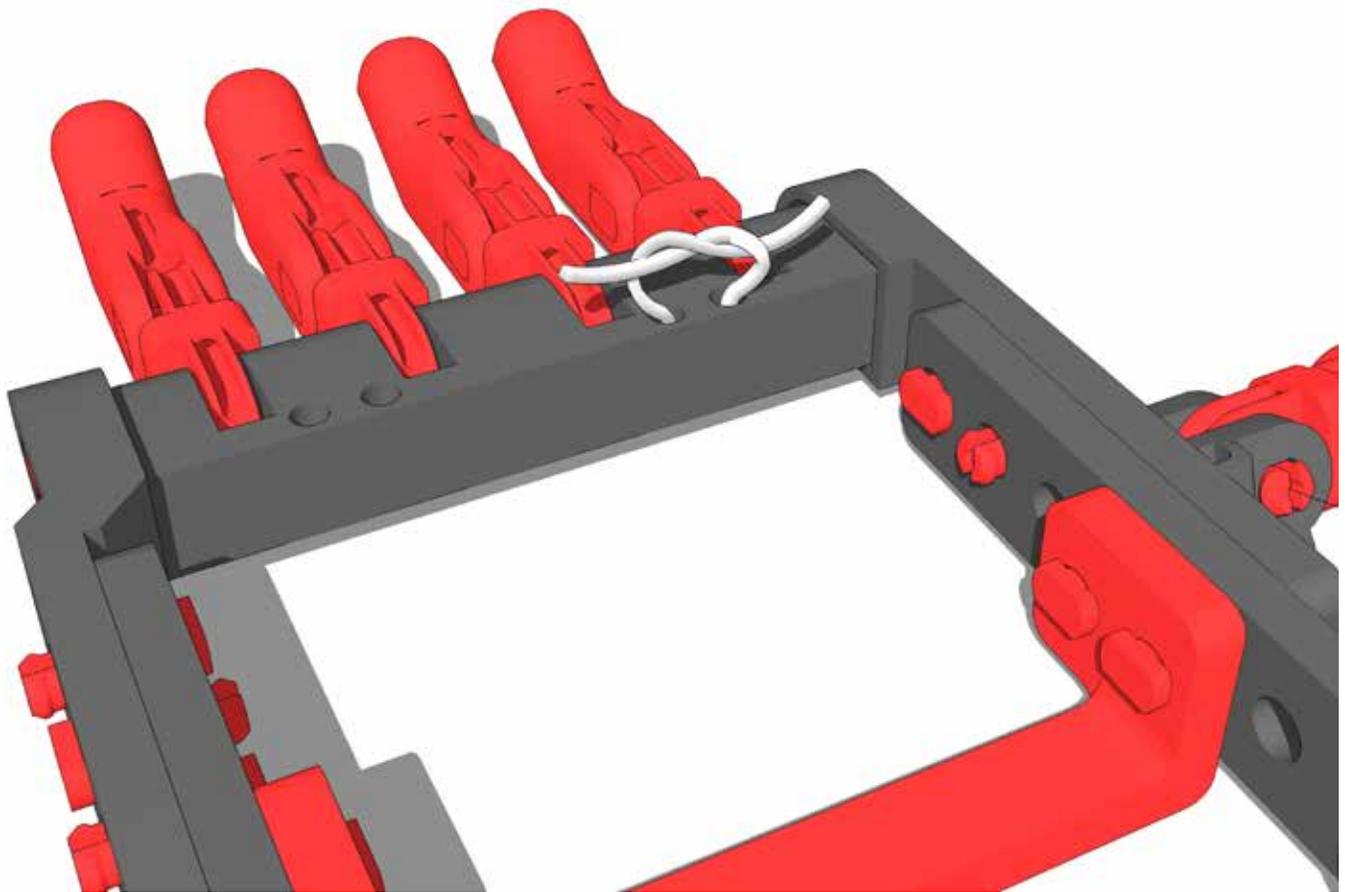
PRINTED PARTS

TIE THE ELASTIC
With the first two fingers threaded, flip the Robohand over and tie the loose
ends of the elastic together. Tie the knot tight to pre-strech the elastic.
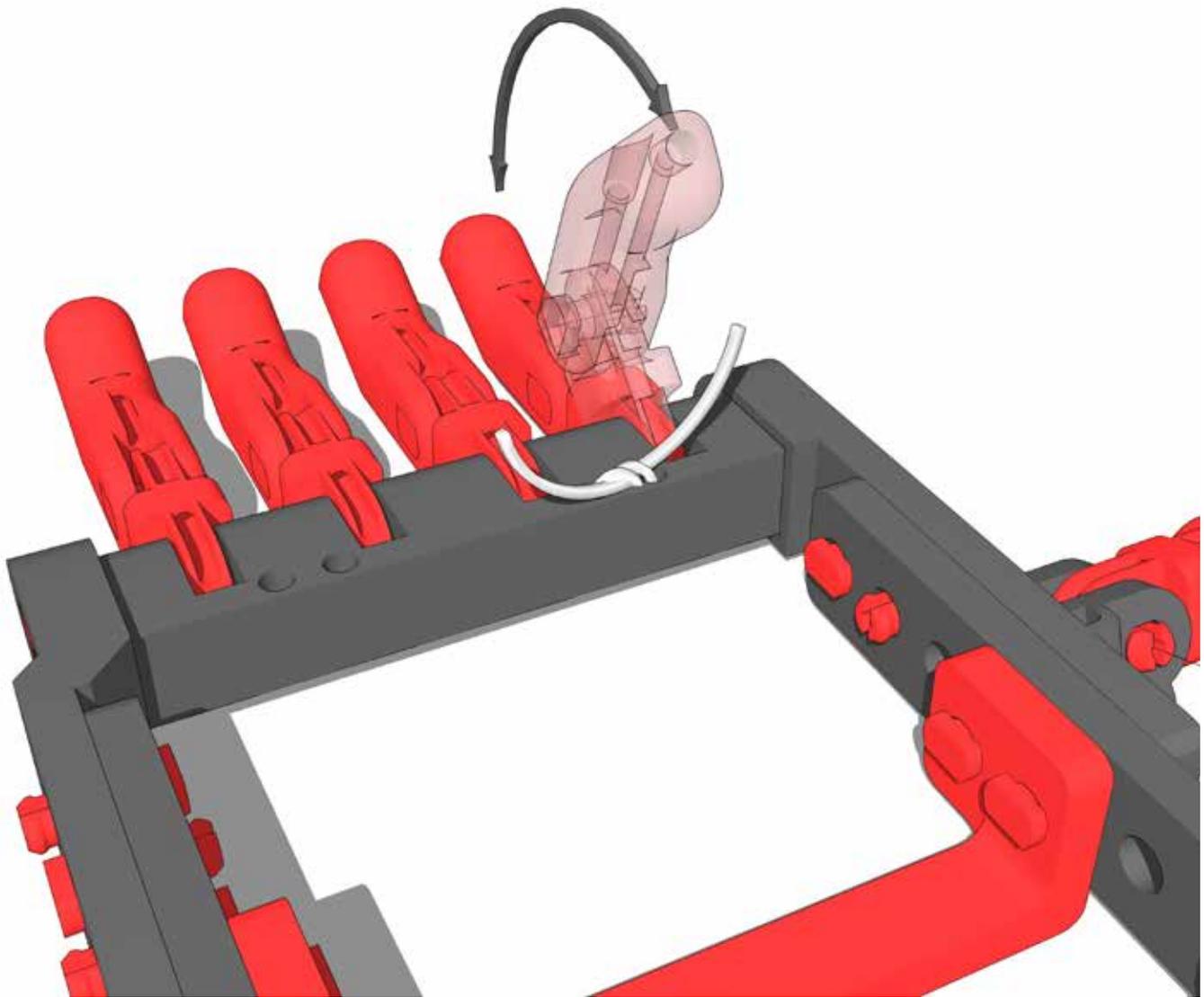
PRINTED PARTS

ADJUSTING THE ELASTIC

Test the spring of the fingers. They should be fairly easy to pull down, but still return freely when released. Adjust the springiness by loosening and tightening the knot in the elastic at the bottom of the knuckle block. When you are happy with the tension of the elastic, tie a second knot to lock it into place.

Repeat these steps for the ring and pinky fingers.
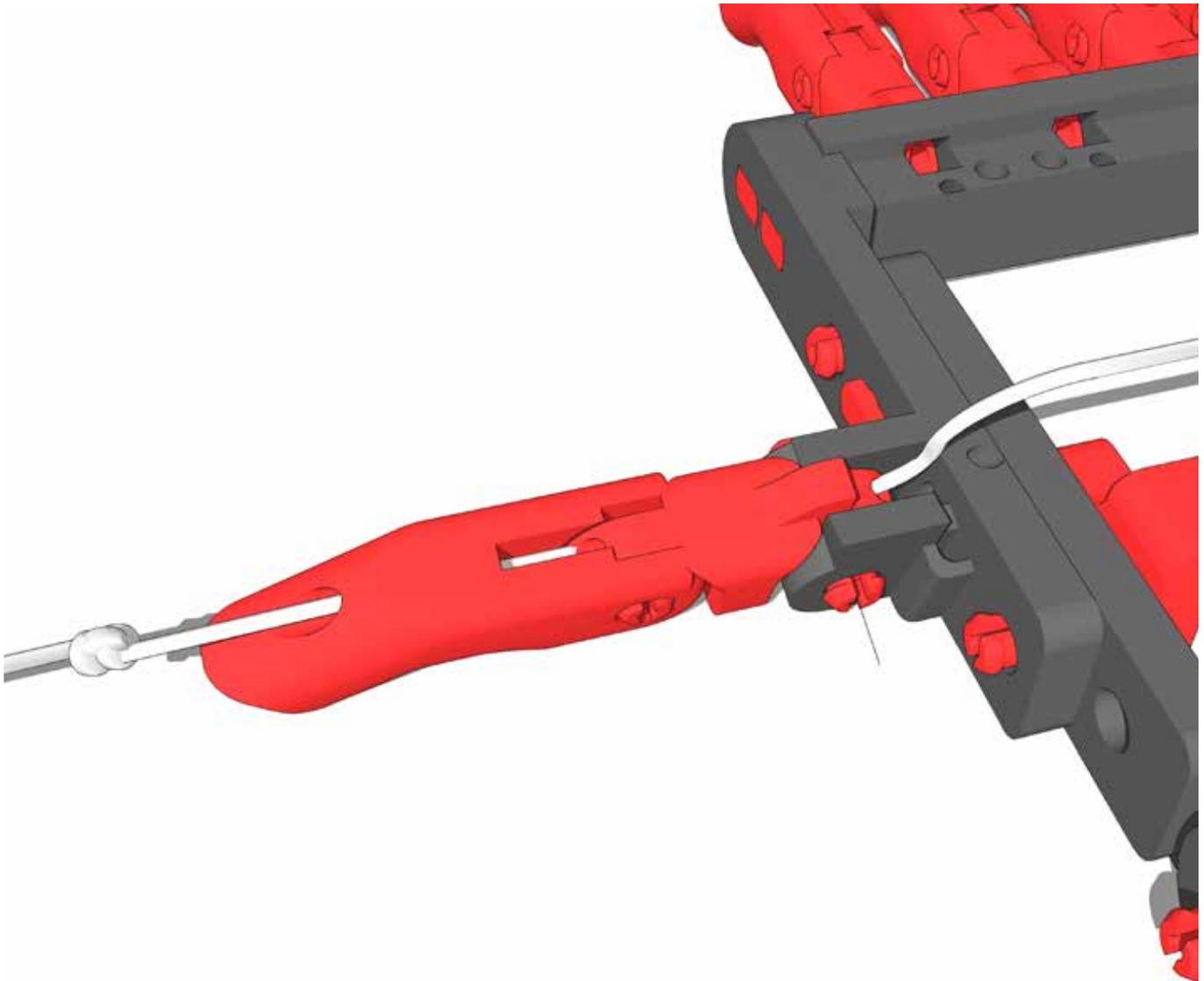
PRINTED PARTS

THE THUMB ELASTIC

Thread the elastic through the top of the thumb and tie a knot at the end, just like the fingers. Pull on the loose end of the elastic until the knot slides completely into the finger tip.

Cut off any excess elastic hanging from the finger tip.
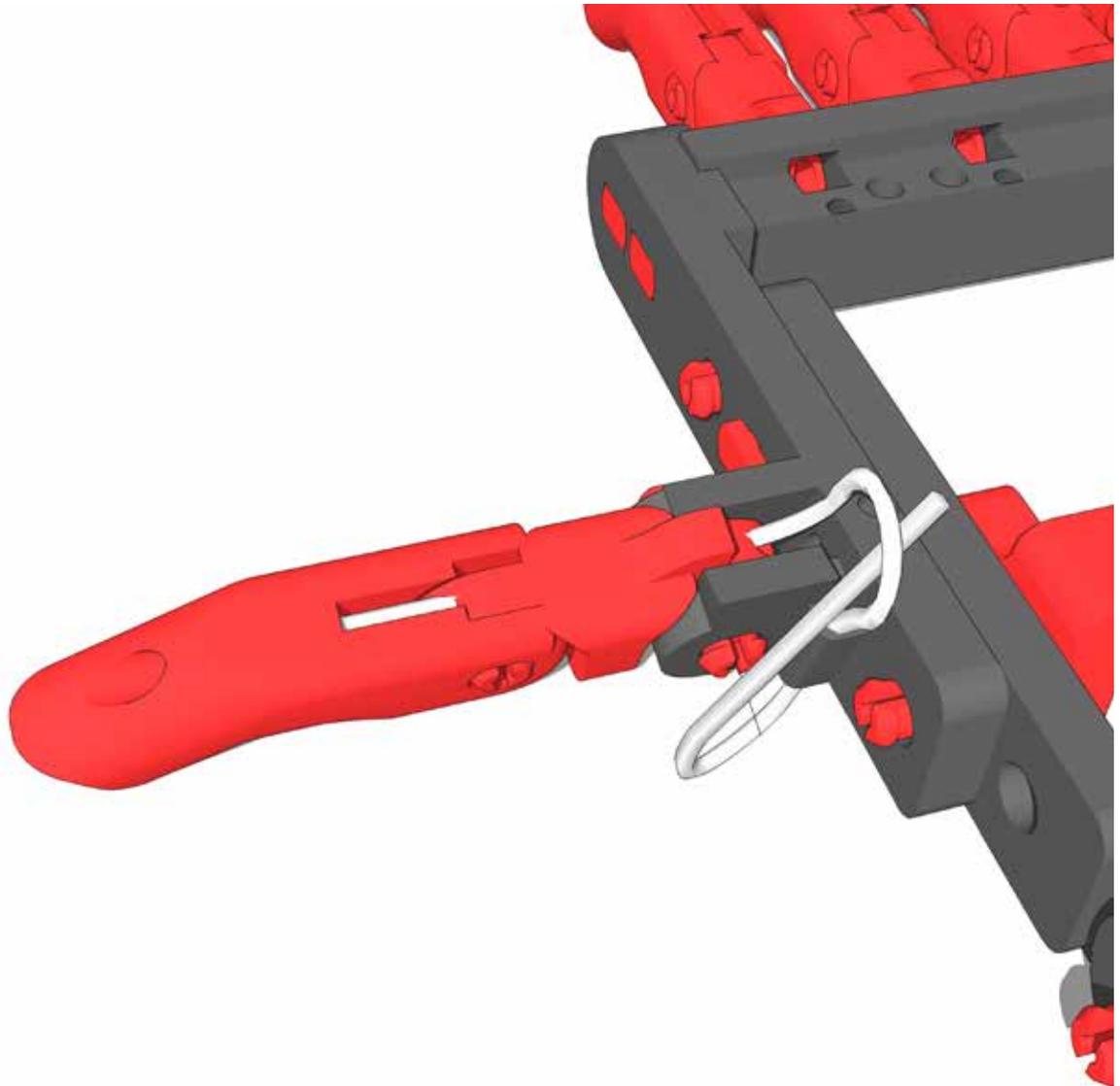
PRINTED PARTS

TIE THE THUMB

Run the elastic down though the channel next to the thumb mount, then loop the elastic back from up under itself as shown.
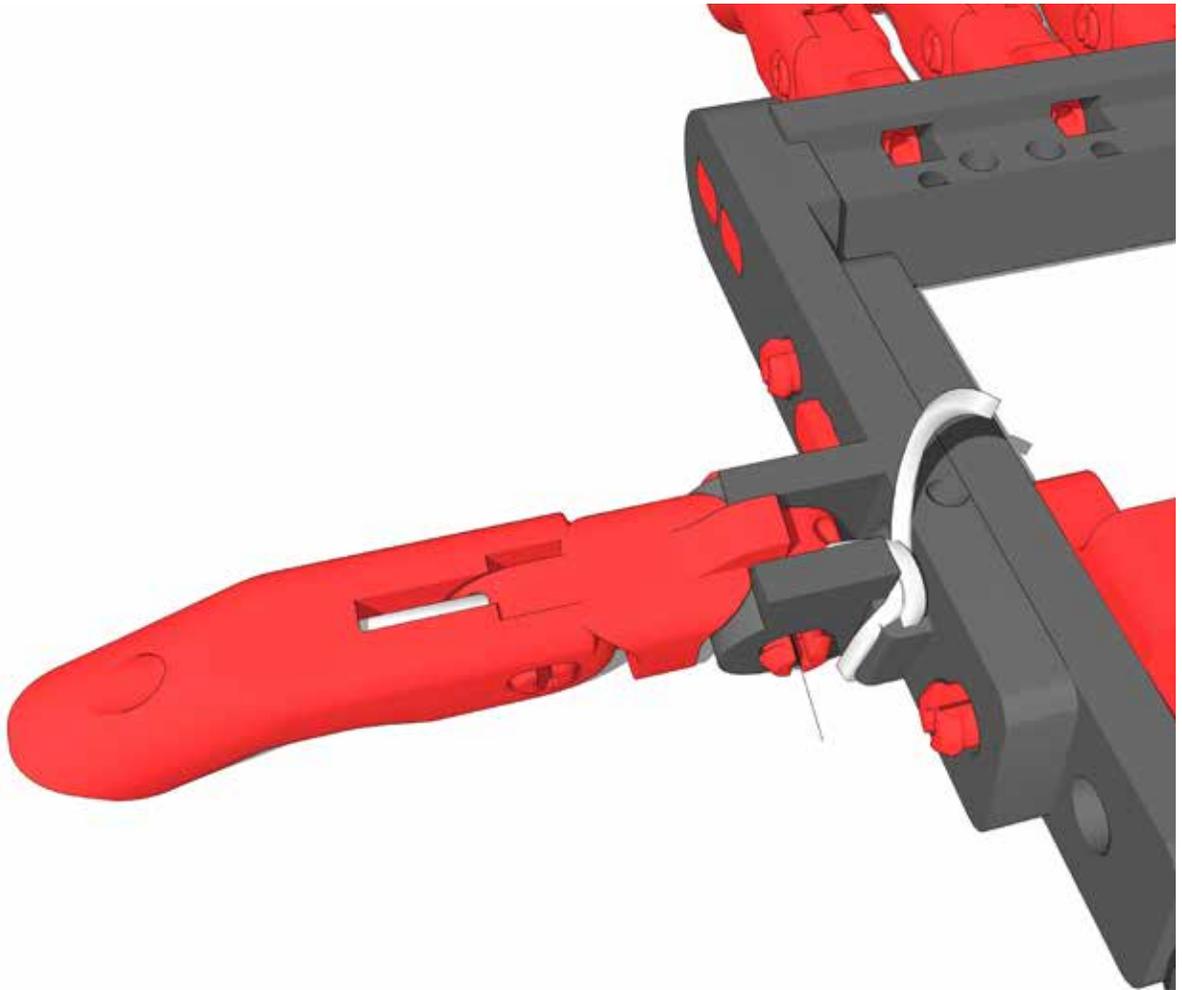
PRINTED PARTS

ADJUSTING THE ELASTIC

Test the springiness of the thumb. It should be fairly easy to pull down, but return freely when released. Adjust the springiness by loosening and tightening the knot.

When you are happy with the tension of the elastic, tie a second knot in the elastic to lock it into place.

The
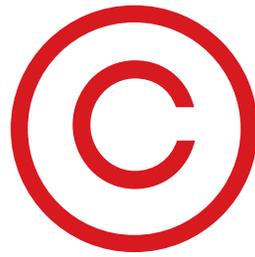
String

PRINTED PARTS

THREAD THE FINGER
Pull a long piece of string though the hole and slot in the bottom of the finger.
Tie a knot on the end of the string at the fingertip. Pull on the loose end of the
string until the knot slides inside the finger tip.
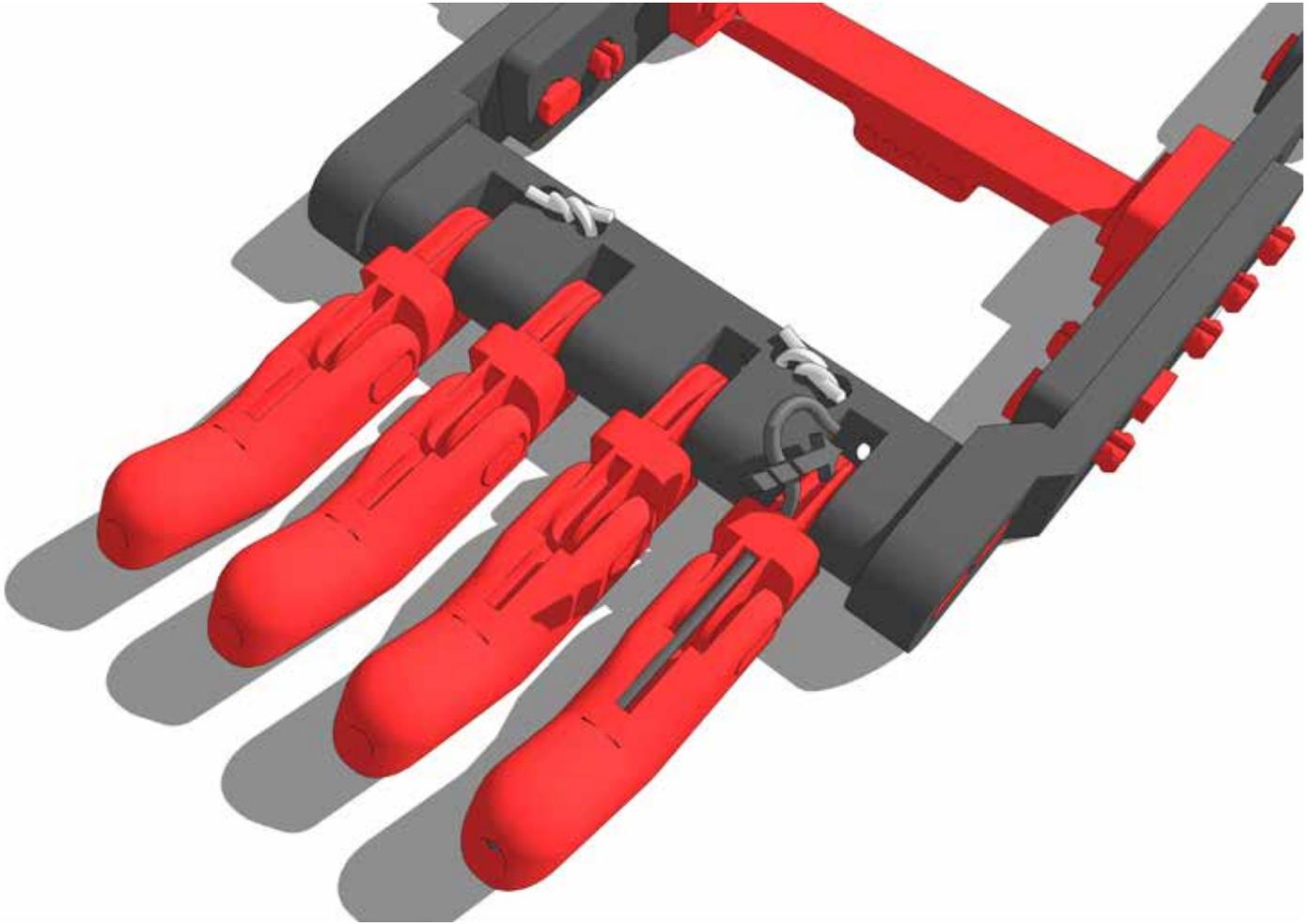
PRINTED PARTS

THROUGH THE KNUCKLE BLOCK

Find the angled hole in the knuckle block behind the finger. Run the thread through the hole and pull it it through to the other side.
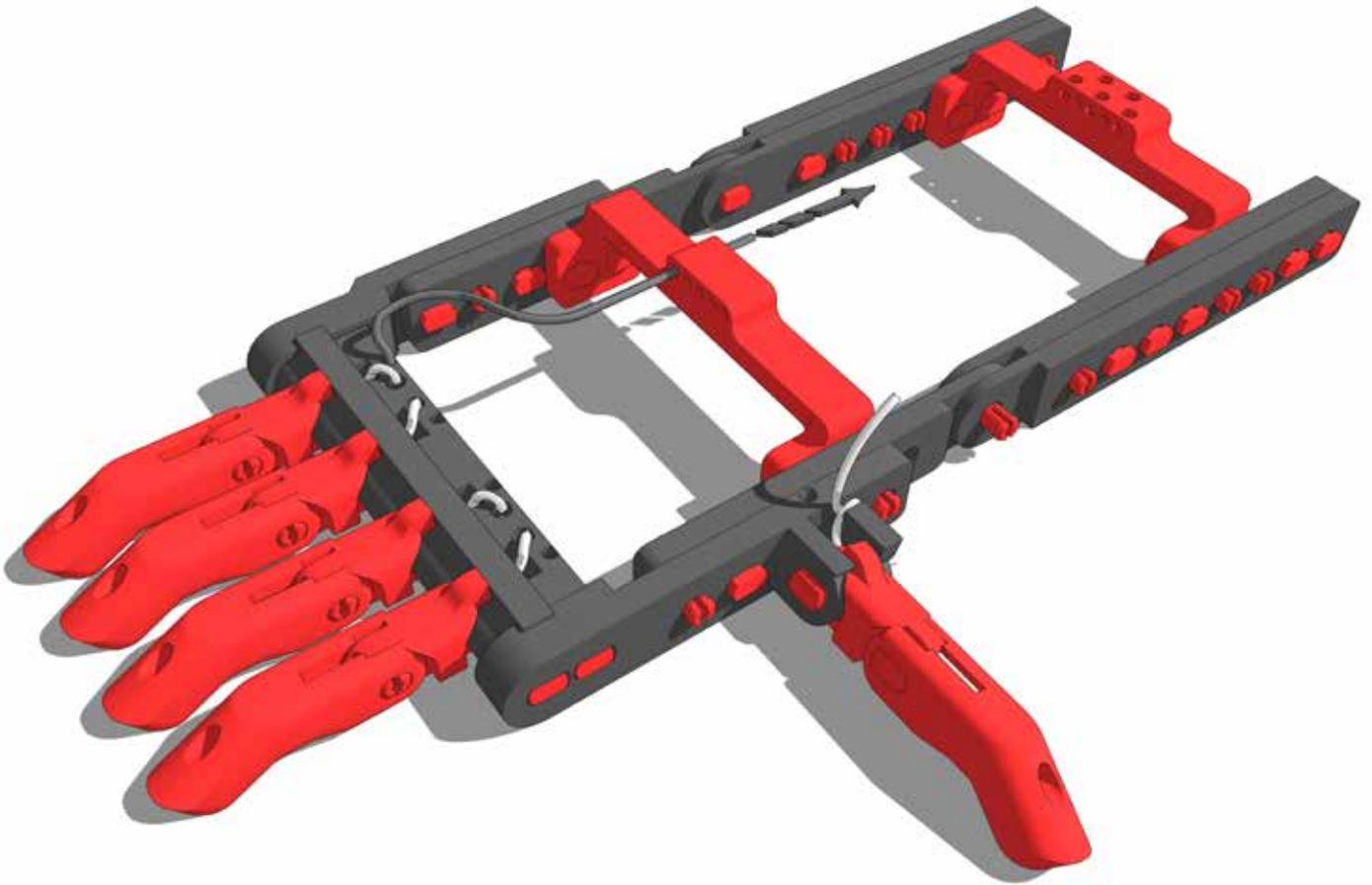
PRINTED PARTS

THE FIRST BRIDGE
Flip the Robohand over and run the string through a hole in the first bridge.
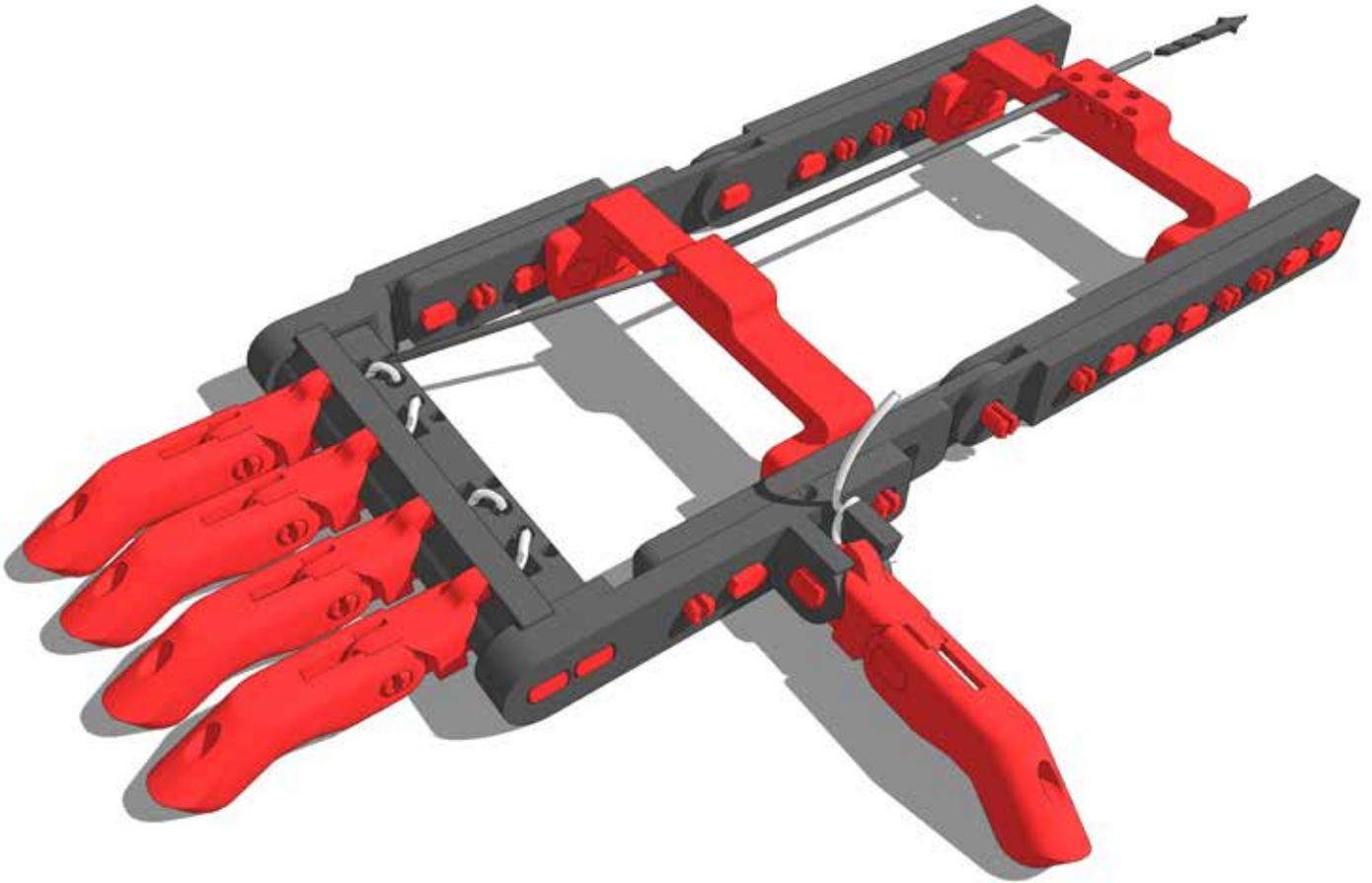
PRINTED PARTS

THE SECOND BRIDGE
Run the thread through the corresponding hole in the second bridge.
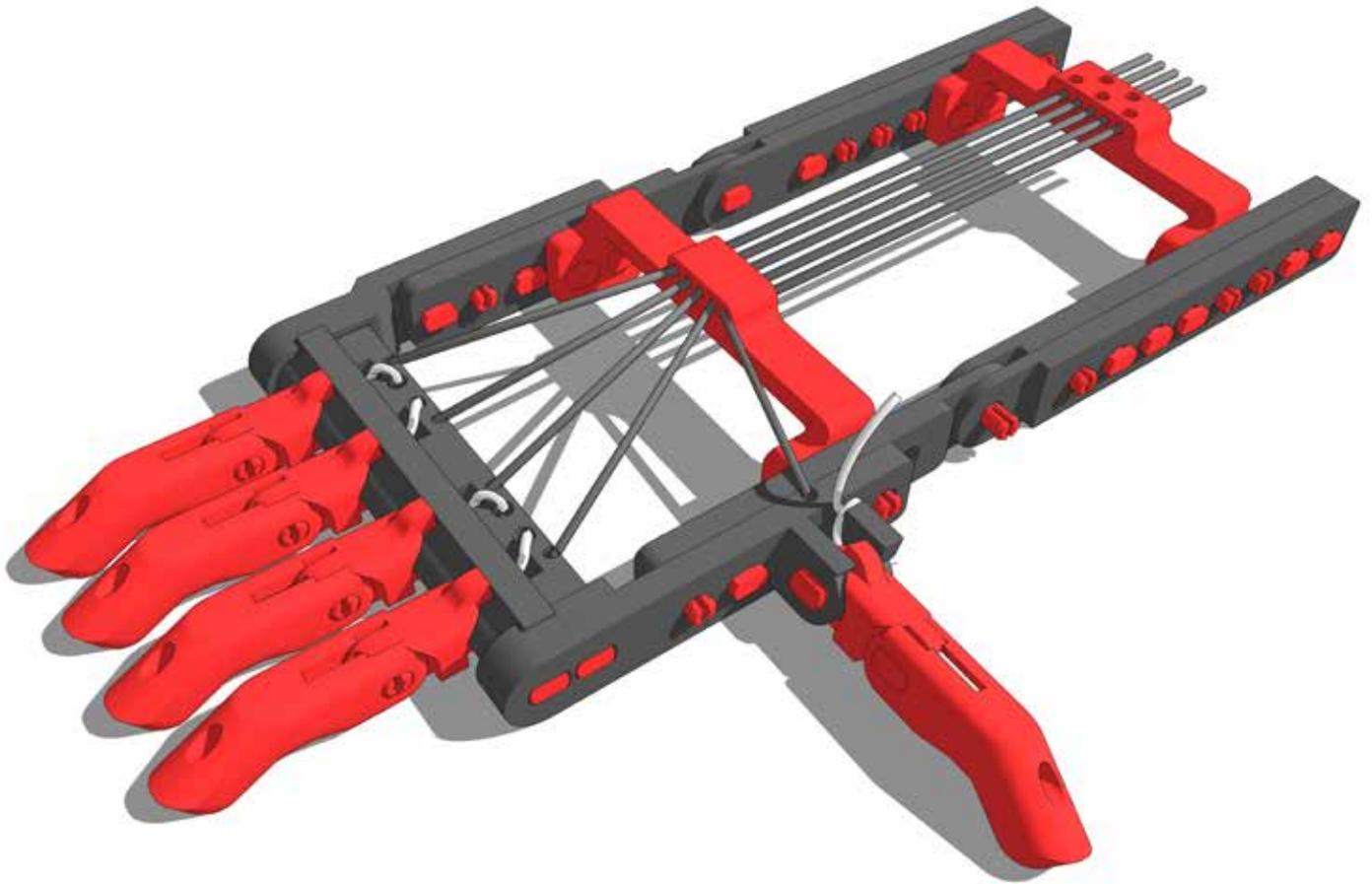
**PRINTED PARTS**

THE SECOND BRIDGE
Repeat the steps to run the string through the other three fingers and the thumb.
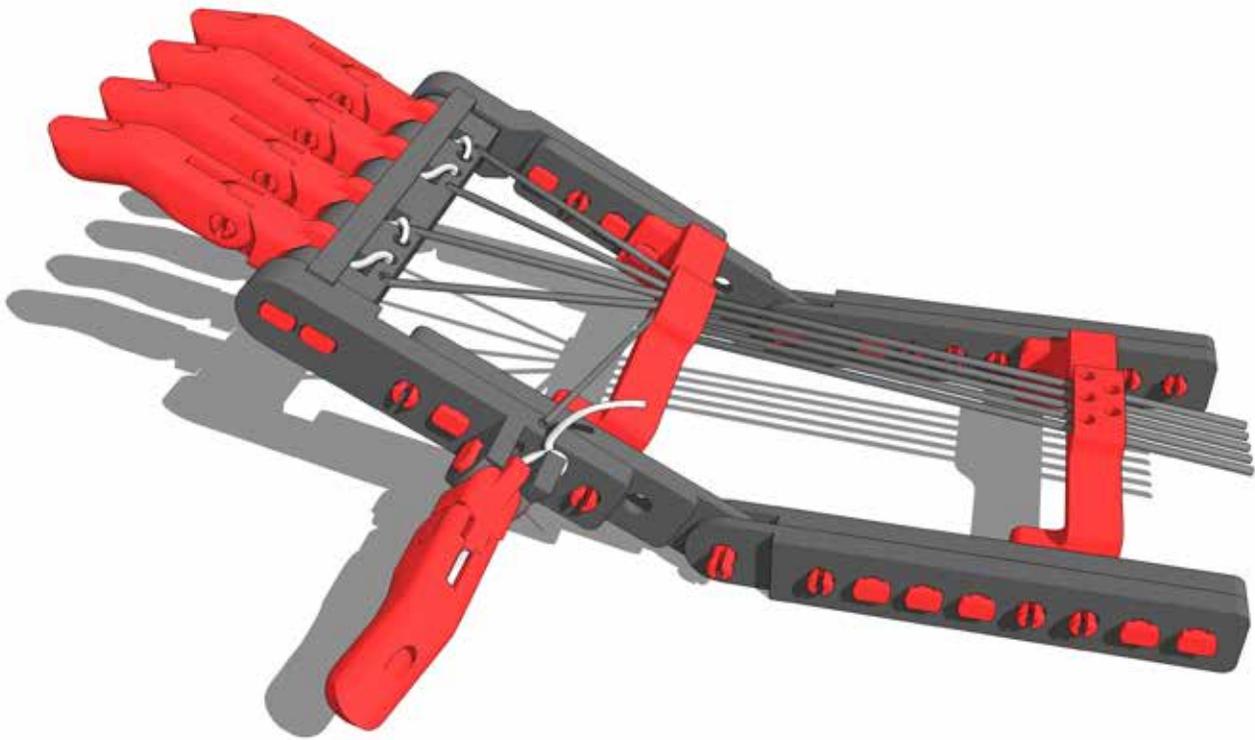
PRINTED PARTS

BEND THE WRIST
Bend the wrist hinge to about a 30 degrees.

THE STRING - STEP 7
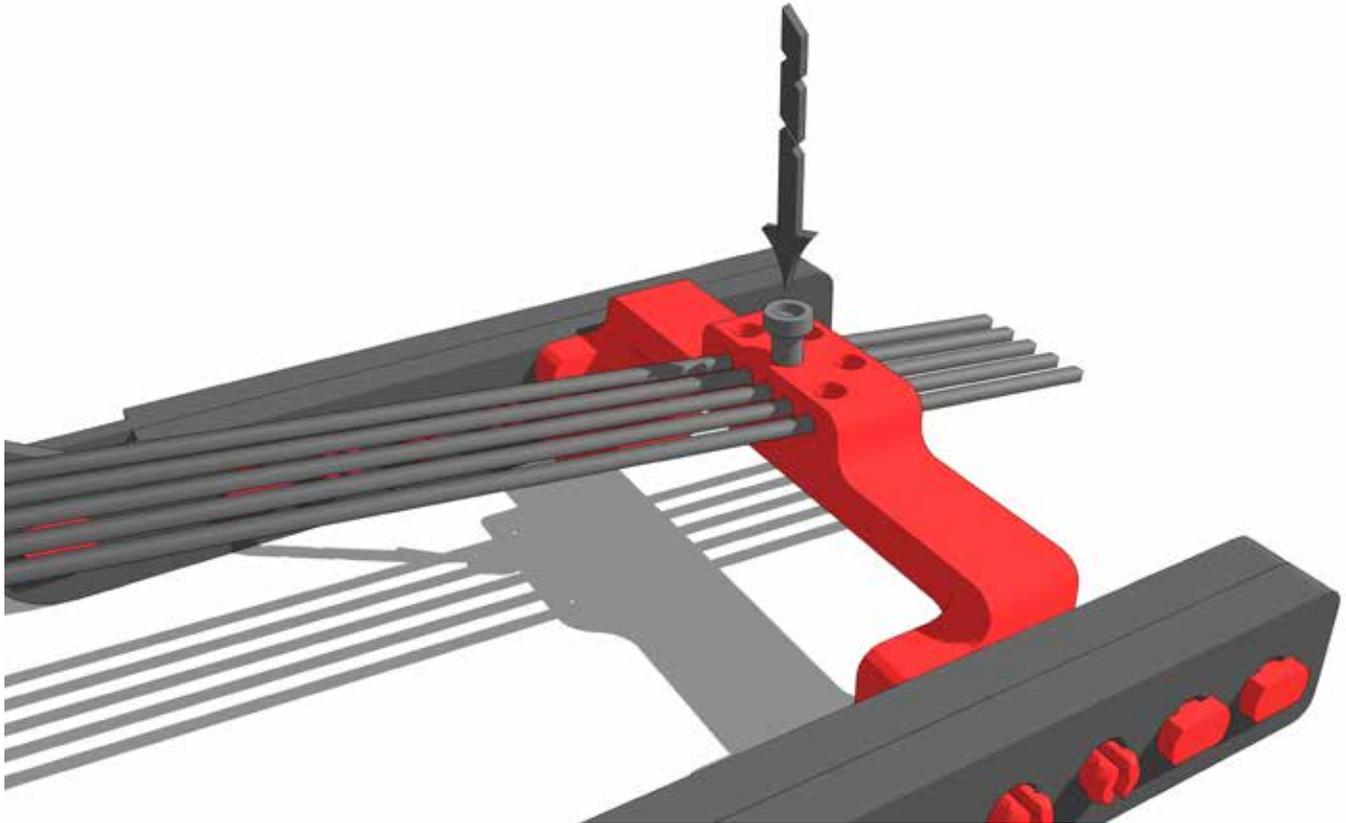
PRINTED PARTS

THE TENSION SCREW

Use a short screw to clamp down on the string. The screw allows you to adjust the tension in each finger, so they all move in unison.

These screws are optional and can be omitted by tying the string to the rear bridge.
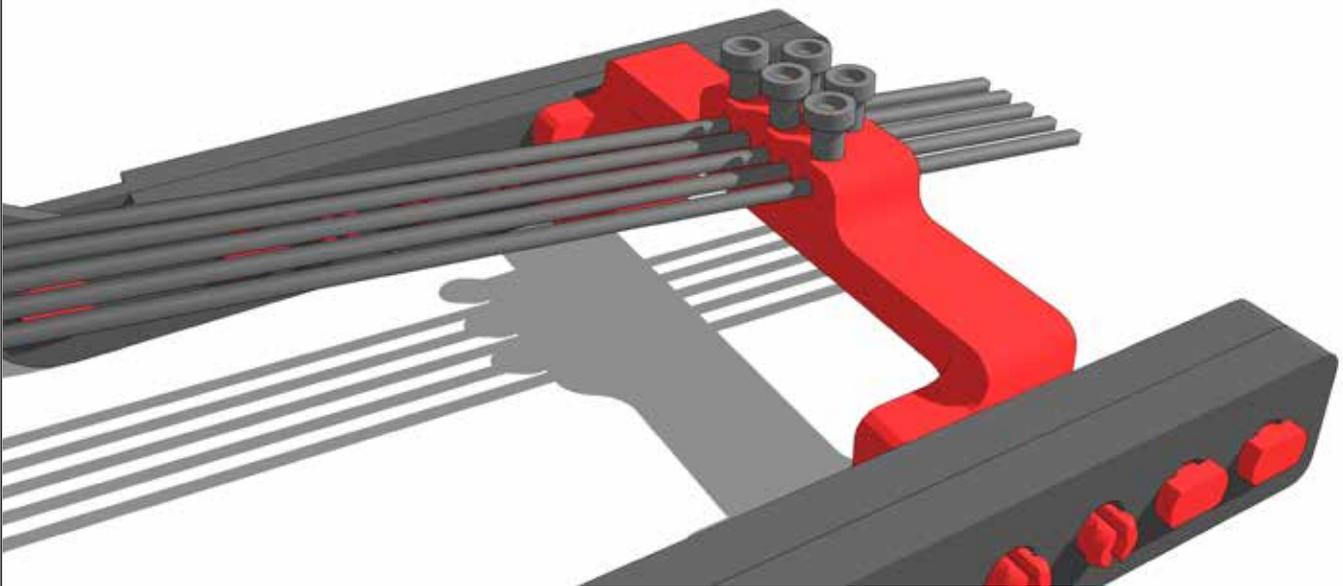
PRINTED PARTS

THE OTHER TENSION SCREW
Use the remaining screws to secure the other four strings.
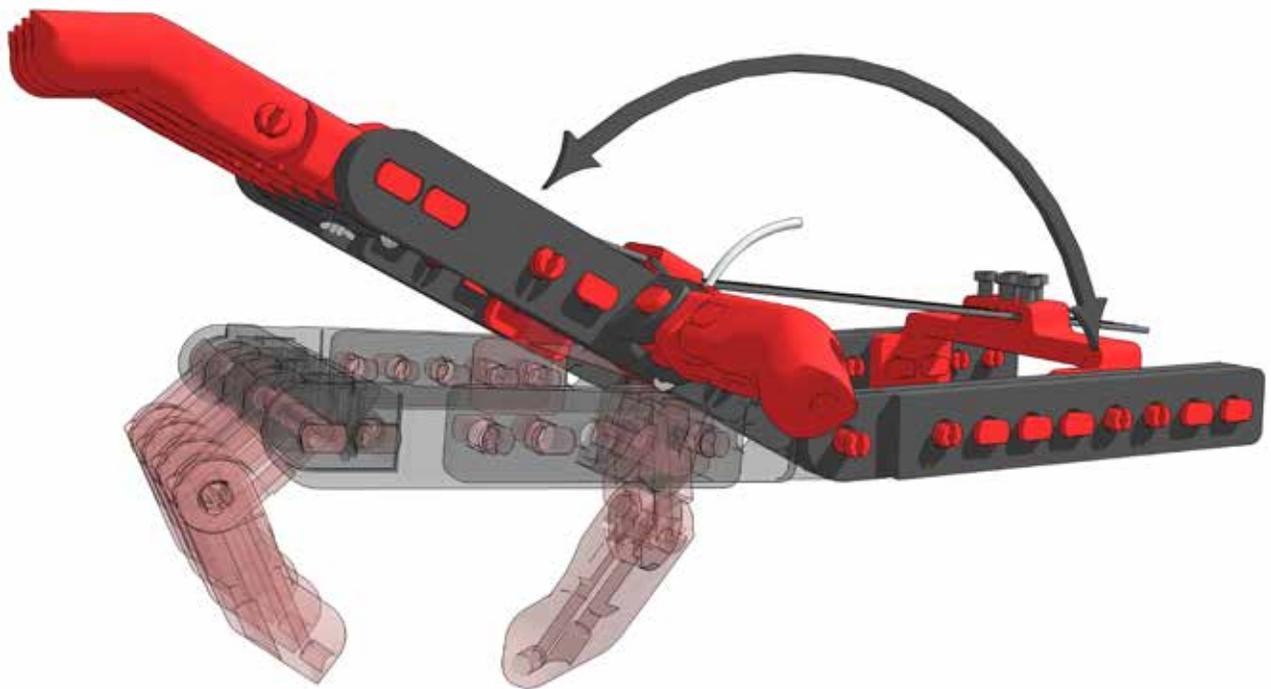
PRINTED PARTS

TESTING

Pushing down on the wrist will cause the fingers to grasp.

Use the screws to adjust the tension so that the fingers close in unison.
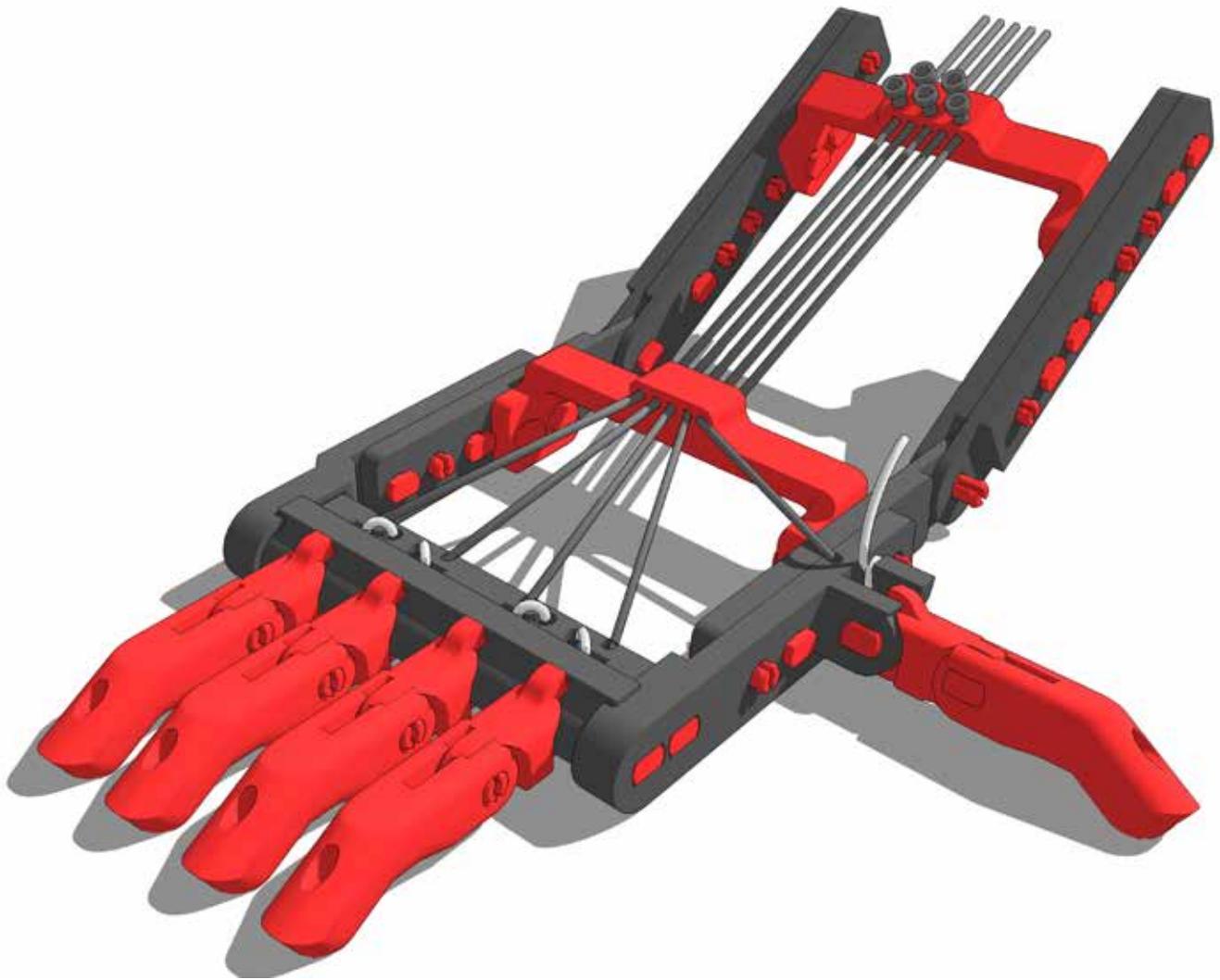
FINISHED

Congratulations, you have successfully built a Snap-Together Robohand.

Robohand is a living open source project, so please share your improvements and modifications by creating a derivative on Thingiverse. Shared insights and ideas will help Robohand continue to develop.