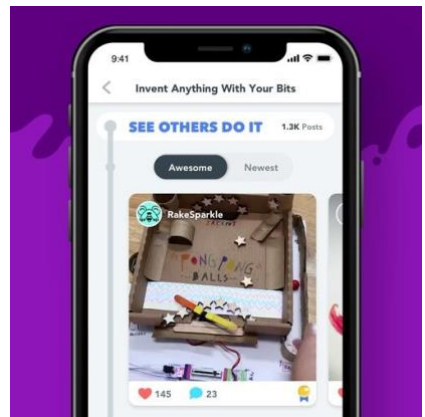


D C I
Design. Create. Invent.
STEM



UCDAVIS
UNIVERSITY OF CALIFORNIA

Generous support provided by The Disney Company.

Student Session Guides

The DCI Stem curriculum is divided into four sections:

1. Intro Sessions
 2. Guided Inventions
 3. Open Challenges
 4. Showcase Challenge
-

Intro Projects

Learn the basics.

PROJECT 1 - Introduction to DCI Stem and littleBits

PROJECT 2 - Introduction to the littleBits Invention Cycle

Guided Inventions

Hone invention skills & start customizing.

PROJECT 3 - The Navigator: Build a handheld device that allows you to navigate in the dark and learn about sensors.

PROJECT 4 - Trash Chomper: Build a garbage eating monster and learn about designing smart objects.

PROJECT 5 - Robo Arm: Create a gripper device that helps you grab stuff and learn about inventing helpful machines.

Open Challenges

Create unique inventions from challenge prompts.

OPTION 1:
ChangeMaker
Challenge

OPTION 2:
ChangeReaction
Challenge

PROJECT 6

Part 1

Part 1

PROJECT 7

Part 2

Part 2

Showcase Challenge

Final challenge & celebration.

PROJECT 8 PROJECT

9

PROJECT 10

Introduction to DCI Stem & littleBits



What is DCI Stem?

Introduction to the DCI Stem Program:

This program is designed for you to explore all sorts of Science, Technology, Engineering and Math (STEM) topics, discover what interests you, and learn to bring your ideas to life through building different inventions.

Let's Get Started!

1. Make sure you have your DCI Stem kit! This kit is made up of electronic building blocks called littleBits that you will use to invent with during the program.
2. Open your kit so all of your pieces are nearby.
3. **Ask your parent** to help you sign up for [DIY.org](https://www.diy.org) (previously JAM.com). You should have received a paper code to access your free subscription.

- On [DIY.org](https://www.diy.org), you will find instructions for inventing with littleBits as well as all sorts of courses and challenges you can participate in to discover your STEM passion.

DCI Stem Program Overview

This program has 12 projects. In each project you will be inventing with littleBits. We want you to walk away with confidence and ideas for what interests you in STEM.

We have some really fun projects for you coming up. Today will be an introduction to littleBits. In upcoming projects, you will also build electronic robot arms, arcade games and more!

Let's dive into learning about littleBits!

Introduction Video to DIY.org:

Watch the video below to learn more about your 1-year DIY.org subscription.

Video Here: <https://youtu.be/Ge1bxhd2zhU>

Introduction to littleBits

Introduction Video to littleBits:

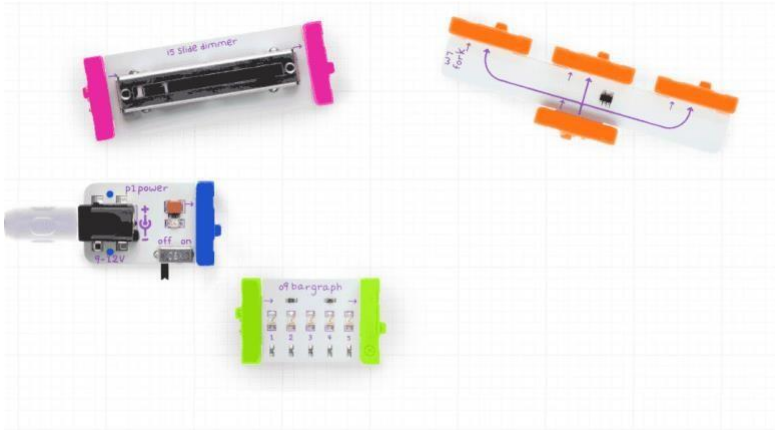
Watch the video below to learn more about your littleBits kit!

littleBits are electronic building blocks that snap together to turn ideas into inventions!

Think about all the ways in which you use and rely on electronics in your everyday life. Do you turn on a lamp to read? Do you ride in a car or on a bus? Do you use the microwave to cook something?

How would your life be different without electronics?

Watch Video Here: [Intro to littleBits Video](#)



Inspire

Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

[LILLIAN GILBRETH AYAH BDEIR](#)

Create

As you work through the mini-projects below, make sure to review all littleBits diagrams to learn how Bits work and how they relate to the real world. You can also find information about each Bit in the [Bit Index](#).

- Complete as many of the 9 mini-challenges as you can!

Watch Intro to littleBits Video Playlist

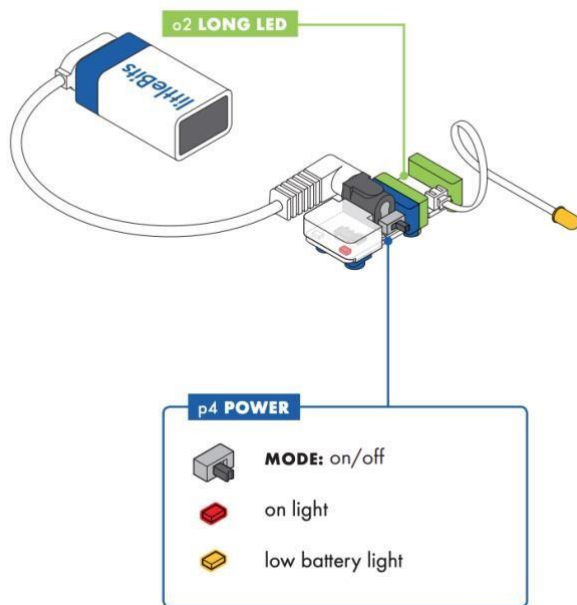
Watch the [video playlist below](#) to learn more about what is in your kit:

1. Inventing
2. Bit Basics
3. Bit Combinations
4. Bit Signals
5. Bit Components

Build a Series Circuit

You are now ready to make a functioning circuit with the Bits.

Build a circuit that will light the long LED. Identify the green Bits as outputs: these are the “doers” of the circuit. (See below)



Think About it:

- What role does the **blue Bit** play in the circuit, and how can you tell that it's powered on?
- What is the role of the **green Bit**?
- Does the order of assembly matter?
- How do you know that the circuit is working?
- How could you stop it from working?

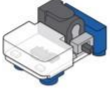
The series circuit is a pathway through which energy can flow in one direction. The circuit has three basic components including:

- power source (*the battery*)
- conductive pathway (*the battery cable and the blue power Bit*)
- output (*the "doer" of the circuit that's using the energy, in this case the RGB LED*)

Review Power Bit and Long LED Bit Index Pages together:

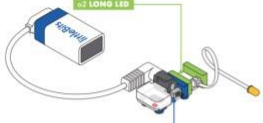
See below to learn about how each of the sample circuits were built using the Power Bit and the Long LED Bit:

p4 POWER



MEET THE BIT
Every circuit starts with power. It provides the electricity that makes your Bits spin, buzz, blink, and shine.


SAMPLE CIRCUIT



HOW IT WORKS
The p4 power Bit converts the 9 volts of electricity in the battery to the 5 volts that littleBits circuits run on.

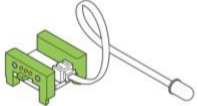
The power Bit also sends a signal through your circuit. Controlling this signal with inputs is how you control your circuit.

REAL WORLD ANALOGIES



PHONE CHARGER

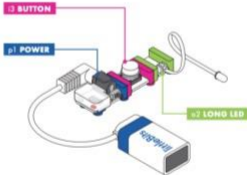
o2 LONG LED



MEET THE BIT
The long LED is a flexible lighting option. We call it the "long" LED because the light is connected to the board by a cable, which lets you put the light in some interesting places.




MINI-CHALLENGE
Can you invent a new wearable accessory using the long LED?

SAMPLE CIRCUIT



HOW IT WORKS
This Bit uses a light-emitting diode (LED) to turn electricity into light. The more signal you send the Bit, the brighter the light shines.

REAL WORLD ANALOGIES

FLASHLIGHT STREET LAMP ANGLERFISH

Make a Connection

When the parts of a circuit are connected correctly, this allows energy to flow from one Bit to the next.

We see this energy as light on the long LED. When you remove one part or change the order of the Bits, you break the flow of energy.

If the parts of a circuit are not connected correctly, then the energy doesn't have a pathway and that's when we see the light go out.



Magnets

Look closely at your circuit.

Flip the direction of the output Bit (so either the Bit is upside down or the name of the Bit is upside down in front of them) and see what happens...*the magnets push back.*

Think About It:

- *What happens when you flip the Bit?*
- *Why do the magnets push back?*
- *How do you know that you are connecting Bits the right way?*

Mini Challenge #1

Build a white reading light using your littleBits that you can use to secretly read books under the covers at night.

Think About It:

- *How can you quickly turn it on and off so you don't get caught?*
- *Did you connect the Bits correctly to create an energy pathway?*
- *Can you name the basic components of the circuit?*
- *Can you provide a simple solution for turning on and off the circuit?*

Switch It Up!

Connect the slide dimmer Bit between the blue power Bit and the green LED.

- Turn the power on and describe what happens.

The pink Bits are inputs: these are the controllers of the circuit. They control how the energy flows through the circuit pathway. The “dimmer” controls the flow of energy.

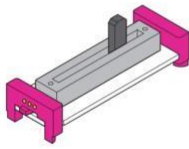
Explore your new circuit. Think about it:

- *What happens when you slide the dimmer?*
- *What is happening to the flow of energy when you slide the dimmer?*
- *What happens when you move the pink slide dimmer to a position after the green LED Bit?*
- *What is the role of the pink Bit?*

Review Slide Dimmer Bit Index Page

See below to learn how the reading light circuit was created using the Slide Dimmer Bit:

15 SLIDE DIMMER



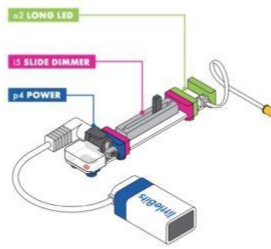
MEET THE BIT

Slide this dimmer back and forth to control your circuit. As you slide it up, more signal goes to the Bits that follow, brightening lights, speeding up motors, and raising the volume on buzzers.

MINI-CHALLENGE

Can you invent something with the slide dimmer that waves a flag back and forth? How could you change the speed it waves?

SAMPLE CIRCUIT



HOW IT WORKS

When the slider is all the way to the left, it's sending an off or 0 volt signal. When the slider is all the way to the right, it's sending an on or 5 volt signal. The slider can be positioned to send any signal between 0 and 5 volts.

REAL WORLD ANALOGIES



HOUSEHOLD DIMMER SWITCH



CAR PEDAL

MINI CHALLENGE #2

How could you change the brightness and use it as a dim nightlight when it's time to go to sleep?

Hint: Use the slide dimmer to control the brightness of the LED.

Think About It:

- Did you identify and connect the slide dimmer Bit?
- Did you arrange the Bits in the correct order?
- Can you explain why you connected the Bits in that order?
- Do you know how the input Bit is controlling the flow of energy through the circuit?

Next, you will continue to build on their inventions by adding additional Bits into the mix!



MINI CHALLENGE #3

Let's change it up! How could you remix your circuit to create a fire engine siren that makes a noise and lights up?

Hint: Think about how each input Bit controls the flow of energy.

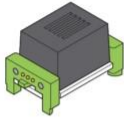
Think About It:

- *Which input would work best for a siren?*
- *Are you remixing the circuit with the slide dimmer and buzzer Bits?*
- *Can you explain why the order of the Bits is important?*

Review Buzzer Bit Index Page:

See below the to learn how the fire engine siren circuit was created using the Buzzer Bit:

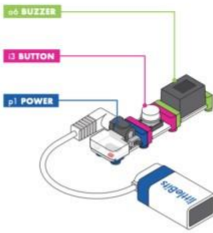
BUZZER



MEET THE BIT
The buzzer makes a sound no one can ignore. It's great at sounding the alarm or annoying those nearby.


MINI-CHALLENGE
Can you invent a way to communicate with your friends using the buzzer?

SAMPLE CIRCUIT



HOW IT WORKS
The buzzer converts the electrical signal it receives into a vibration, which creates a buzzing sound. The higher the signal it receives, the more intense the vibration, and the louder the sound is.

REAL WORLD ANALOGIES



DOORBELL CAR ALARM WASHING MACHINE

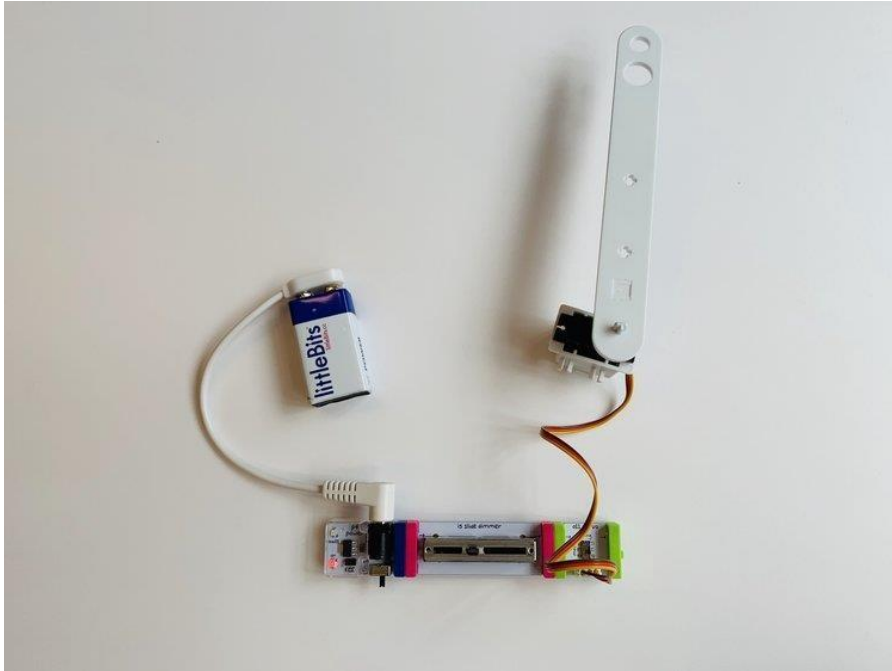
Motion & Modes MINI CHALLENGE #4

Build a musical metronome that can play a beat to help a musician keep time.

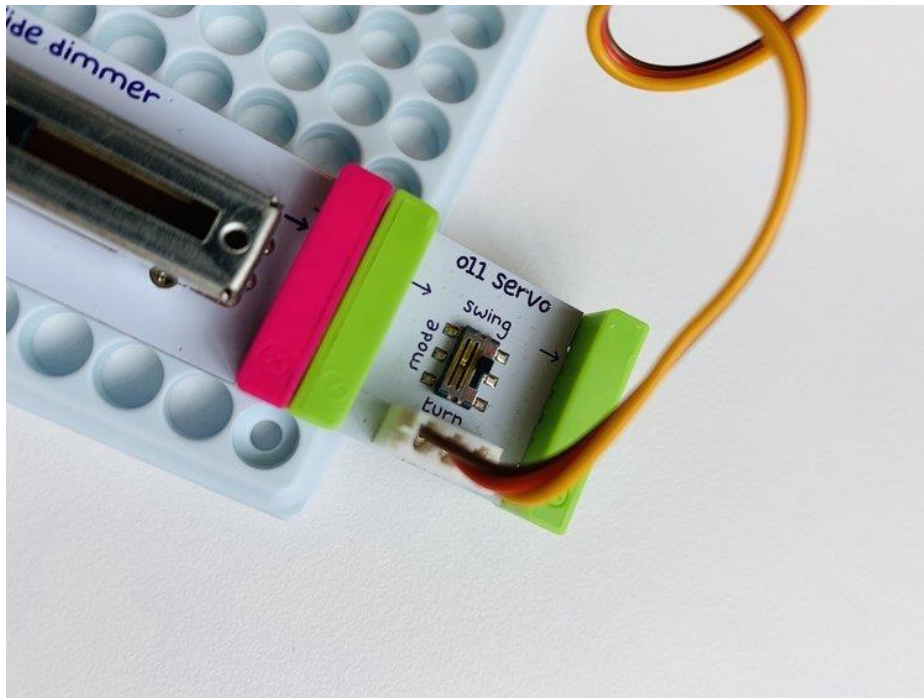
A *Metronome* is a mechanical or electrical instrument that makes repeated clicking sounds at an adjustable pace. This video provides an example: <https://bit.ly/2UDICSG>.

To make the *Metronome* you will need to use the Servo Bit. Find the piece labeled **Servo** in your kit.

- Attach the mechanical arm and use the servo mount to press the servo into a mounting board. ◦ Hint: Make sure the Servo Bit being used is in SWING mode (flip the tiny black switch).
- Place an object (for example, a water bottle or glass mug) in the pathway of the servo that plays a noise each time the arm strikes it.



Attach mechanical arm to Servo Bit



Make sure Servo Bit is set to SWING mode (flip the tiny black switch)

Think About It:

- *Is the circuit assembled in a way that it keeps a steady beat?*

Review Servo Bit Index Page:

See below to learn how the metronome invention circuit was created using the Servo Bit:

MEET THE BIT

The servo is a motor that can swing back and forth or be turned to a specific position.

There are a few accessories you can use with the servo (like the mechanical arm). You can find out how to use those on page 26.

MINI-CHALLENGE

Can you invent something that uses the servo to clean up your desk?

SAMPLE CIRCUIT

IS SLIDE DIMMER

5V POWER

01: SERVO

MODE: turn or swing

Feet for attaching to mounting boards or shoes

HOW IT WORKS

The servo has two modes. In **TURN** mode, the input from other Bits determines the position of the hub - try using a dimmer to set the angle you want. In **SWING** mode, the servo will move back and forth on its own like a pair of windshield wipers - the input signal controls the speed of the swing.

The servo's range of motion is about 180 degrees.

The servo motor is contained within a servo bucket. Simply press the plastic feet into a mounting board for extra stability.

REAL WORLD ANALOGIES

TRUCK CRANE

WINDSHIELD WIPERS

ROBOT

MINI CHALLENGE #5

Improve your musical metronome circuit from Mini-Challenge 4. **How could you change the beat to be faster or slower to keep time with your favorite song?**

Play music or sing along to the beat.

Think About It:

Hint: Use the slide dimmer to control the speed of the swing.

What happens when you switch the servo to TURN mode?

- *Can you correctly identify and connect the slide dimmer Bit?*
 - *Can you switch the servo to SWING mode?*
 - *Can you arrange the Bits in the correct order?*
 - *Can you explain why the connected Bits are in that order?*
 - *Can you explain the function of the input Bit in controlling the flow of energy through the circuit?*
-

MINI CHALLENGE #6

Let's change it up! **Can you invent something with the Servo to help clean your desk?**

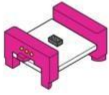
- *Are you using multiple input and output Bits on the same circuit?*
 - *Can you explain why the order of the Bits is important?*
-

Sensors & Logic

Review Proximity Sensor Bit Index Page:

See below to learn how the sample circuit was created using the Proximity Sensor Bit:

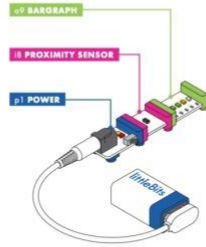
18 PROXIMITY SENSOR



MEET THE BIT

This Bit beams an infrared light that allows it to sense objects in front of it.

SAMPLE CIRCUIT



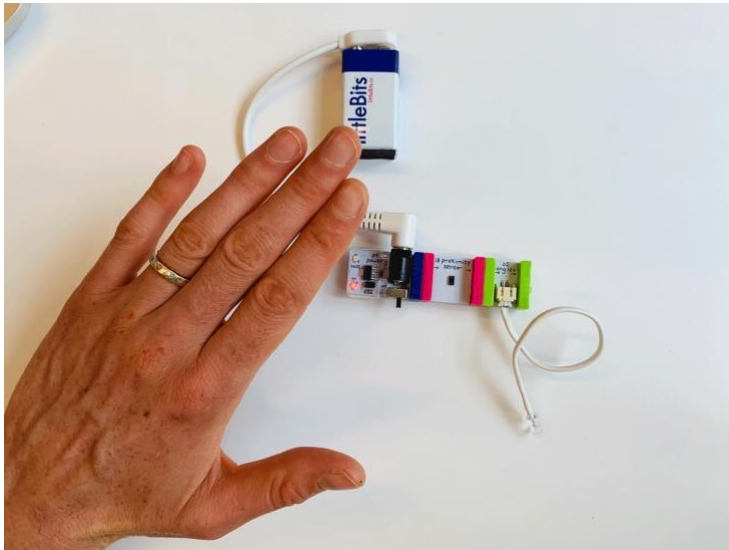
HOW IT WORKS

The proximity sensor is like a pair of eyes for your circuit. It detects objects by using an infrared beam to sense what's in front of it. As the object gets closer to the proximity sensor, more signal will pass to the following Bits in the circuit.

REAL WORLD ANALOGIES



BAT VISION



MINI CHALLENGE #7

Imagine that you work for an electronics company that is tasked with building the technology for a smart house.

Our client has several ideas that they'd like us to prototype. (Hint: Prototype means to test or try out a few ideas).

Create an intruder alarm that sounds when someone is close by.

Think About It:

- Can you hear the buzzer when you move your hand over the top of the proximity sensor?
- What happens if you trade out the proximity sensor for the sound trigger?
- Try clapping your hands over the sound trigger and move the sensitivity slider back and forth to see what happens. How soft can the noise be to set off the alarm?

Review Sound Trigger Bit Index Page:

See below to learn how the sample circuit was created using the Sound Trigger Bit:

120 SOUND TRIGGER

MEET THE BIT
Use this Bit to control your circuits with sound. It's a great way to make your inventions hands-free!

MINI-CHALLENGE
Can you invent something that moves at the snap of your fingers?

SAMPLE CIRCUIT

HOW IT WORKS
The sound trigger has a microphone that measures how much noise is around it. When the noise goes above a certain level, the sound trigger will send out an on or 5 volt signal to the following Bits in the circuit. Use the adjustment slider to set the sensitivity (how much noise is needed to trigger your Bit).

REAL WORLD ANALOGIES

CLAP ON LIGHT HUMAN EAR BEAR IN HIBERNATION

MINI CHALLENGE #8

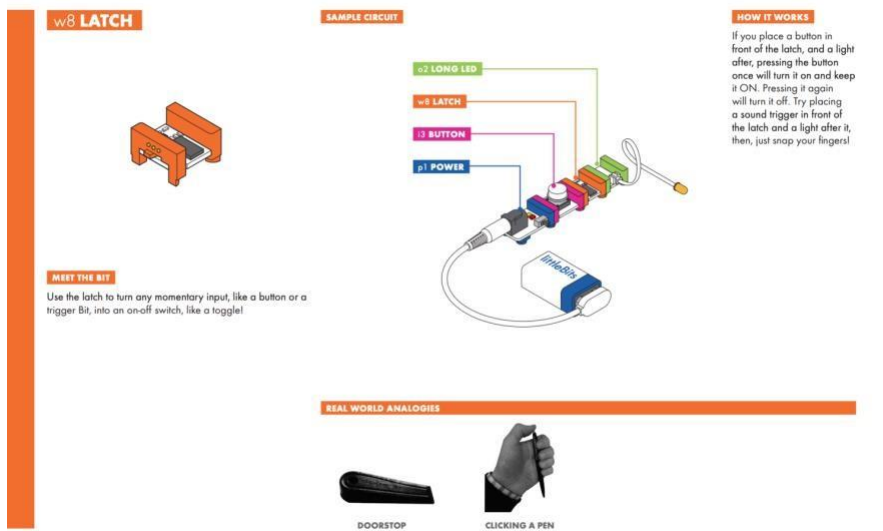
The client also wants a lighting system that turns on when someone makes noise.

Think About It:

- Where can you add the Long LED to your alarm so it lights up when you make a noise?
- Can you arrange the Bits in the correct order?

Review Latch Bit Index Page:

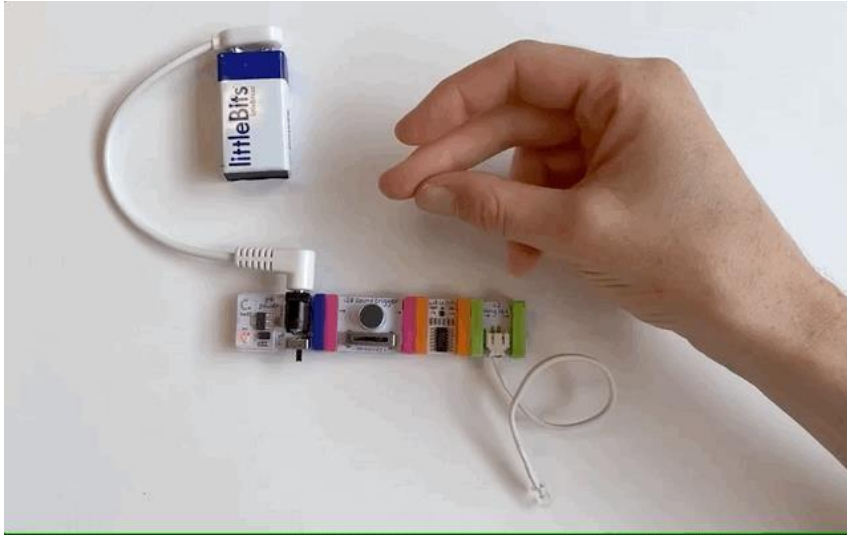
See below to learn how the sample circuit was created using the Latch Bit:



MINI CHALLENGE #9

Now, the client wants a little more control over the lighting system. **Modify your automatic light to stay on or stay off.**

Hint: Make sure you insert the Latch Bit. The picture below is there to help you!



Resources

Inspirational Links:

[TED Talk: Building Blocks that Blink and Teach - Ayah Bdeir](#)
[littleBits Brings STEAM to Life](#)

[Welcome to littleBits](#)

Helpful Links:

[DCI Stem STEM Kit Overview](#)

[DCI Stem STEM Kit Bit Index](#)

[littleBits Basics](#) [littleBits Troubleshooting](#)

Introduction to the littleBits Invention Cycle

There are four stages to the littleBits Invention Cycle:

1. **CREATE** is where you brainstorm ideas, explore Bits, and create a first model or prototype.
2. **PLAY** is where you test your invention. As you play, you identify what's working well and come up with improvements or changes along the way.
3. **REMIX** is when you change up your design, you re-make your invention, and you change one or more things about it.
4. **SHARE** is an essential part of the invention cycle. You can share with classmates, friends, your family, or other inventors.

Let's put the Invention Cycle into practice through building inventions that move. You will start off by building a tail wagging creature. Then you will make an electronic trick candle and also a moving invention of your own!

As you work through the session, make sure to review all Bit diagrams to learn how Bits work and how they relate to the real world. You can also find information about each Bit in the [DCI Stem](#).

Inspire

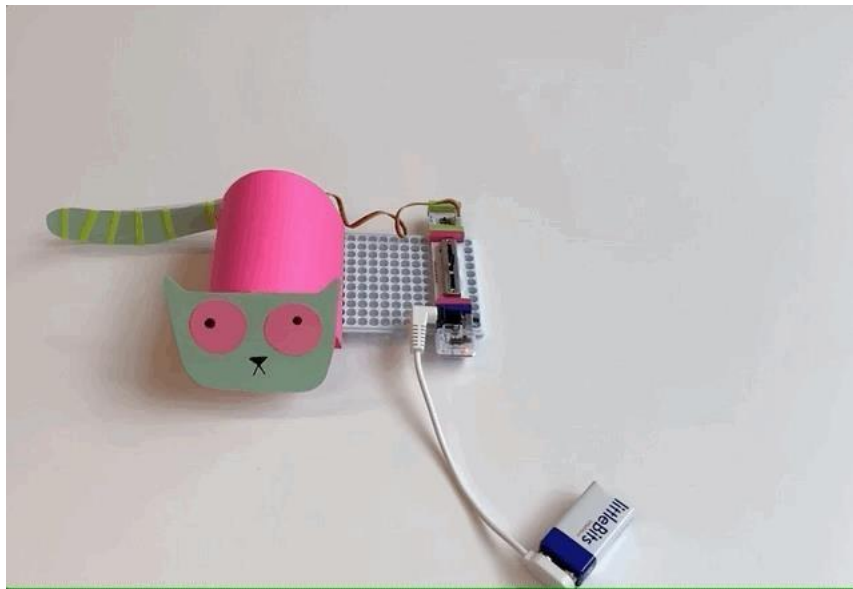
Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

Invent: Tail Wagging Creature

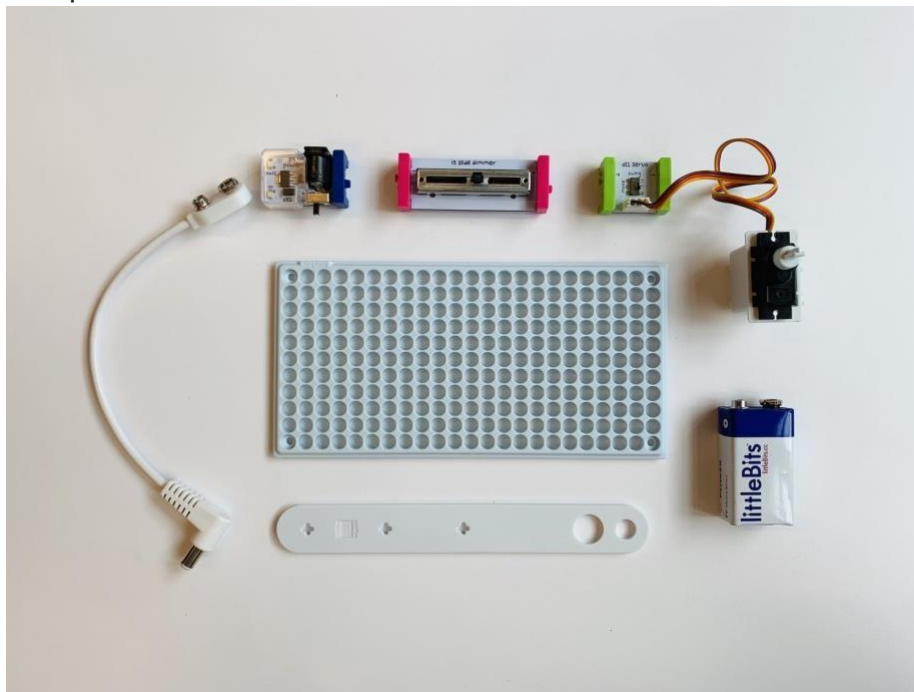


Tail Wagging Creature

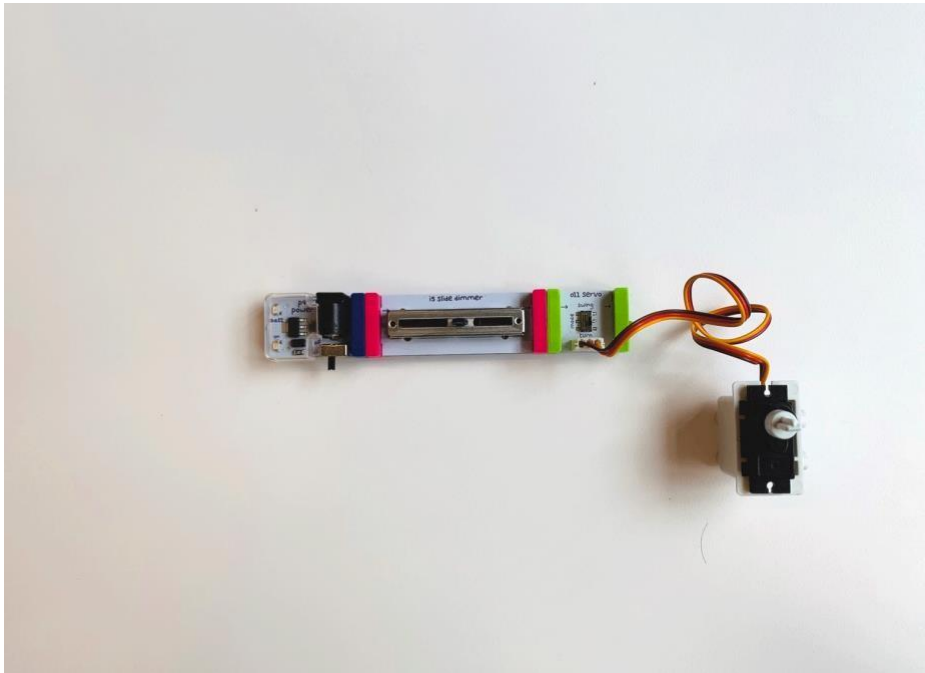
Create a cute animal friend that automatically wags its tail!

CREATE: Follow these step by step instructions to create your first prototype of your creature.

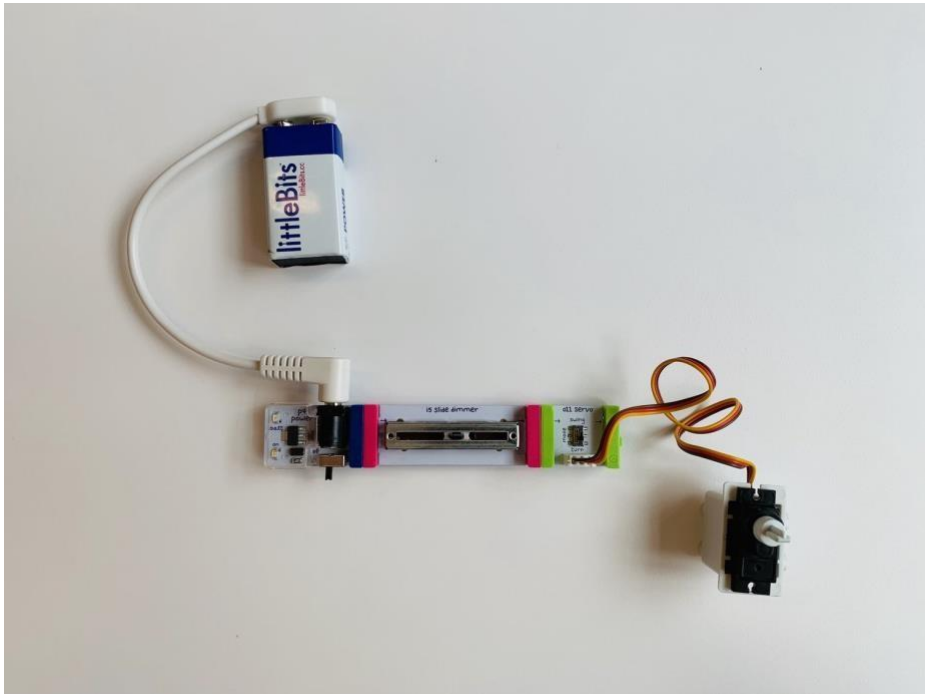
Step 1: Gather these Bits and Accessories.



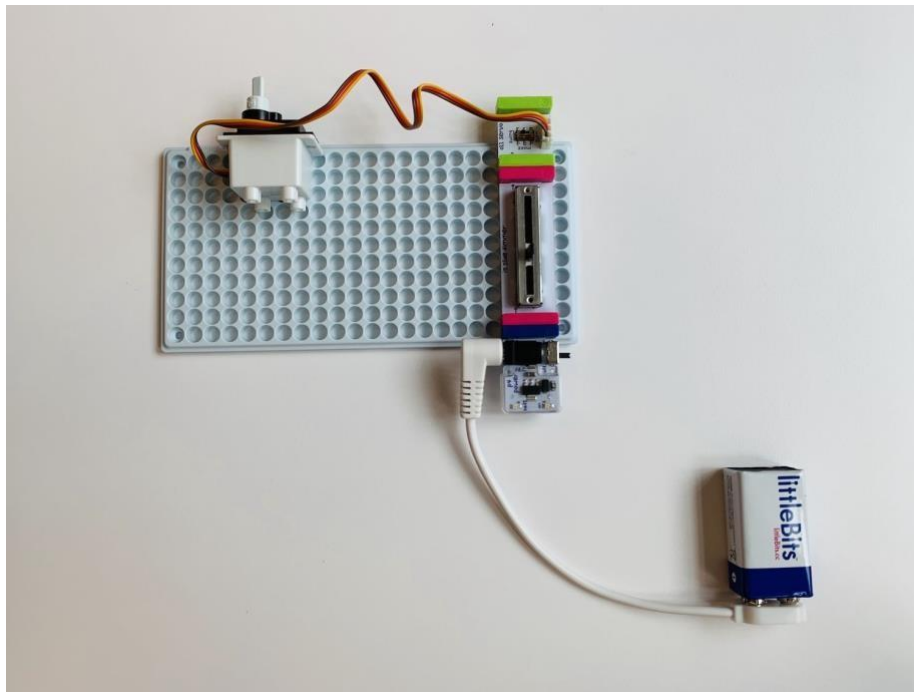
Step 2: Snap these Bits together



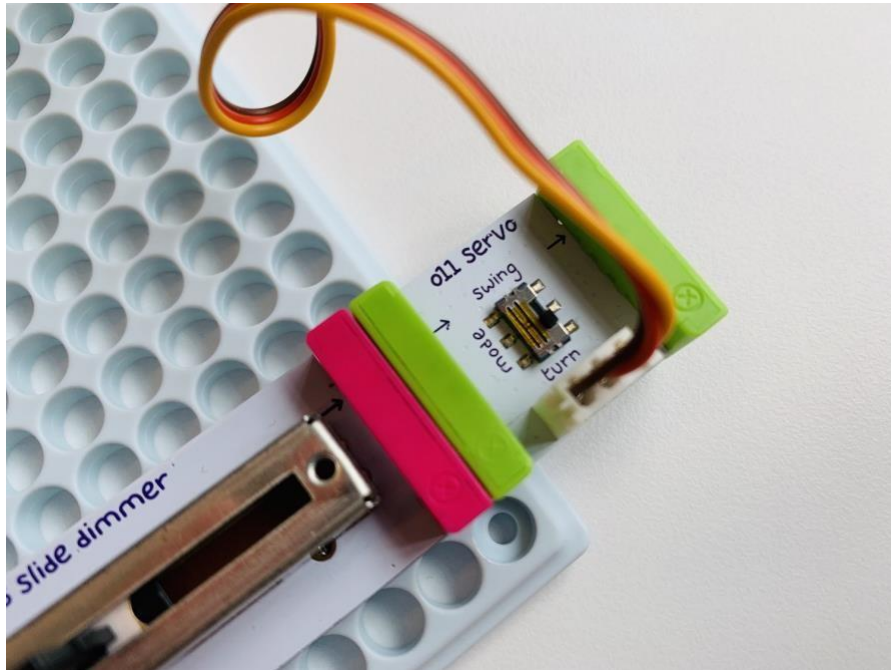
Step 3: Connect the battery and power it on



Step 4: Press the circuit onto the mounting board

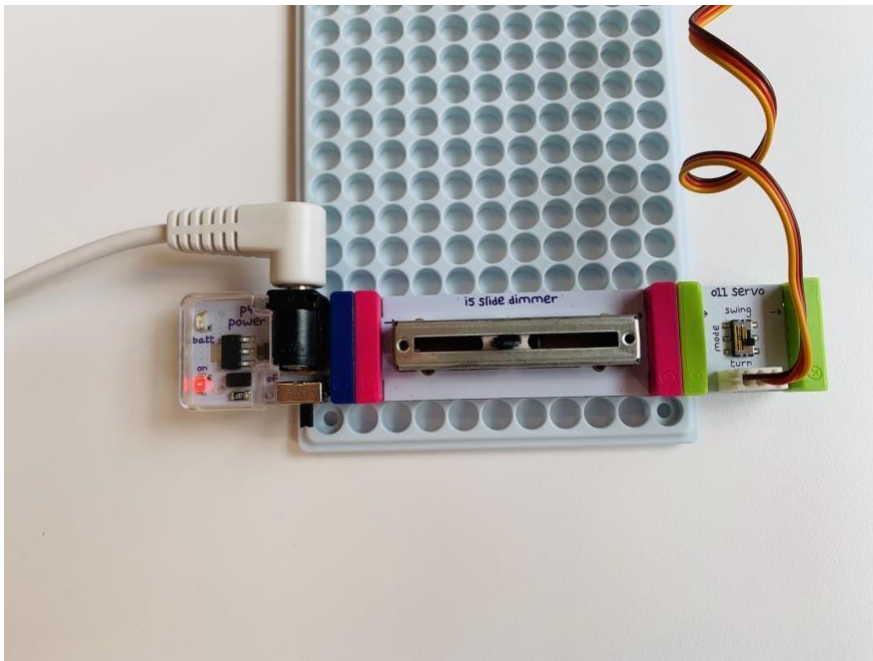


Step 5: Set the Servo Bit to TURN Mode

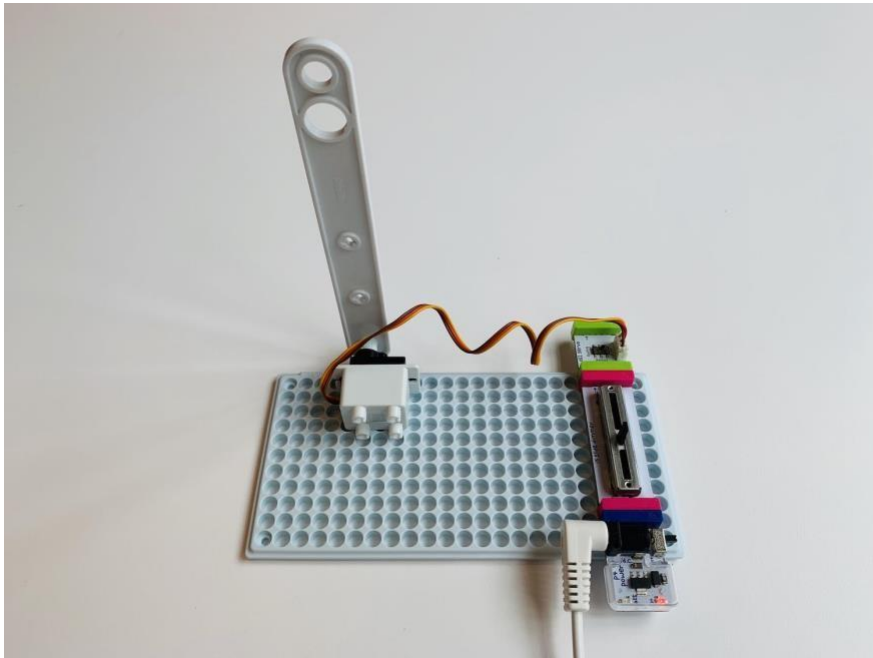


Step 6: Set the Slide Dimmer Bit to the middle position

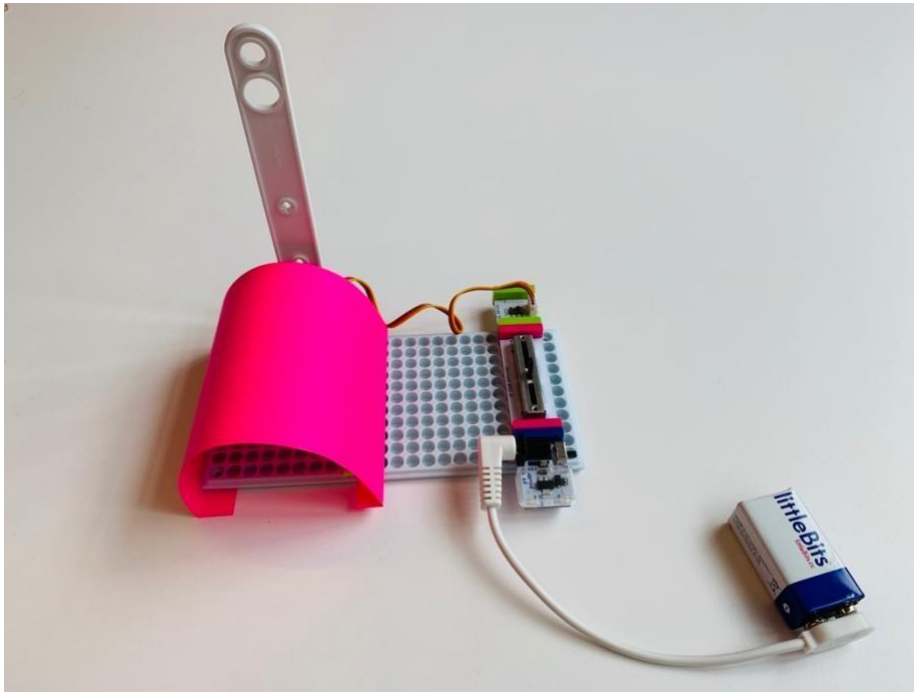
This will position the servo at the best angle for attaching the mechanical arm in the next step.



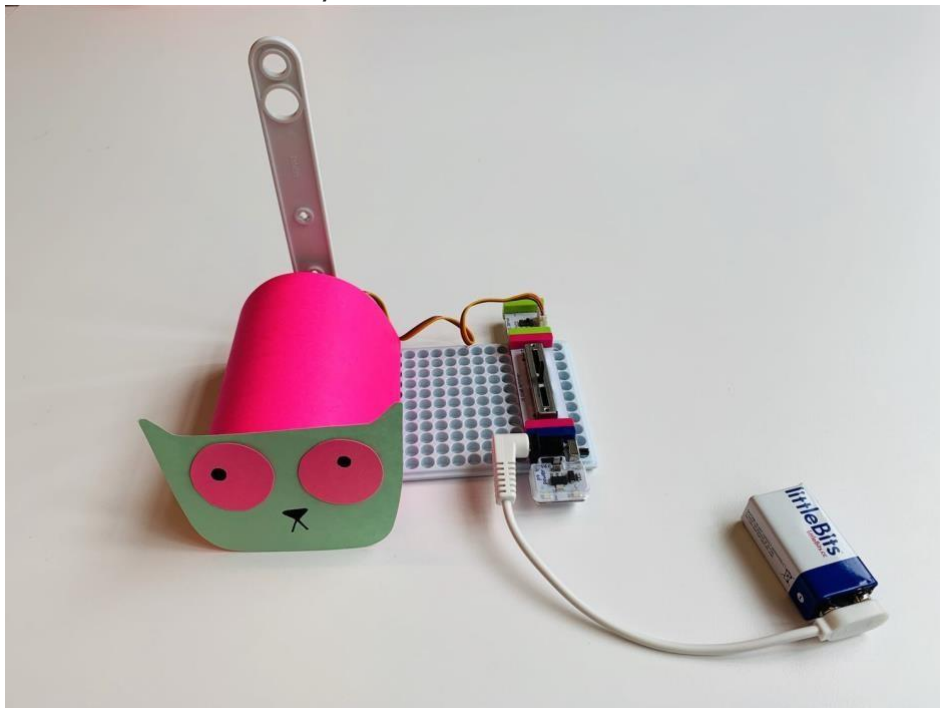
Step 7: Press the mechanical arm onto the Servo Bit



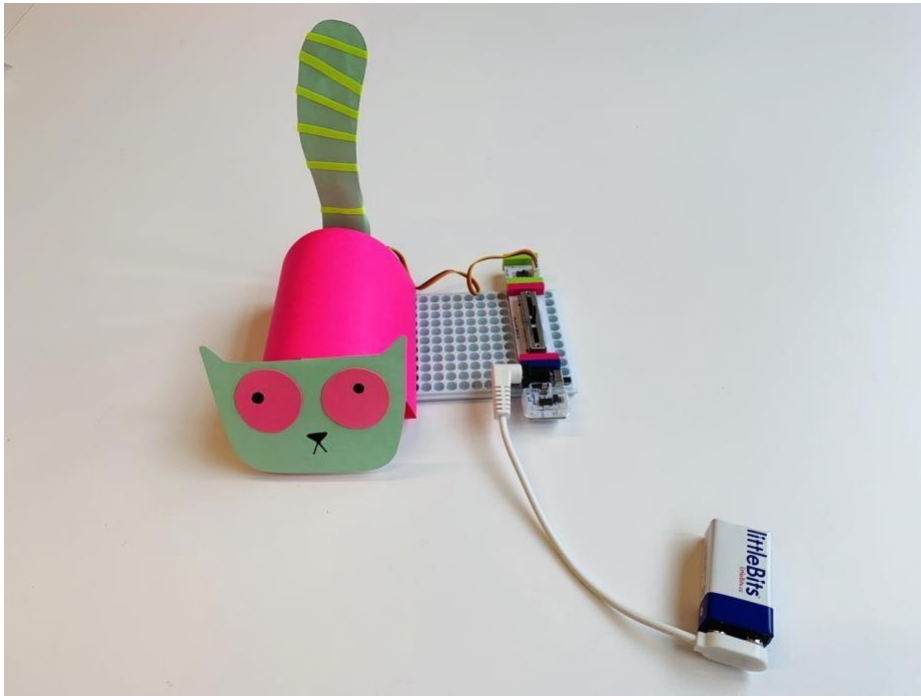
Step 8: Create a body for your creature by cutting out a rectangular piece of construction paper and attaching it to the mounting board with tape



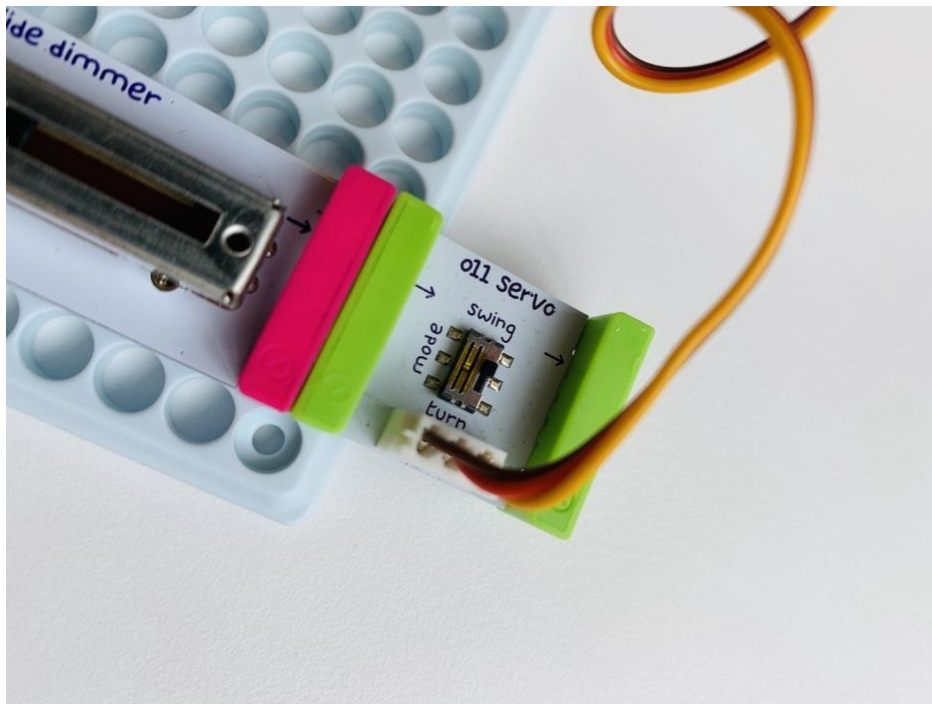
Step 9: Create a face for your creature and tape it onto the front of the body



Step 10: Create a tail and tape it onto the mechanical arm



Step 11: Set the Servo Bit to Swing Mode



PLAY: Try out your invention!

- To use your invention, power on the circuit. Adjusting the slider on the dimmer will change the tail's speed.

- What other things in the world that have a similar function to the servo's motion?
 - Ex: Metronome
-

REMIX: Update or Improve your Prototype

How can you use Bits and craft materials to improve or customize your invention?

How are some ideas:

- Add an additional output to your circuit. ◦ *How does this change what your creature does?*
 - Swap out the slide dimmer for another input Bit. ◦ *How does it change the way your creature interacts?*
 - How can you modify the look of your creature?
 - *Can you transform it from one animal to another using paper or stickers?*
-

SHARE: Share your invention with friends or family!

Here are some ideas how you can share about your invention:

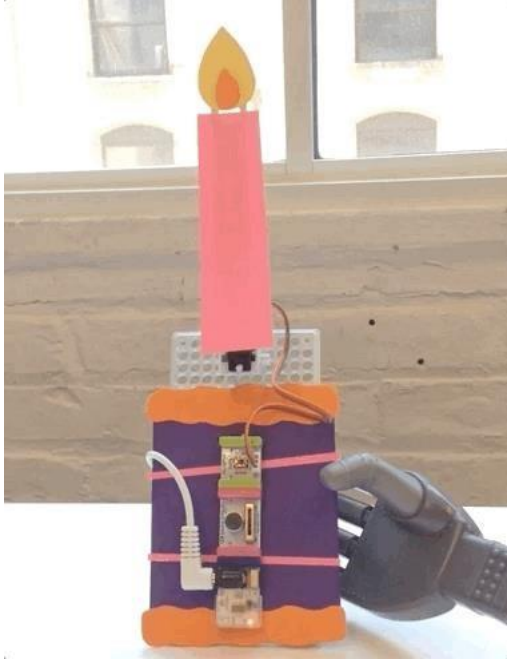
- Create a story about your creature.
- Talk about the updates or unique features you added to the original prototype and why you decided to make these changes.
- Snap photos of your final invention and send to your site coordinator!

Congratulations! You just completed your first Invention Cycle!
Let's try it again with a new invention.

Invent: Trick Candle

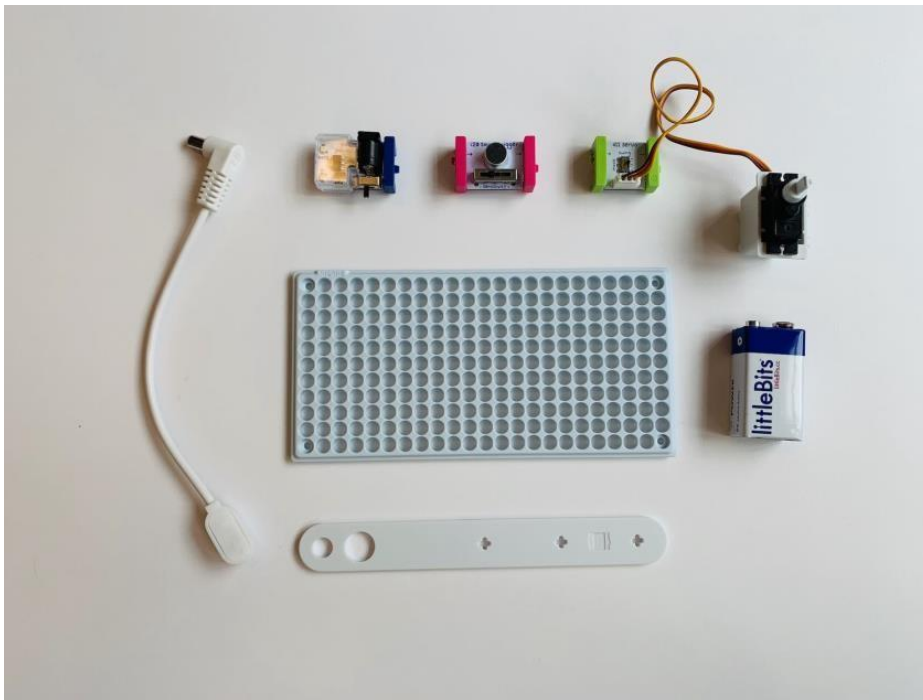
Trick Candle

This candle flips down when you blow on it, then back up. Use it to trick your friends!

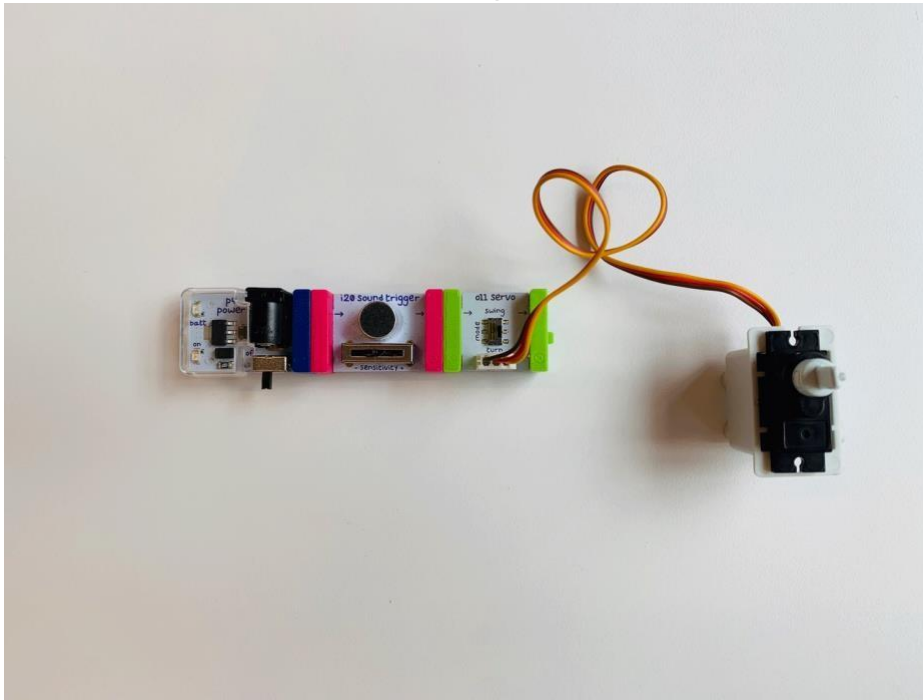


CREATE: Follow these step by step instructions to create your prototype of your Trick Candle.

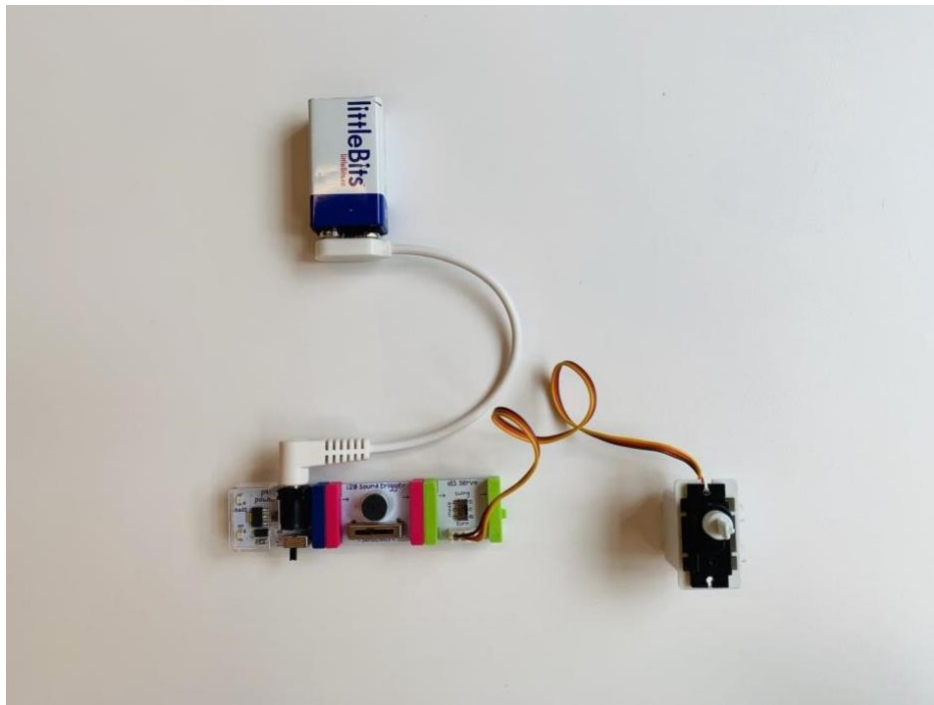
Step 1: Gather these Bits and Accessories



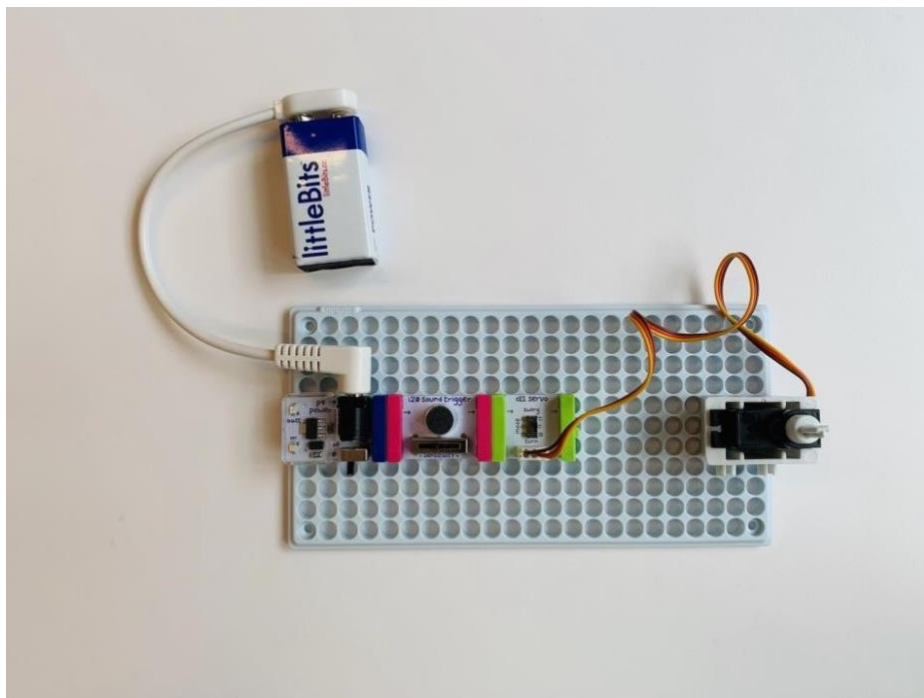
Step 2: Snap these Bits together



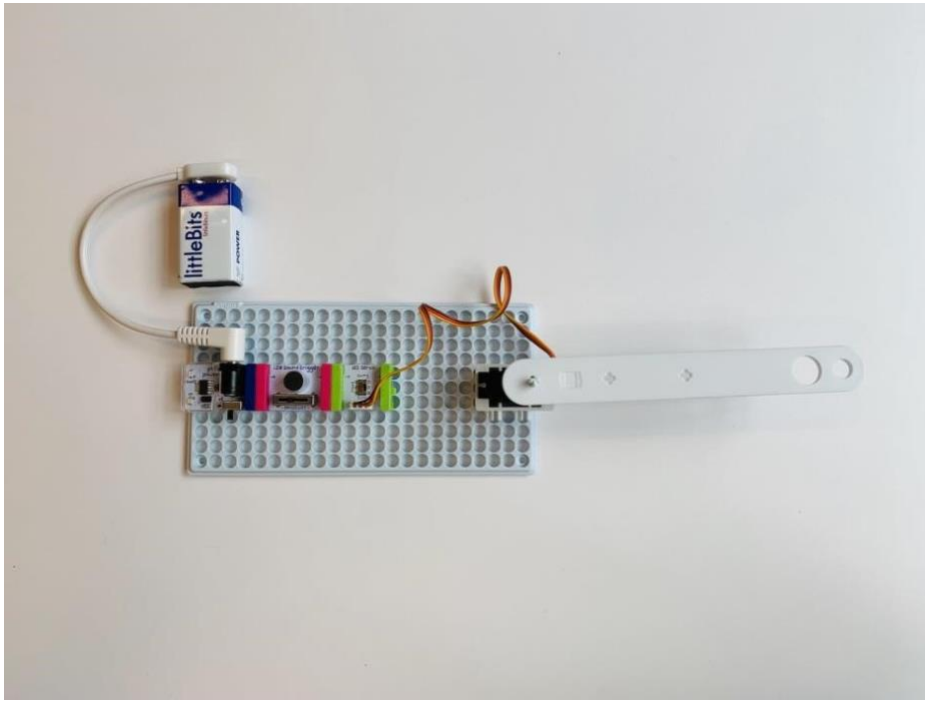
Step 3: Connect the battery and power it on



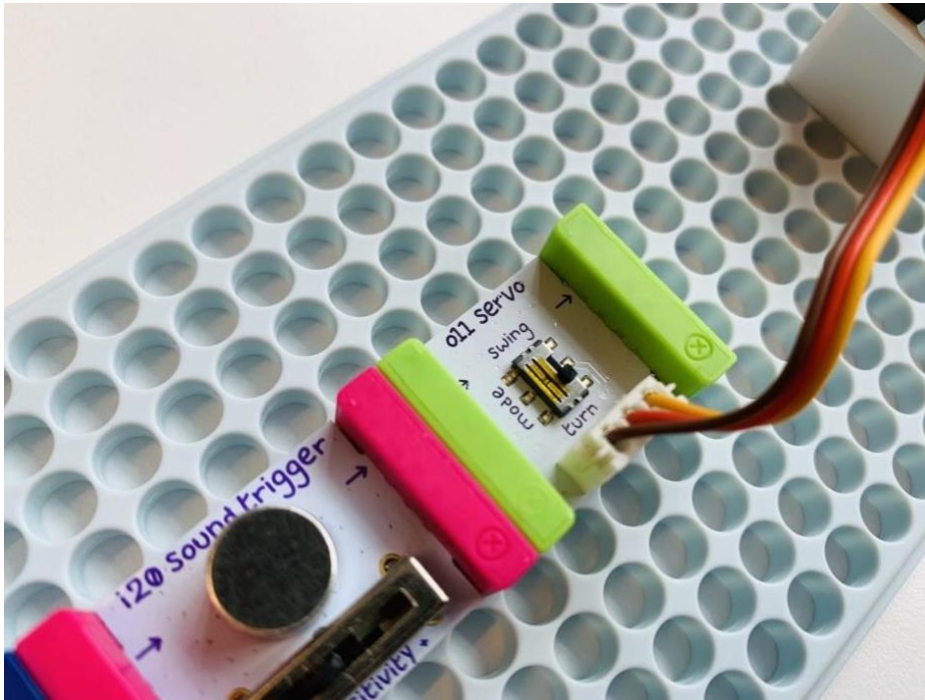
Step 4: Press the circuit onto the mounting board



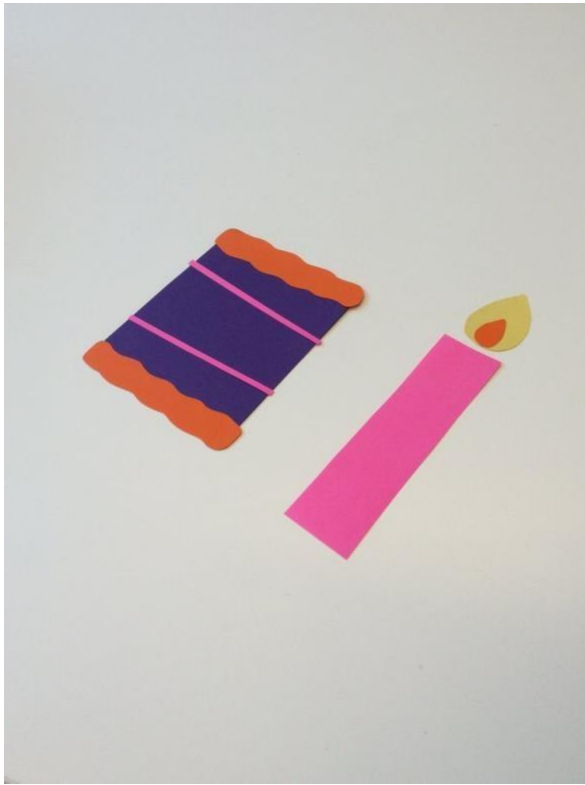
Step 5: Press the mechanical arm onto the Servo Bit



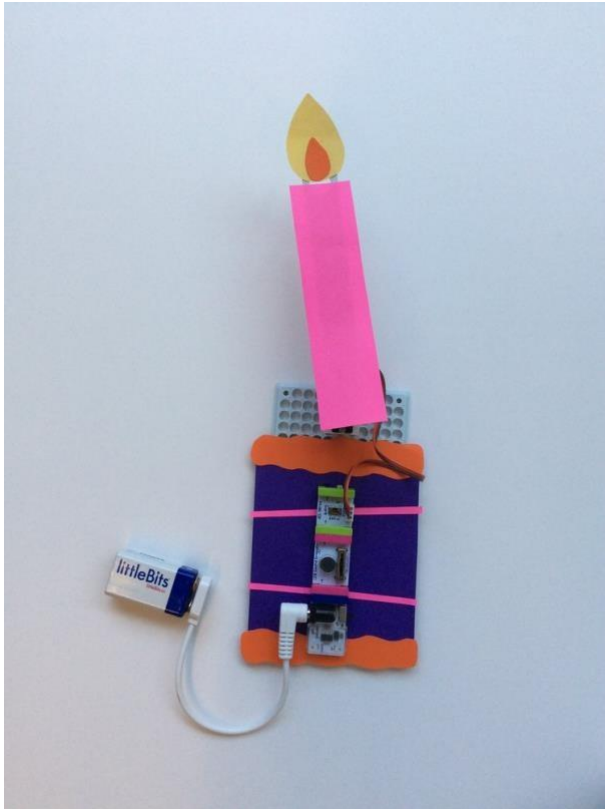
Step 6: Make sure the Servo Bit is in Turn Mode



Step 7: Make your candle and cake



Step 8: Attach your craft materials to your circuit with tape



out your invention!

PLAY: Try

- Power on your circuit and blow on the sound trigger!
 - The servo should flip down and back up.
 - Adjust your mechanical arm and the sensitivity on the sound trigger until your invention works how you want.
-

REMIX: Update or Improve your Prototype

How can you use Bits and craft materials to improve or customize your invention?

Here are some ideas:

- Add outputs.
 - You can try adding sound or light. What Bits can help make the celebration more fun?
 - Decorate your cake!
 - Use paper and stickers to make it unique.
-

SHARE: Share your invention with friends or family!

Here are some ideas how you can share about your invention:

- Talk about the updates or unique features you added to the original prototype and why you decided to make these changes.
- Snap photos of your final invention and send to your site coordinator!

CONGRATULATIONS, YOU HAVE COMPLETED YOUR PROJECT!

Resources

Tips + Tricks:

[littleBits Basics](#) [littleBits Troubleshooting](#)

[Servo Modes](#)

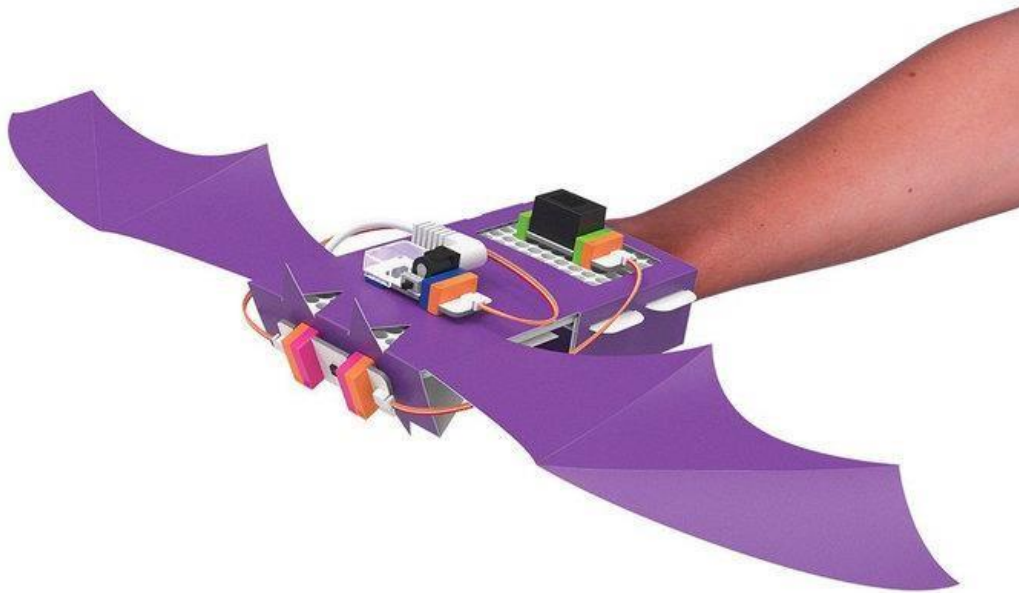
Helpful Links:

[DCI Stem STEM Kit Overview](#)

[DCI Stem STEM Kit Bit Index](#)

The Navigator

Build a handheld device that allows you to navigate in the dark!



As you work through the session, make sure to review all Bit diagrams to learn how Bits work and how they relate to the real world. You can also find information about each Bit in the [DCI Stem](#).

Inspire

Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

[KATHERINE JOHNSON DR. JEDIDAH ISLER](#)

INSPIRATIONAL INVENTION VIDEO OF THE DAY

Kid Inventor Anahit invented echolocation device for detecting obstacles in low/no visibility conditions and for blind people.

Watch Video here: <https://youtu.be/uOI7hxzVKVo>

Create

The Navigator

Build a handheld device that allows you to navigate in the dark.

Watch the video playlist below to learn how to build the Navigator:

https://youtu.be/yPQpZPIO2s0?list=PLr9Bpv_A0ChenOgHWB5-IliVMwCBjHhu1

1. Intro to Wearables
2. Create Navigator

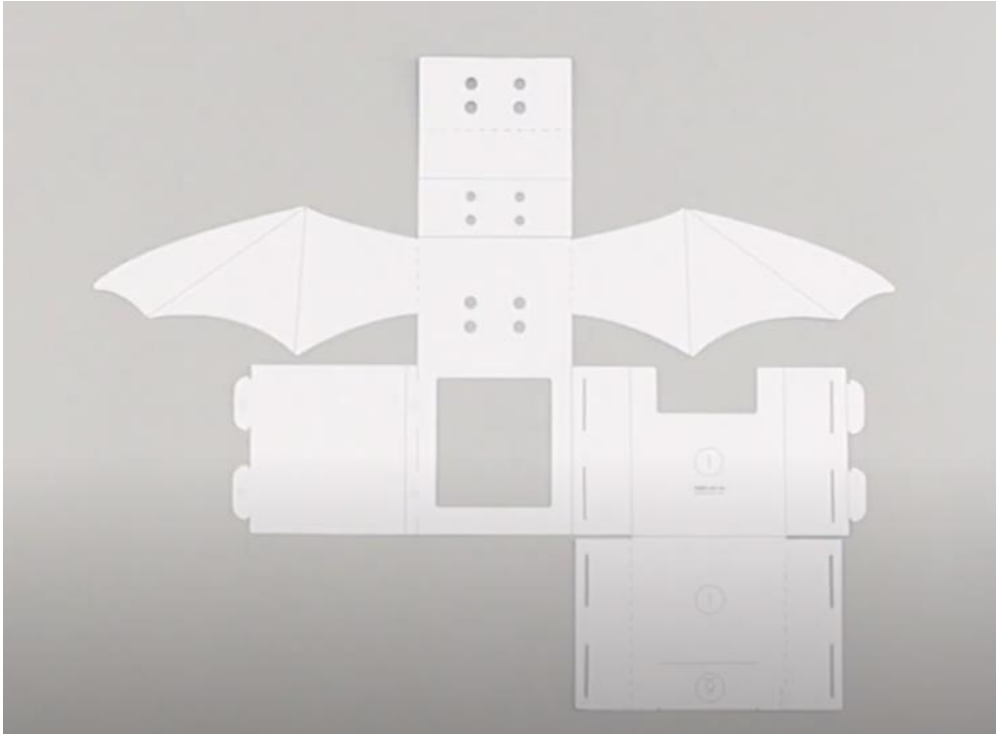
CREATE: View the following photo slideshow on how to build your Navigator invention.

1. Building your Template
2. Building your Circuit
3. Building your Invention

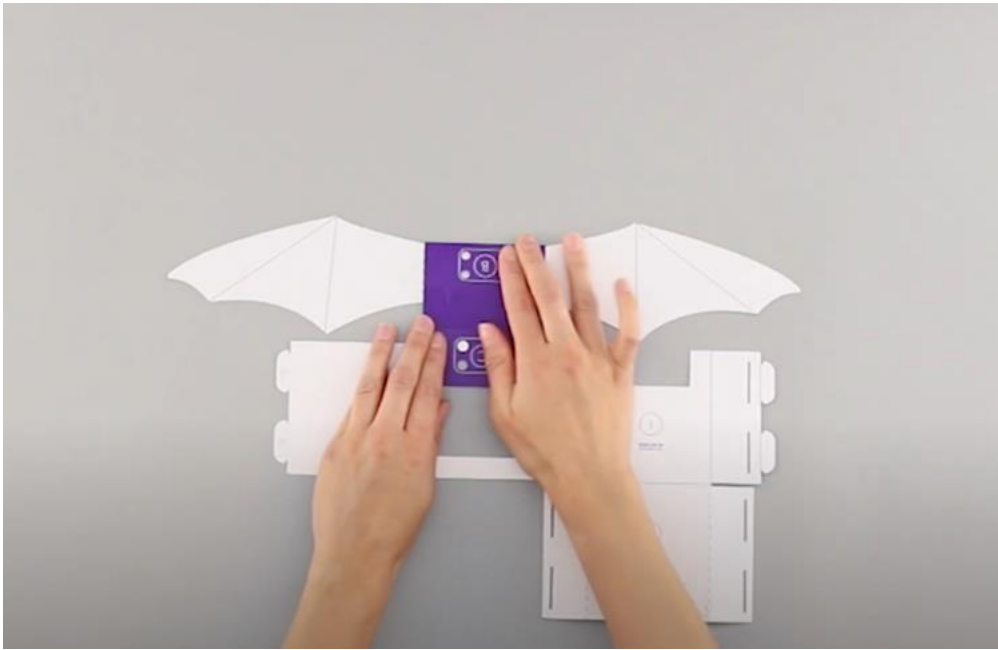
View Here: <https://snapthegap.org/the-navigator-slideshow>

Building your Template

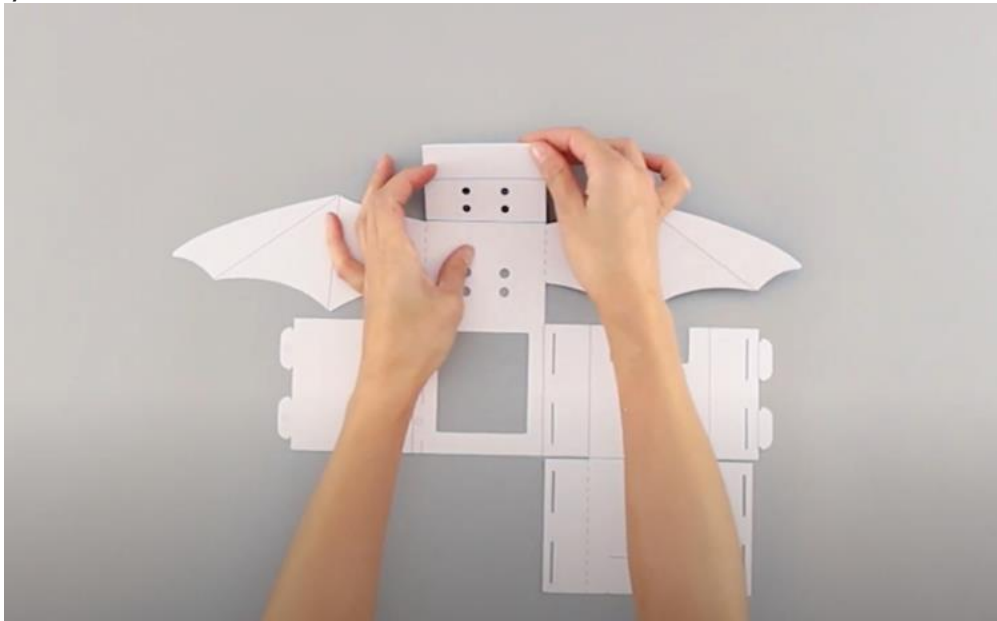
Step 1: Find Template #4 in your Kit.



Step 2: Start by folding all the solid lines upward toward yourself like so.



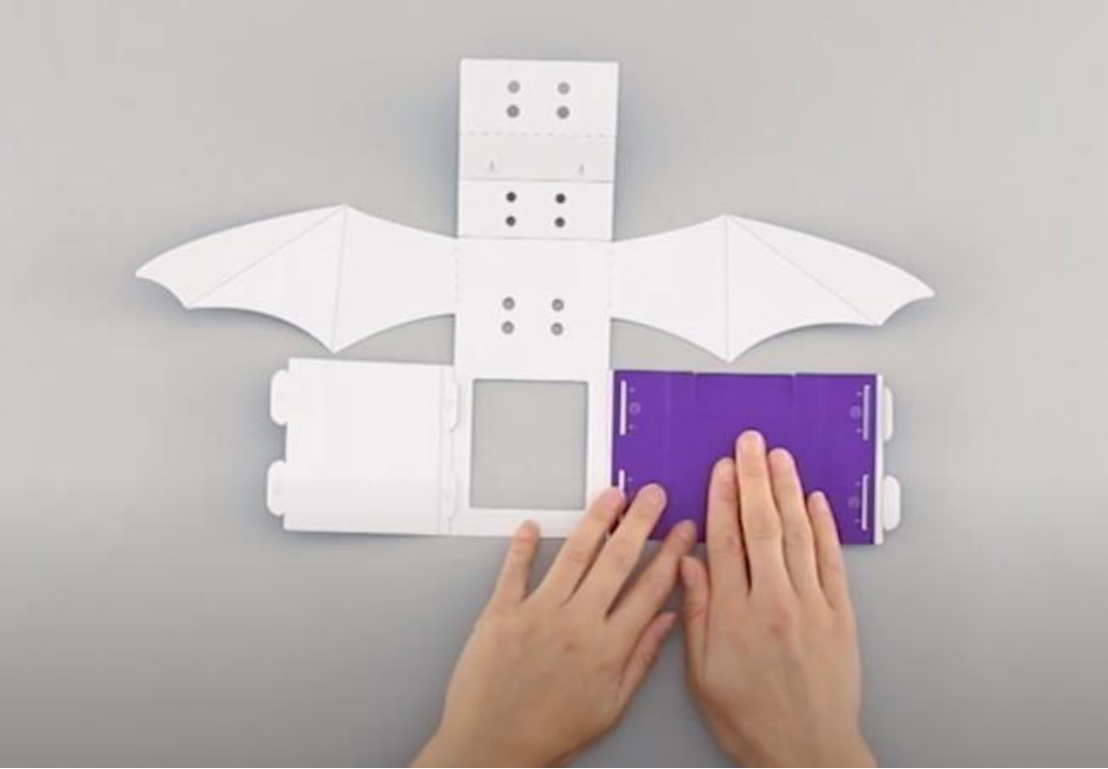
Step 3: Start by folding all the dotted lines downward away from yourself like so.



Step 4: Begin matching the numbered faces and numbered tabs & slots together in order starting with #1 and ending with #6.



Step 5: See how faces #1 are folded and matched together.



Step 6: Now, let's move on to the tabs marked 2 and 3.



Step 7: As you insert the tabs into the matching slot, make sure to slightly lift up and pull tabs to lock in place.



Step 8: Open up the tabs numbered 4 & 5 on the edge opposite of the ones you just locked in place and pull through the matching slots.



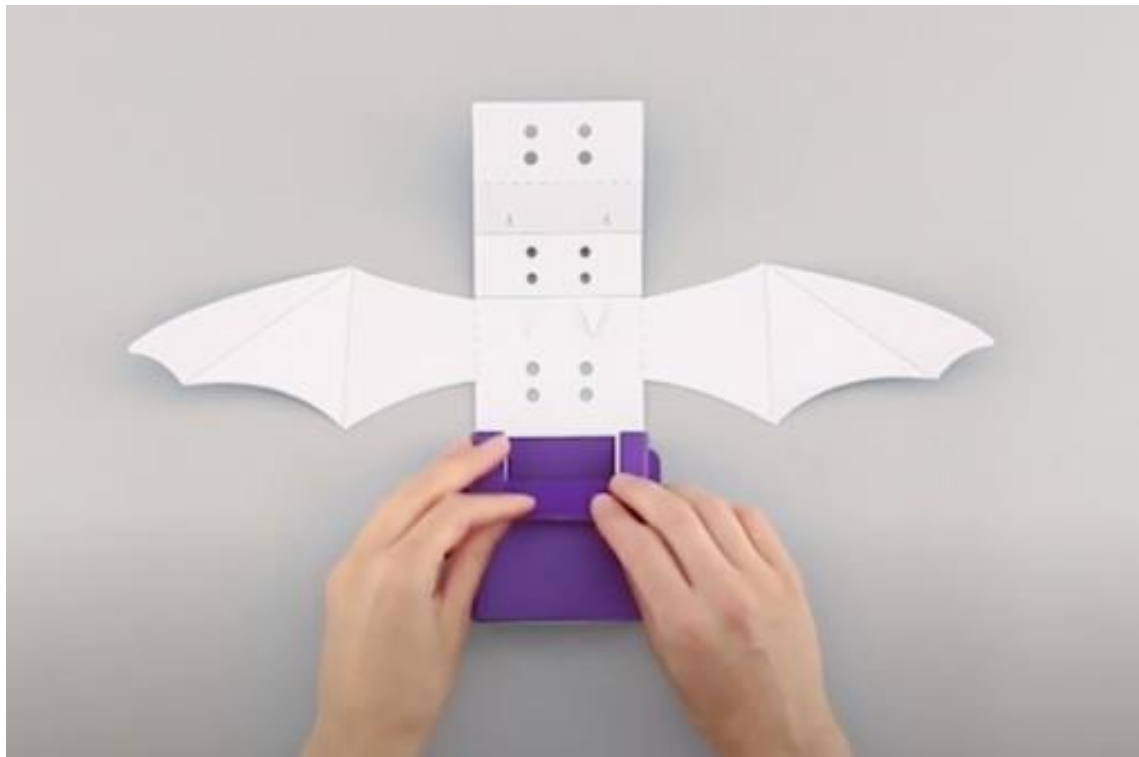
Step 9: Then take the tabs that are facing up and carefully push them into the openings.



Step 10: Now, flip over the template, and fold down face #6 onto matching face #6.



Step 11: See face #6 folded over face #6.



Step 12: Now fold any dotted and solid lines back in place if needed.

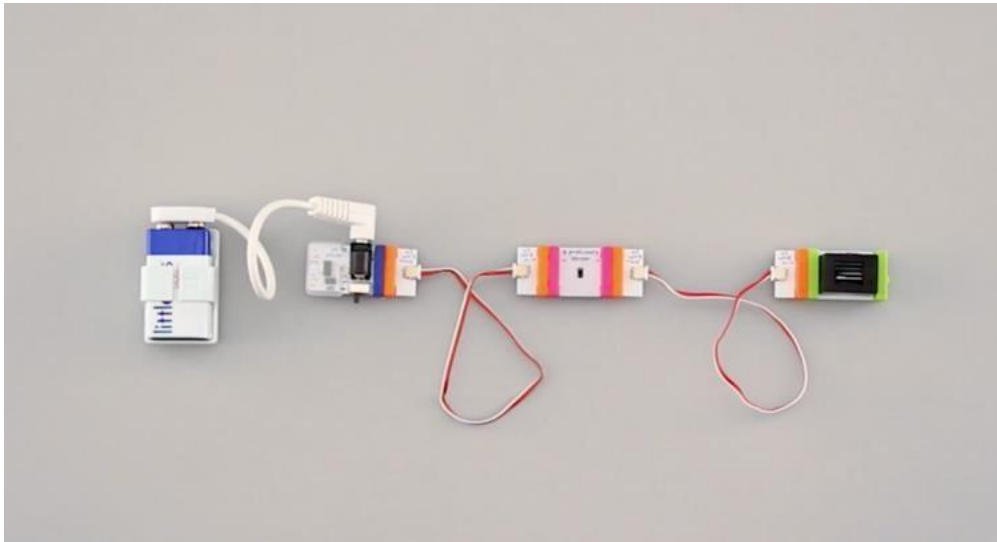


Step 13: Flip your template around and it is ready to go.



Building your Circuit

Step 1: Now it is time to build your circuit by plugging in your battery into your power bit, snap orange wire to power bit, add the proximity sensor, the wire, and then the buzzer.



Building your Invention

Step 1: Start by sliding your mounting board into the open slot on your Navigator template like so.



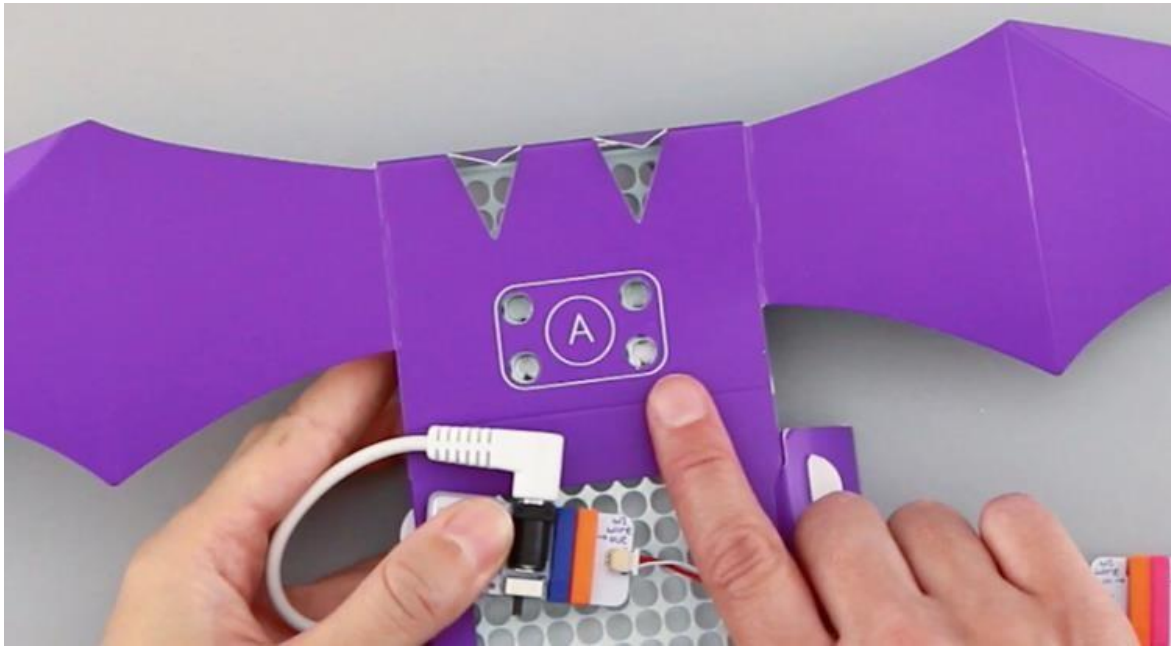
Step 2: Flip your template over and attach the battery to bit holder + holes marked "C."



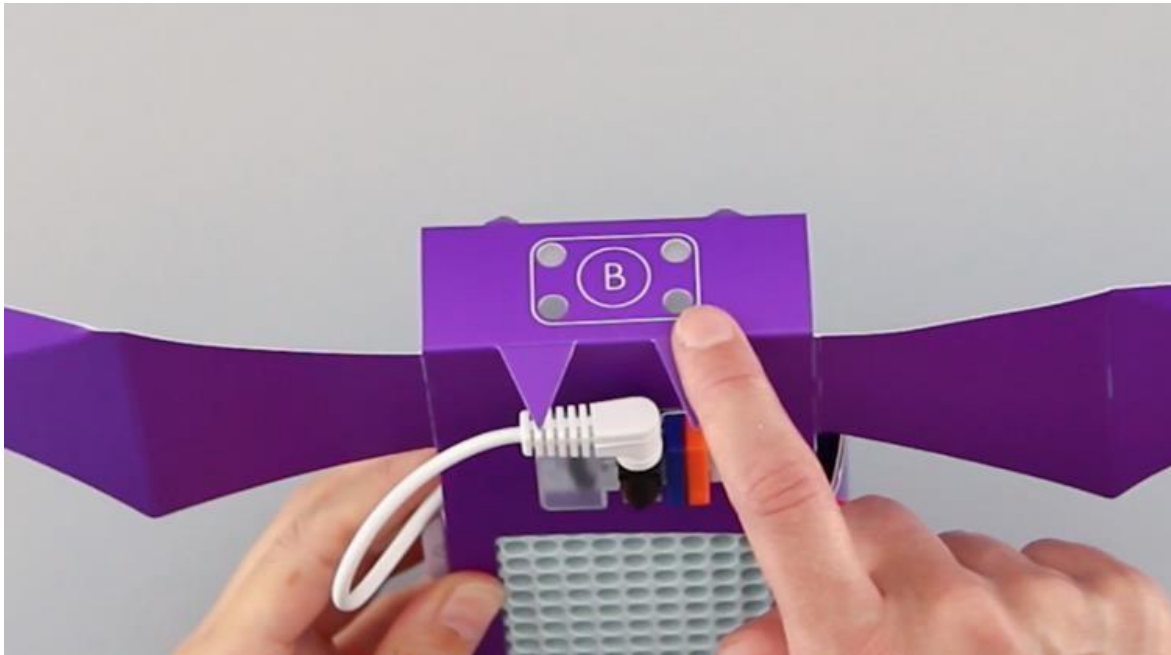
Step 3: See how the battery is now attached to the bit holder “C.”



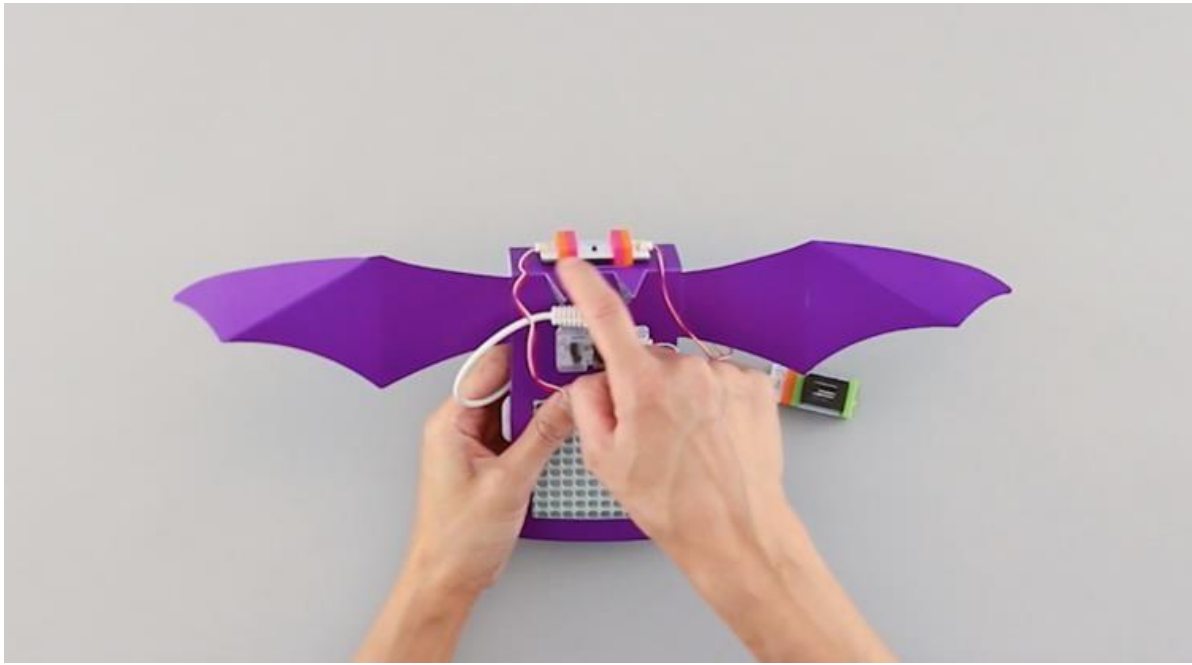
Step 4: Next, attach the power bit to the bit holder marked “A.”



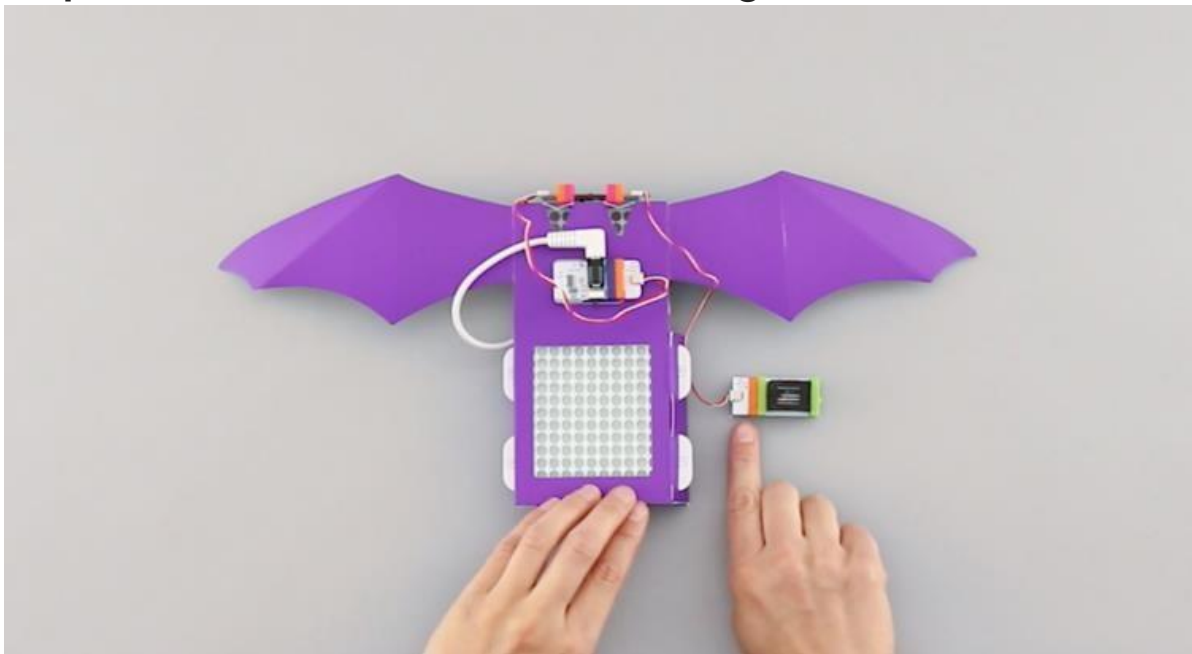
Step 5: Attach the proximity sensor to bit holder marked "B."



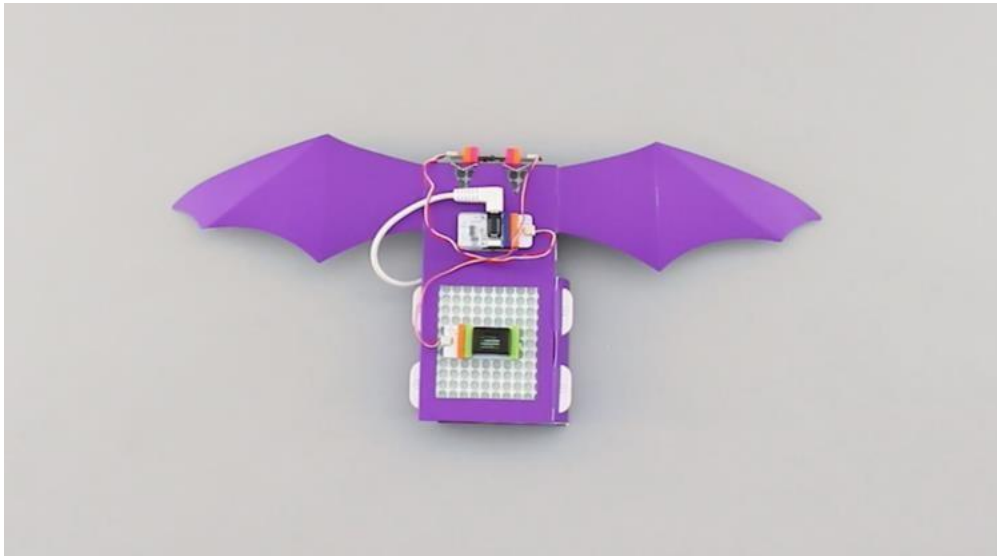
Step 6: See how the proximity sensor is attached to the template.



Step 7: Add the buzzer to the mounting board.



Step 8: If needed, add wires to hide any wires or add tape to tape down tabs. Now your invention is complete!



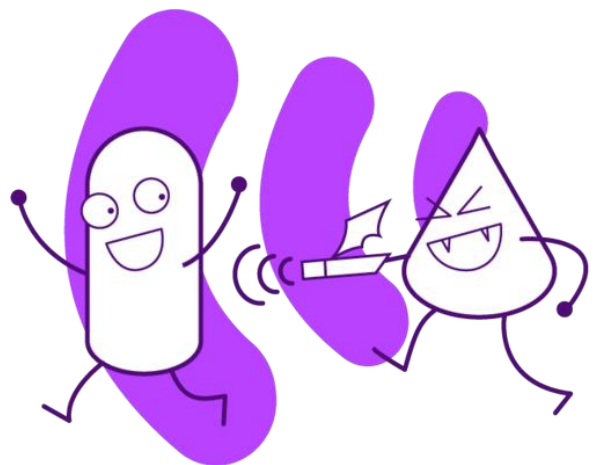
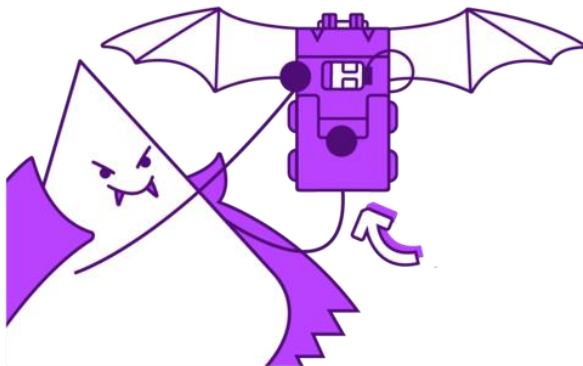
Play

PLAY: Try out your invention!

Watch here: <https://youtu.be/4Y-pCurkuIM>

Once you have been built your Navigator invention, test it out to make sure it works.

- Is your invention sensing objects in front of it?
- What is the ideal distance for sensing objects in front of you?



Remix

REMIX: Update or Improve your Prototype

How can you use Bits and craft materials to improve or customize your invention?

Here are some more ideas:

- **Try using your Navigator in different places/scenarios:**

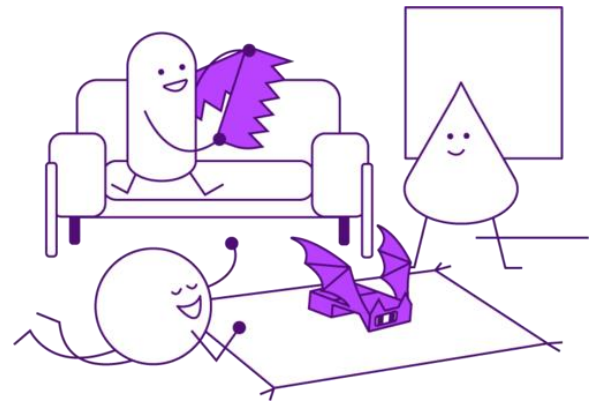
- Can you use for something else besides navigating? Can it be a prank? An intruder alert?

- **Experiment with Bits:**

- Try swapping the **Sound Trigger Bit** in place of the **Proximity Sensor Bit**.
 - *How does this change the function of your navigator?*
 - Hint: try shaking your arm :)
- Try adding other Bits.
 - *What happens if you add a Long LED?*
 - *How could this improve your wearable device?*
- How could the navigator be adjusted for someone with a hearing disability?

- **Add Other Craft Materials:**

- Customize your Navigator.
 - How would someone know it is yours?
 - Hint: Add your name with marker or stickers to your Navigator.



- Wrap a paper cup or cone around the speaker to make it louder.
-

Share

SHARE: Share your invention with friends or family!

Here are some ideas how you can share about your invention:

- Create a story about your invention.
- Talk about the updates or unique features you added to the original prototype and why you decided to make these changes.
- Snap photos of your final invention and send to your site coordinator!

CONGRATULATIONS, YOU HAVE COMPLETED YOUR PROJECT!

Resources

Inspirational Links:

[Bat Vision Invention](#)

Helpful Links:

[DCI Stem STEM Kit Overview](#)

[DCI Stem STEM Kit Bit Index](#)

[littleBits Basics littleBits](#)

[Invention Cycle littleBits](#)

[Troubleshooting](#)

Trash Chomper

Build a garbage eating monster!



As you work through the session, make sure to review all Bit diagrams to learn how Bits work and how they relate to the real world. You can also find information about each Bit in the [DCI Stem](#).

Inspire

Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?

- What inspires you about this role model?

Download Women in STEM postcards here:

[SALLY RIDE JANE X. LUU VIRGINIA HOLSINGER](#)

INSPIRATIONAL INVENTION VIDEOS OF THE DAY

Turn boring objects like trashcans into smart objects. These trashcans are interactive and help the environment by making it fun to pick up trash and recycle. [Video 1:](#) A trash can that makes a sound when you throw something away keeps people from littering.

[Video 2:](#) A littleBits-Powered Recycling Bin.

[Video 3:](#) A smart recycling bin that turns recycling into a game.

Create

The Trash Chomper

Build a garbage eating monster.

CREATE: Watch the following video playlist below for the building instructions to create the Trash Chomper:

1. Robots
2. Create Trash Chomper

Watch the video playlist here:

https://youtu.be/bZ8kiUPspQU?list=PLr9Bpv_A0CheCMbJZ7DMW34Y4VTHWIQtb

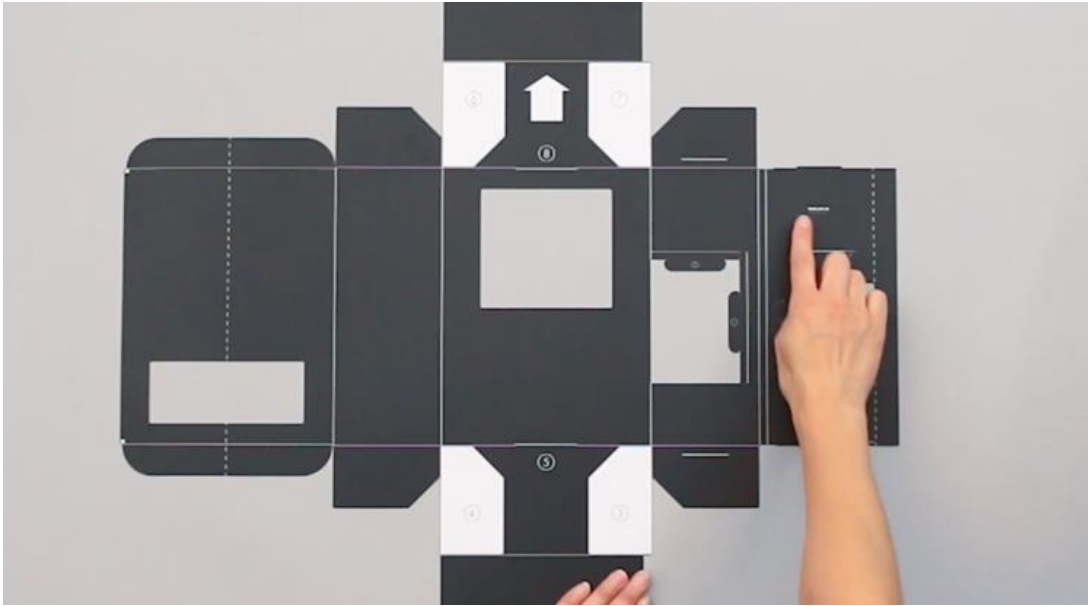
CREATE: View the following photo slideshow on how to build your Trash Chomper invention.

1. Building your Template
2. Building your Circuit
3. Building your Invention

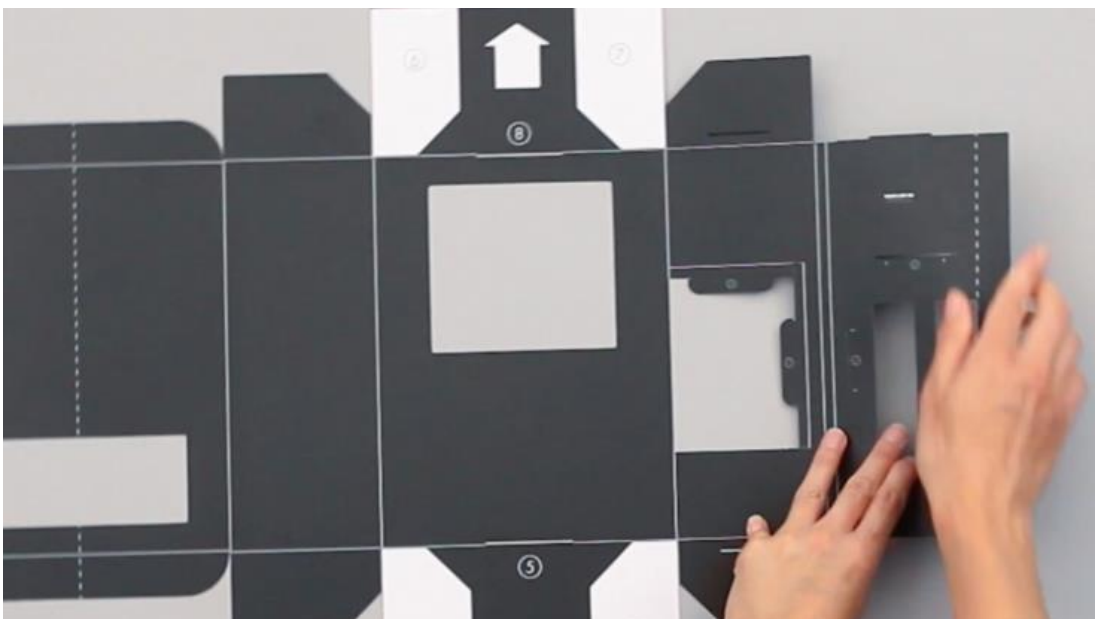
View Here: <https://snapthegap.org/trash-chomper-slideshow>

Building your Template

Step 1: Find Template #8 in your Kit.



Step 2: Start by folding and then unfolding all dotted lines downward and away from yourself like so.



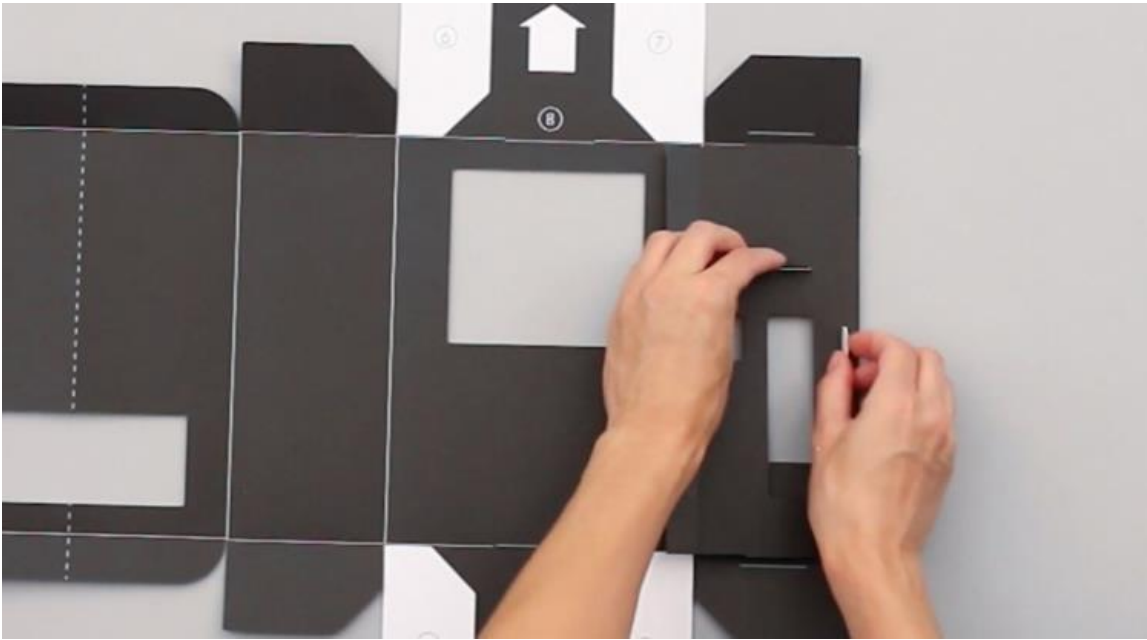
Step 3: Fold and then unfold every solid line upward towards yourself like so.



Step 4: Next, start matching numbered tabs and faces with corresponding numbered slots and faces in order from #1 to #10.



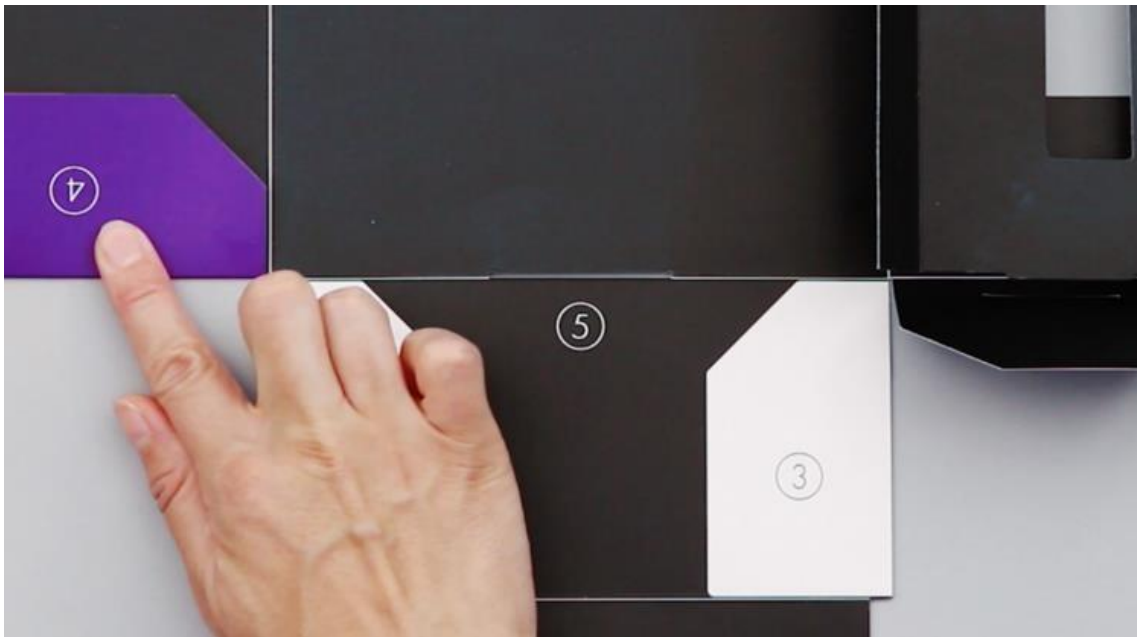
Step 5: Now move onto placing tab #2 into slot #2 like so.



Step 6: Next, we are going to match face #3 with the other face #3.



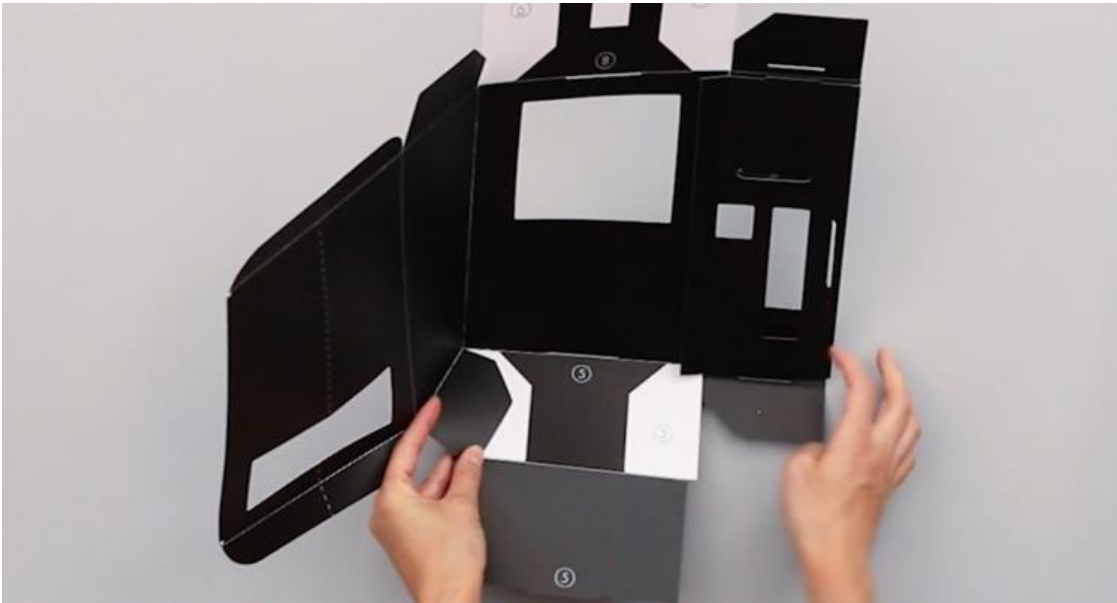
Step 7: Next, we are going to match face #4 with the other face #4.



Step 8: Match face #3 and #4 and fold inward like so.



Step 9: Then fold face #5 to match other face #5.



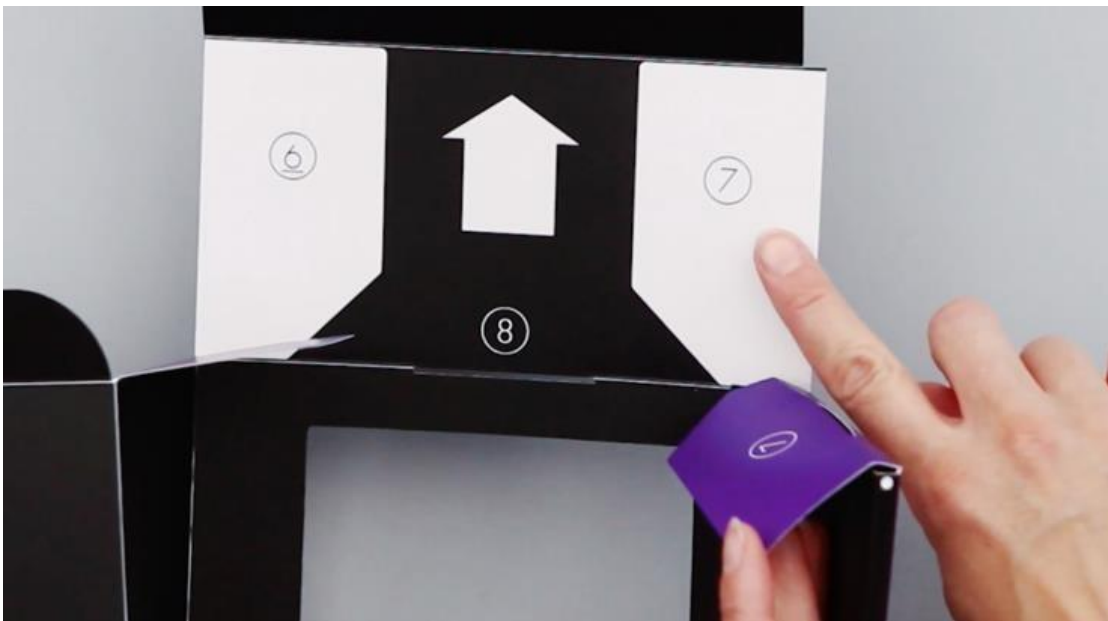
Step 10: These steps create base at the bottom of your Chomper bot.



Step 11: Next, move to the top to face #6 and fold it to match the other face #6.



Step 12: Fold face #7 as well to match the other face #7.



Step 13: See how this step also replicates the steps from the bottom creating another base as we fold face #6 and #7 inward.



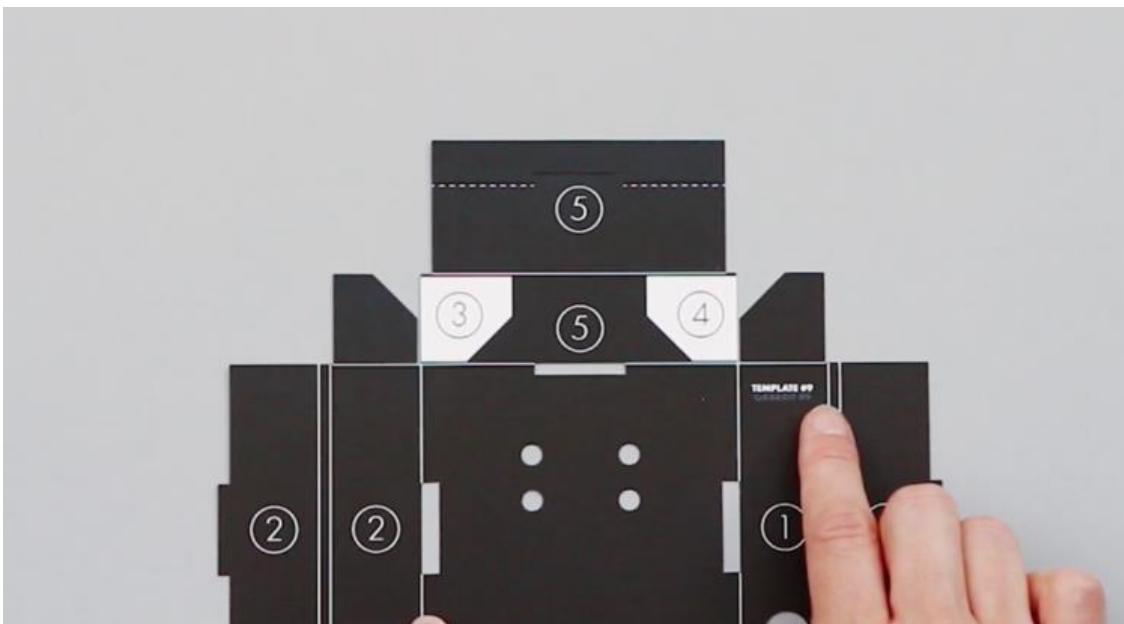
Step 14: Next, fold over face #8 onto the matching face #8.



Step 15: We are now finished with this part of invention.



Step 16: Next, we are going to build the Chomper part of invention using Template #9.



Step 17: Again begin by folding and unfolding all dotted lines downward and solid lines upward.



Step 18: Then begin folding matching numbered faces or tabs in order from #1 to #7 like so.

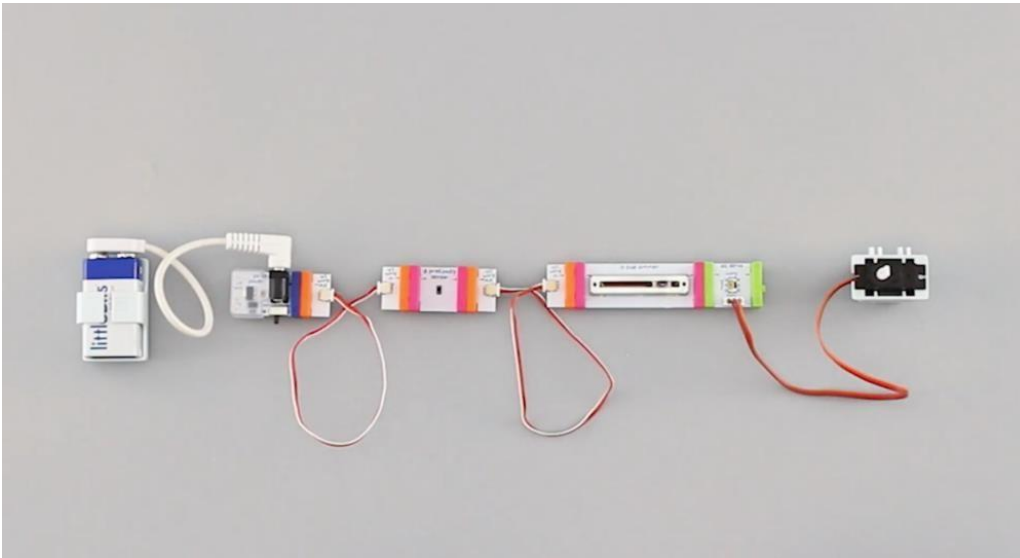


Step 19: See how we have created a small box with an opening for our invention.

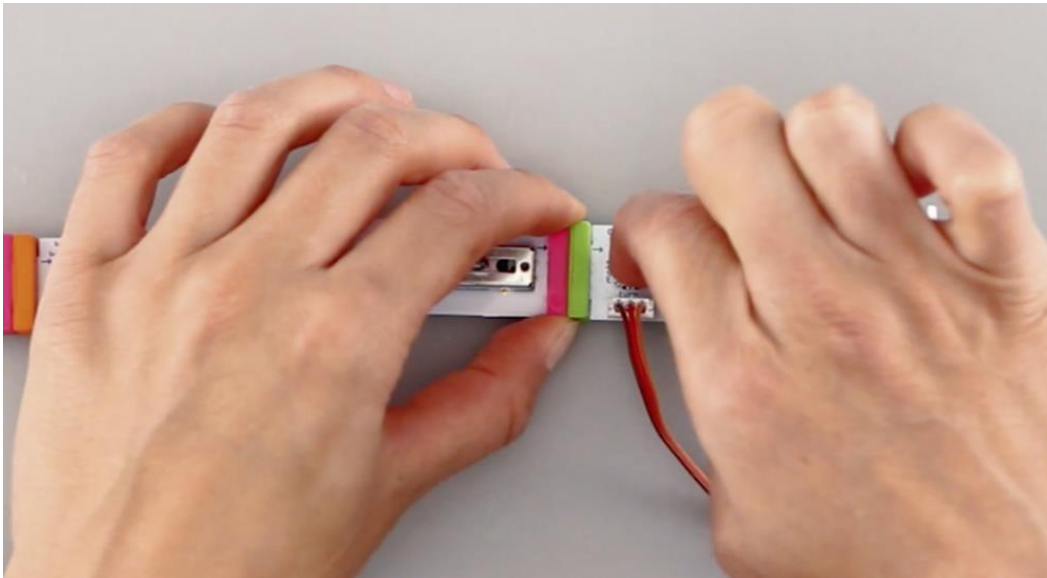


Build your Circuit

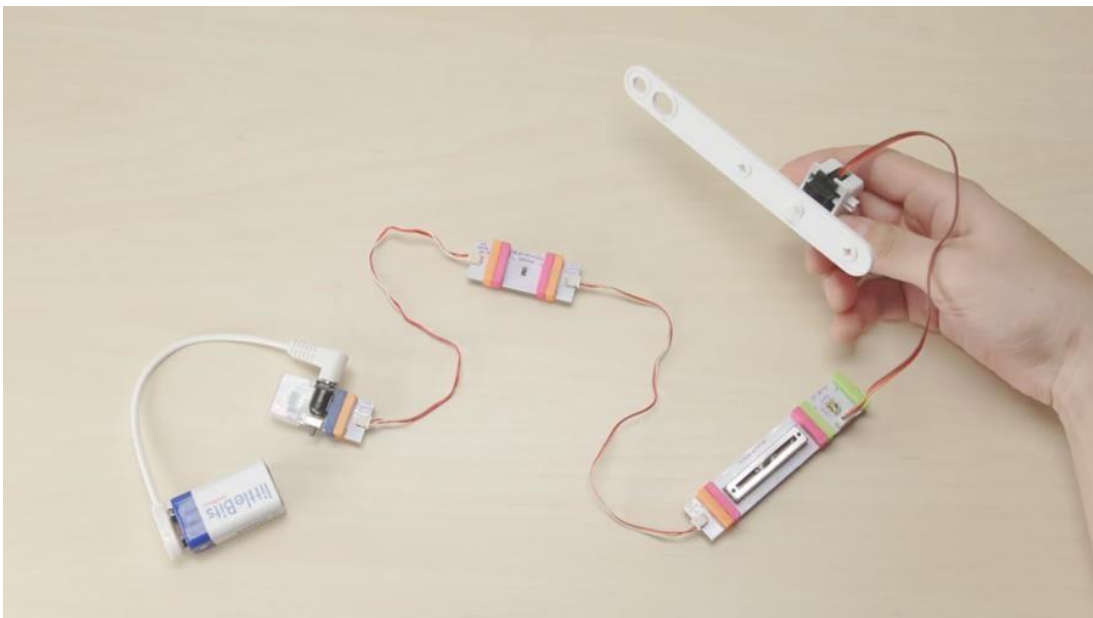
Step 1: For the circuit, attach the battery, power bit, wire, proximity sensor, wire, slide dimmer, and servo bit with attachment (motor for arm) together like so.



Step 2: Make sure the green servo bit switch is set to TURN mode.



Step 3: In addition, we will be adding the arm to the servo bit motor, however, you can keep it off of the circuit for now to make it easier to build.



Build your Invention

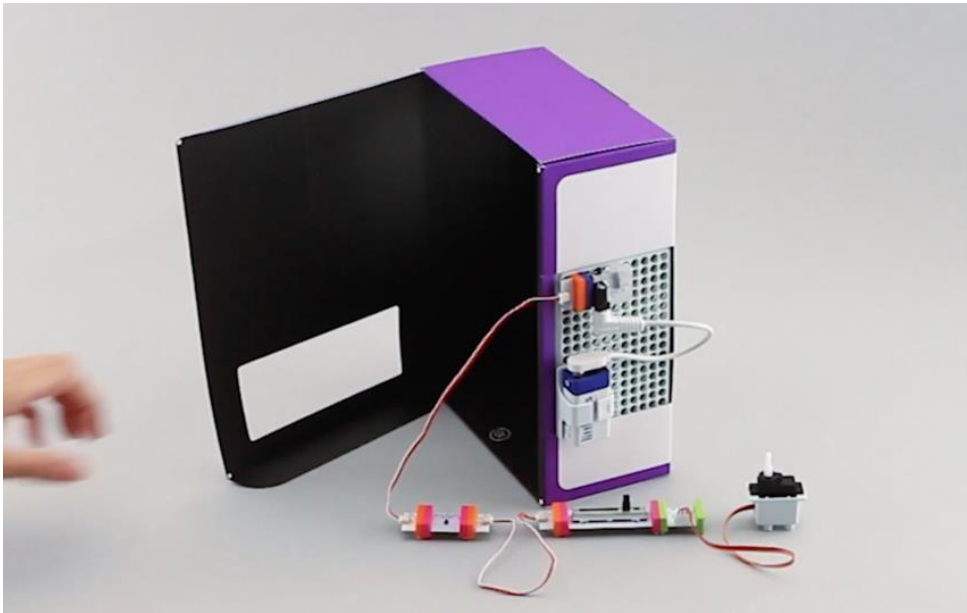
Step 1: Start by sliding the mounting board into the rectangular side of the Chomper bot like so.



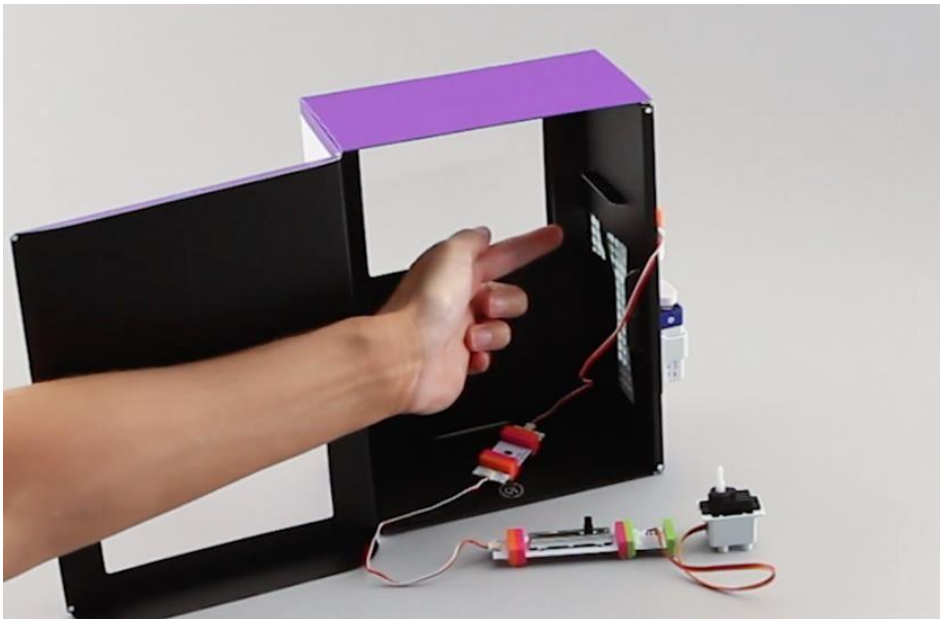
Step 2: Next, attach your battery and power bit onto the board.



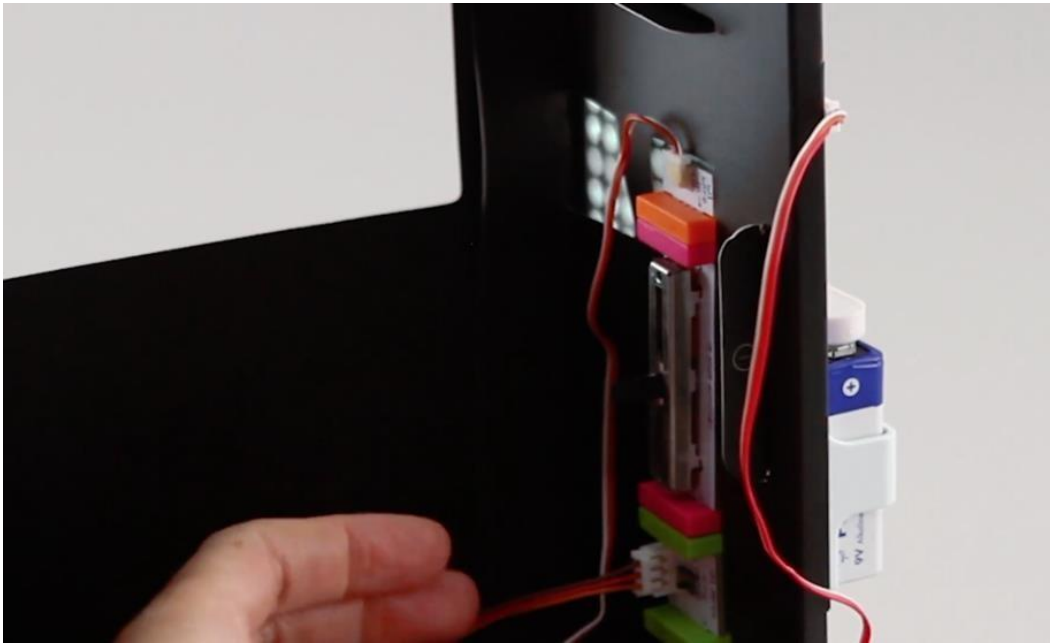
Step 3: Place the bits like so onto your Chomper bot.



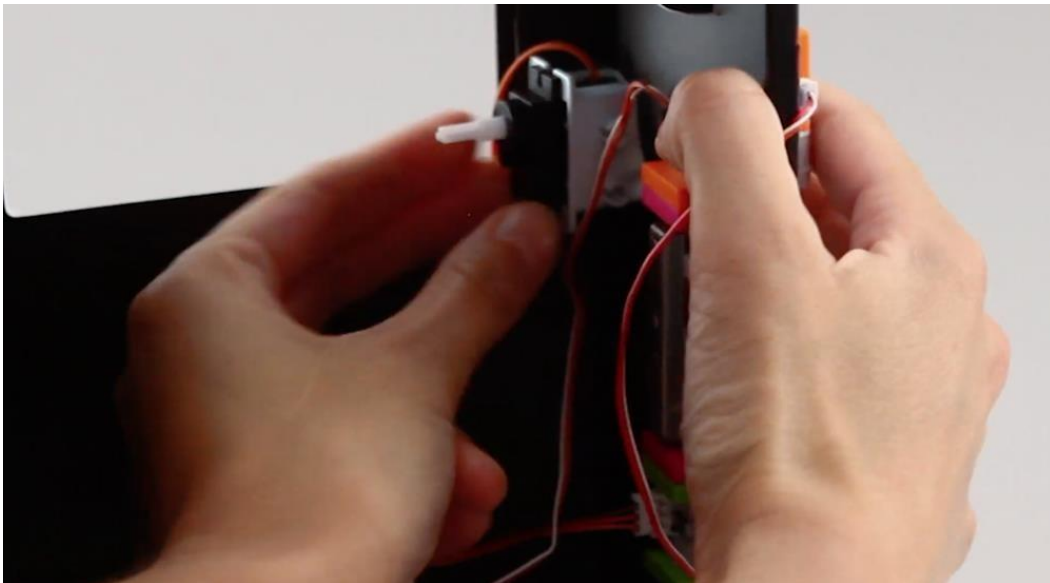
Step 4: Next, let's move into your Chomper bot by placing the slide dimmer and servo bit on the inside.



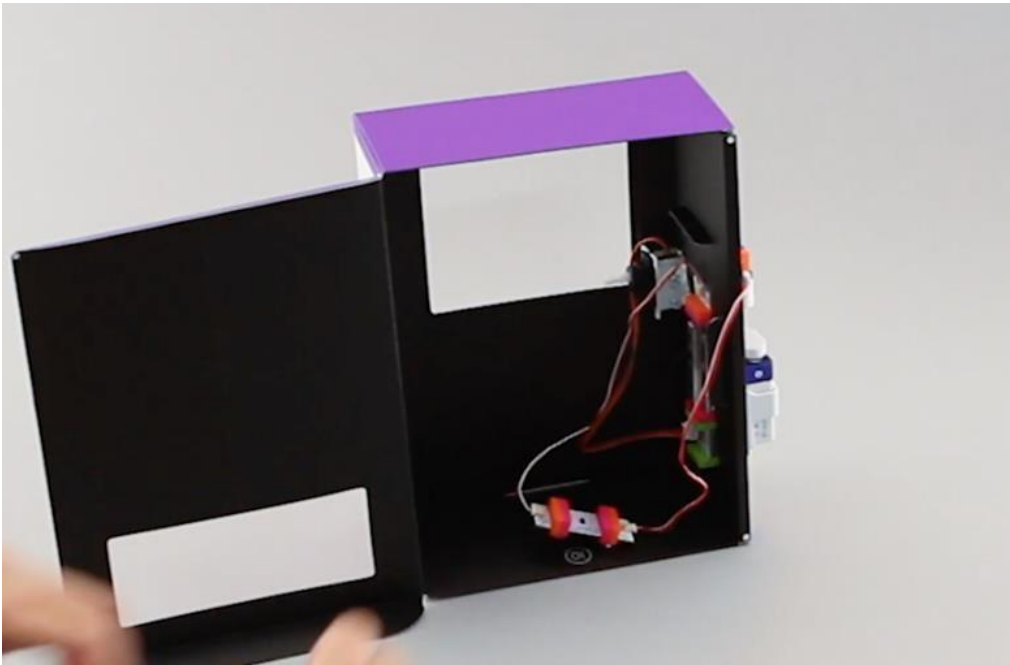
Step 5: See how the wire orange bit is at the top while the green servo bit is at the bottom like so.



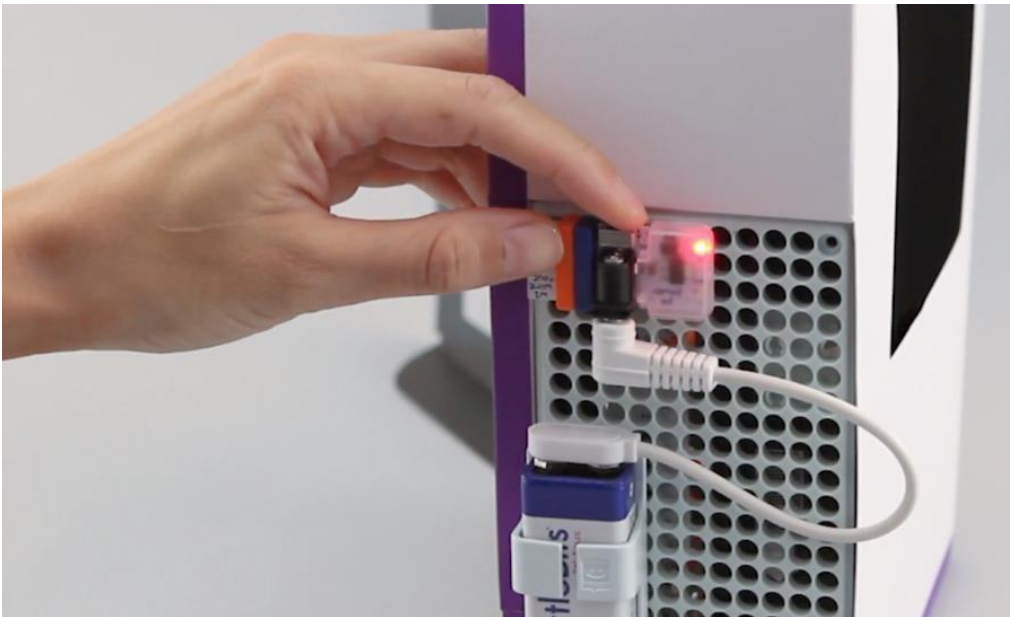
Step 6: Next, attach the motor bit like so.



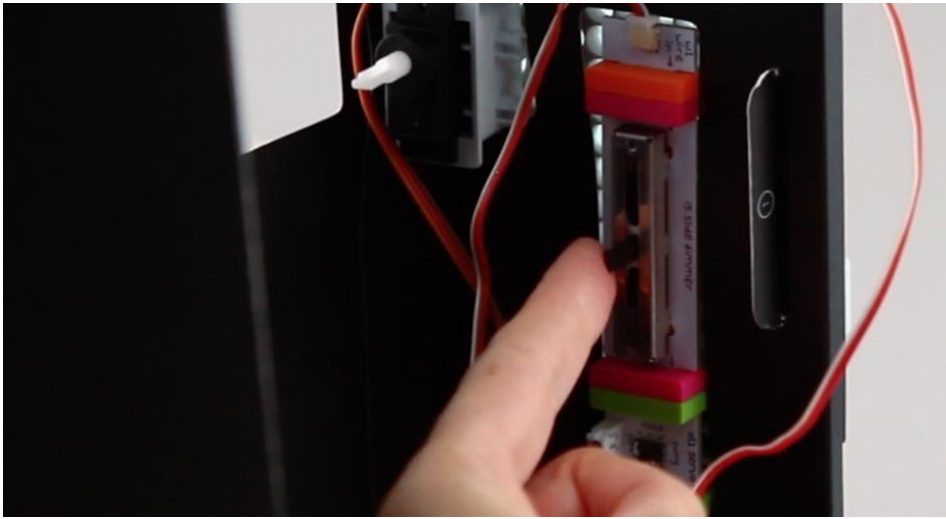
Step 7: See how the bits are attached.



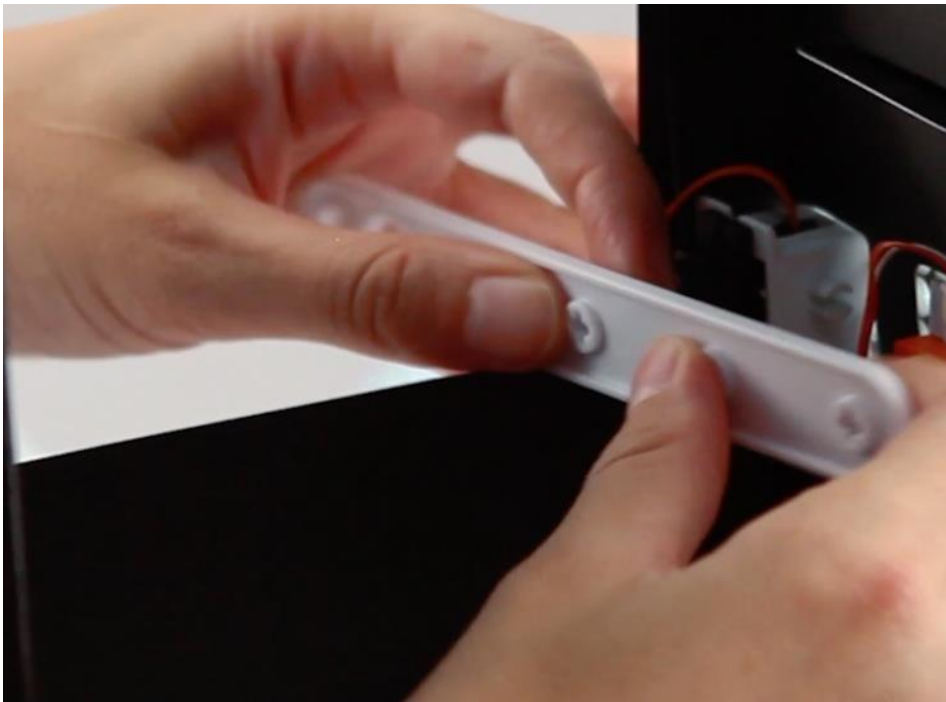
Step 8: Power on the power bit.



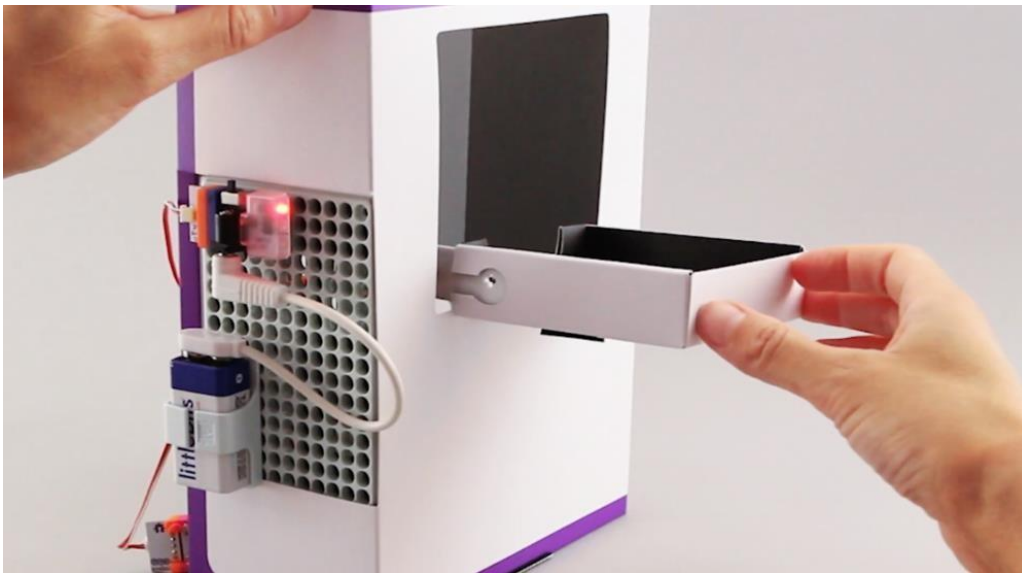
Step 9: Next, push the slide dimmer all the way to the top of the dimmer to place the motor in neutral.



Step 10: Attach the center of the arm onto the motor like so.



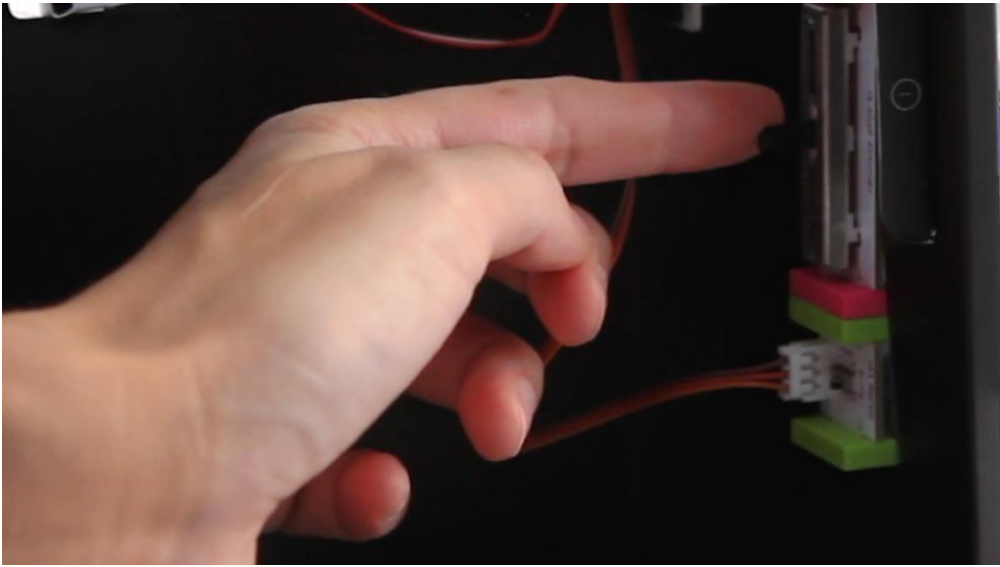
Step 11: Now attach the second part of the invention by sliding it onto the moving arm like so.



Step 12: Next, attach the pink proximity sensor bit onto the holes onto the chomper piece like so.



Step 13: Next, push the slide dimmer to the center.



Step 14: Finally, close the door of the chomper bot.



Step 15: Now, test out your invention!



Play

PLAY: Try out your invention!

Watch video here: <https://youtu.be/Sd7S9nX5mWk>

Once you have been built your Trash Chomper invention, test it out to make sure it works.

- Does the Proximity Sensor Bit sense when you throw something in your Trash?
- Does the Trash Chomper quickly chomp the trash away?
- Keep in mind that the first prototype likely won't work perfectly the first time; failure is part of the process.

Remix

Remix: Update or Improve your Prototype

How can you use Bits and craft materials to improve or customize your invention?

Here are some ideas:

- **Try using your Trash Chomper in different places/scenarios:**
 - Can it be used for something other than trash?
 - *Can it be a secret compartment? A piggy bank? A pet food dispenser? What other ideas do you have?*
 - What happens if you turn it upside down or on its side?
 - *Does that change how it works?*
 - **Experiment with Bits:**
 - Try swapping the **Sound Sensor Bit** in place of the **Proximity Sensor Bit**.
 - *How does this change the function of your Trash Chomper? Hint: Try clapping to make it chomp.*
 - Try adding other Bits.
 - *What happens if you add a **Long LED Bit** or a **Buzzer Bit**? How could this improve your invention?*
 - **Add Other Craft Materials**
 - How can materials transform your Trash Chomper into something else like a mailbox or a pet feeder?
 - Use stickers or add other craft materials and get creative.
 - Give your invention some personality - does it look like an animal? A plant?
 - Add a sign or message
-

Share

SHARE: Share your invention with friends or family!

Here are some ideas how you can share about your invention:

- Create a story about your invention.
- Talk about the updates or unique features you added to the original prototype and why you decided to make these changes.

- Snap photos of your final invention and send to your site coordinator!

CONGRATULATIONS, YOU HAVE COMPLETED THE PROJECT!

Resources

Inspirational Links:

[World's Deepest Bin](#)

[Bottle Bank Arcade](#)

[littleBits Powered Recycling Bin](#)

[littleBits Invention Cycle](#)

[littleBits Troubleshooting](#)

[DCI Stem STEM Kit Overview](#)

[DCI Stem STEM Kit Bit Index](#)

Helpful Links: [littleBits Basics](#)

Robo Arm

Create a gripper device that helps you grab stuff!



As you work through the session, make sure to review all Bit diagrams to learn how Bits work and how they relate to the real world. You can also find information about each Bit in the DCI Stem.

Inspire

Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

[UMA CHOWDHRY GWYNNE SHOTWELL](#)

INSPIRATIONAL INVENTION VIDEO OF THE DAY

These videos show different ways in which machines can help people in their daily lives.

Video 1: Simone Giertz Nose Blowing Machine - engineer who makes hilarious “helpful” machines

Watch video below:

<https://youtu.be/6nw9RJCGkCw?list=PLcycpKIXS5t1iBdWv4DCERYx8tOkh-Uyn>

Create

Robo Arm

Create a gripper device that helps you grab stuff!

CREATE: Watch the video playlist below for building instructions to create the Gripper.

1. Intro to Wearables
2. Create Gripper

Watch Here:

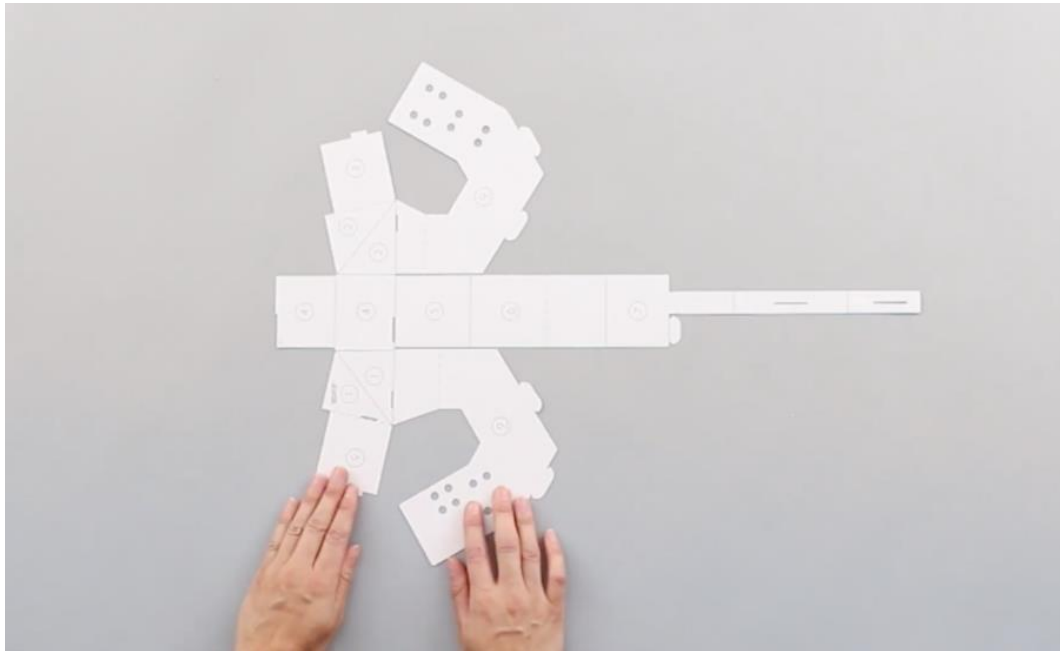
https://www.youtube.com/playlist?list=PLr9Bpv_A0ChfBRzlhRyehPgBWWR9OUdgz

CREATE: View the following photo slideshow on how to build your Robo Arm/Gripper invention.

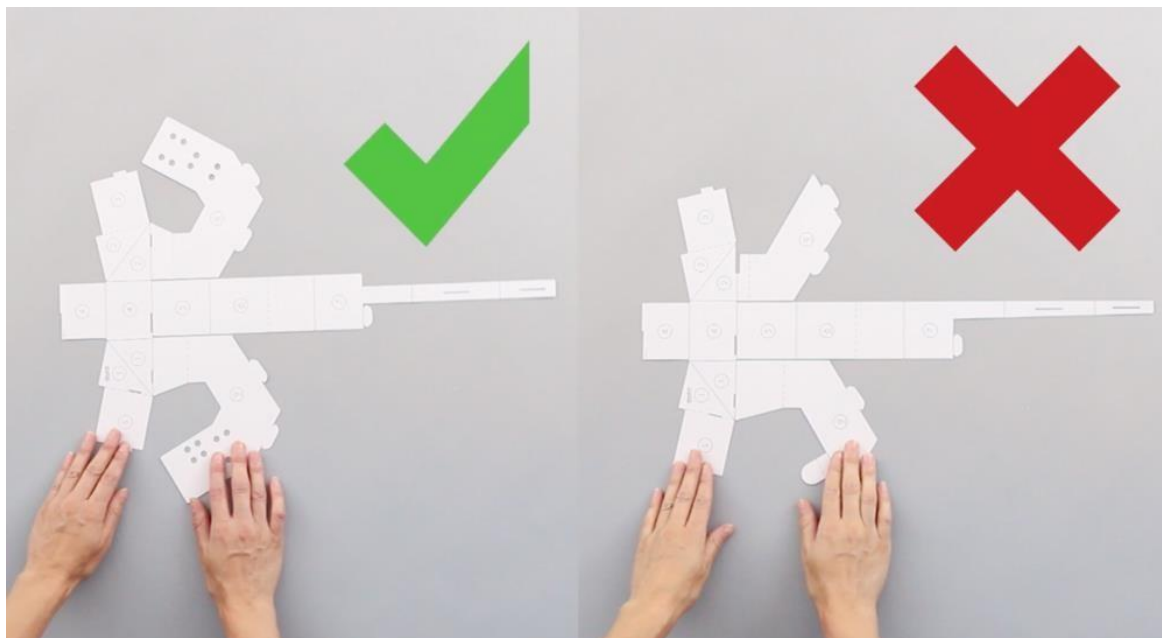
1. Building your Template
2. Building your Circuit
3. Building your Invention

View Here: <https://snapthegap.org/the-gripper-slideshow> **Building your Template**

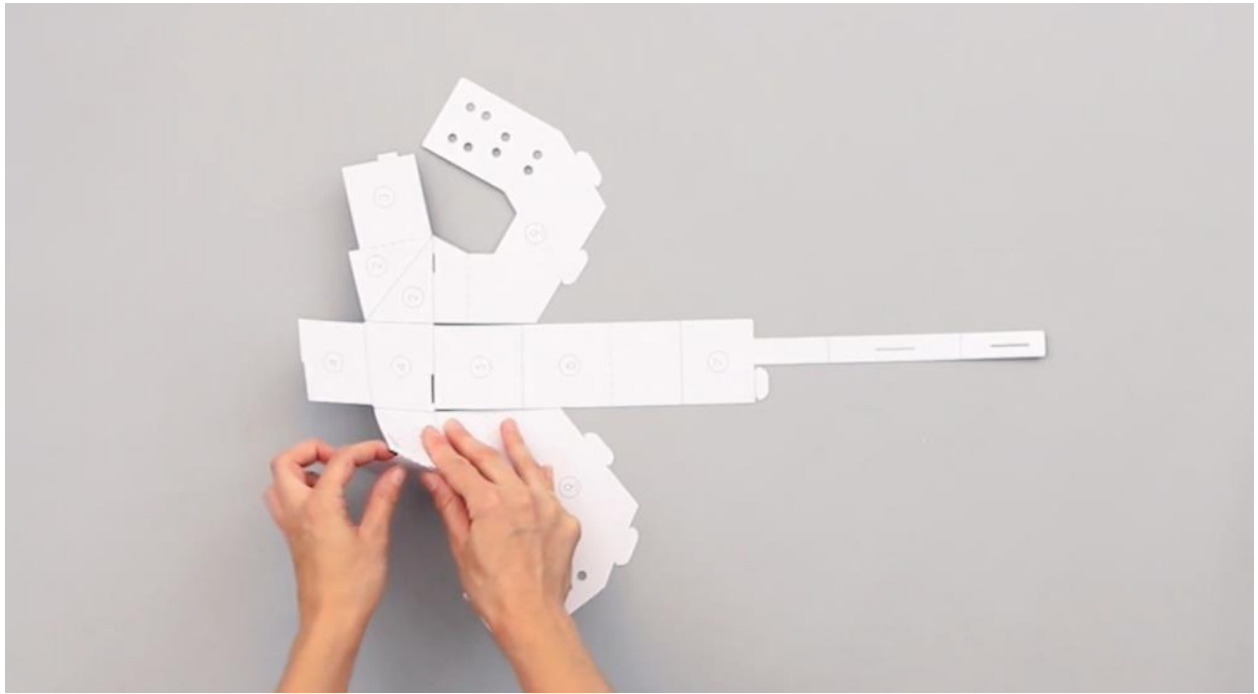
Step 1: This invention requires us to build out three templates. The first template is Template #2.



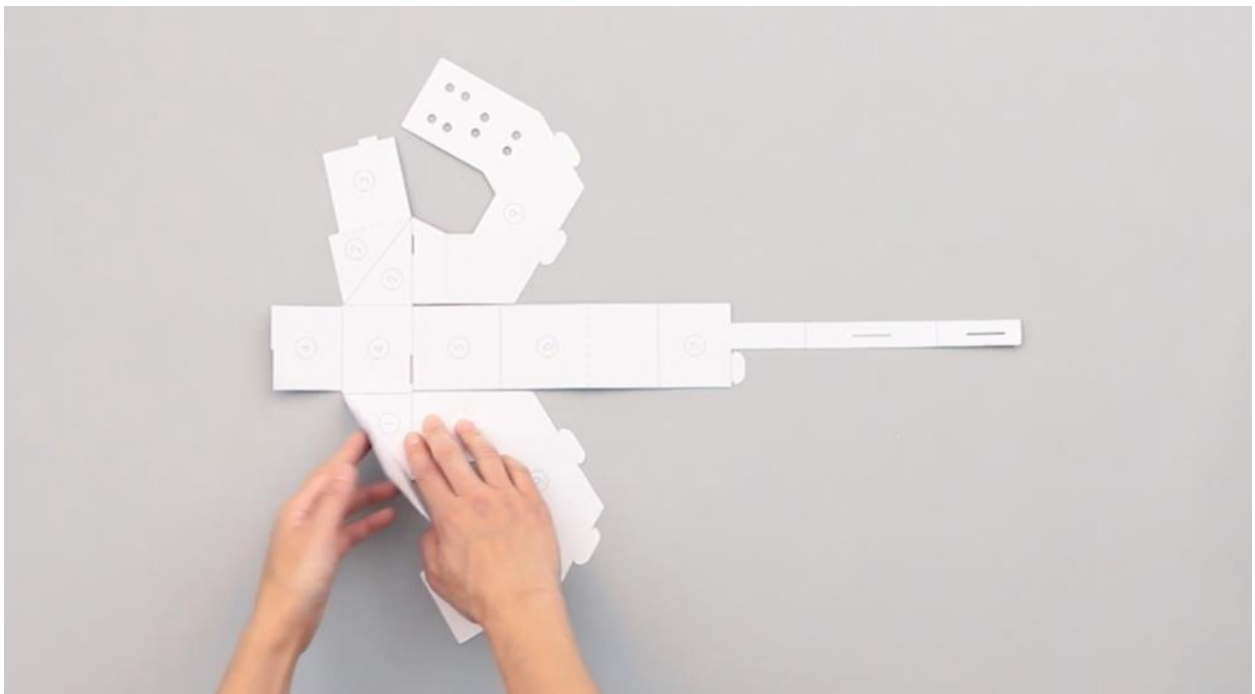
Step 2: Template #2 is the photo on the left, save the one on the righthand side for later.



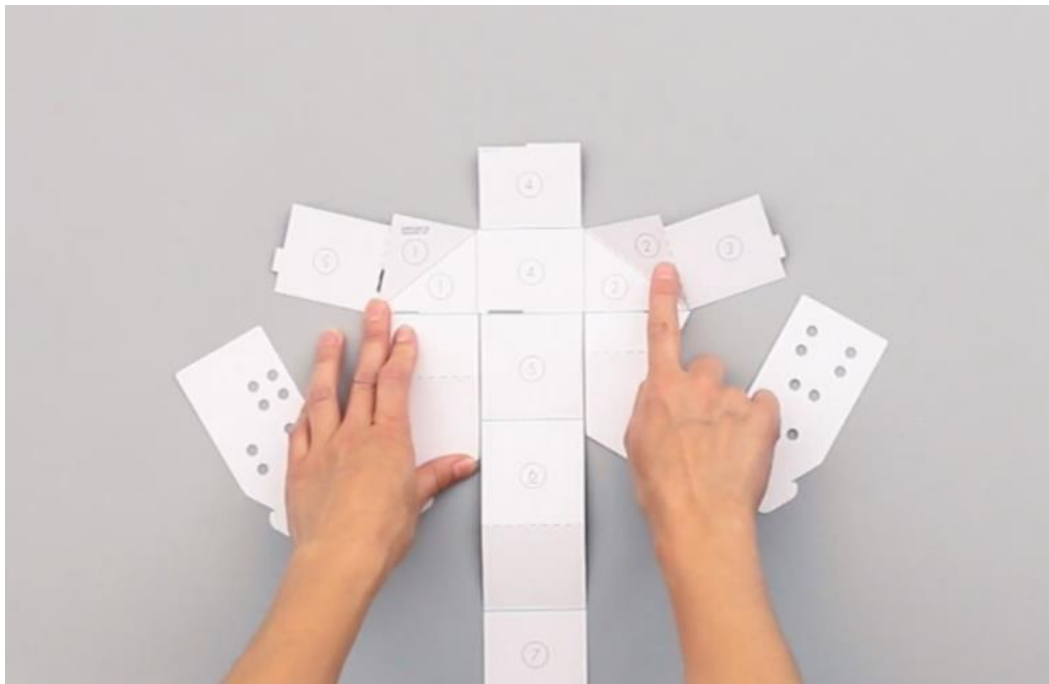
Step 3: Start folding and unfolding all the dotted lines downward.



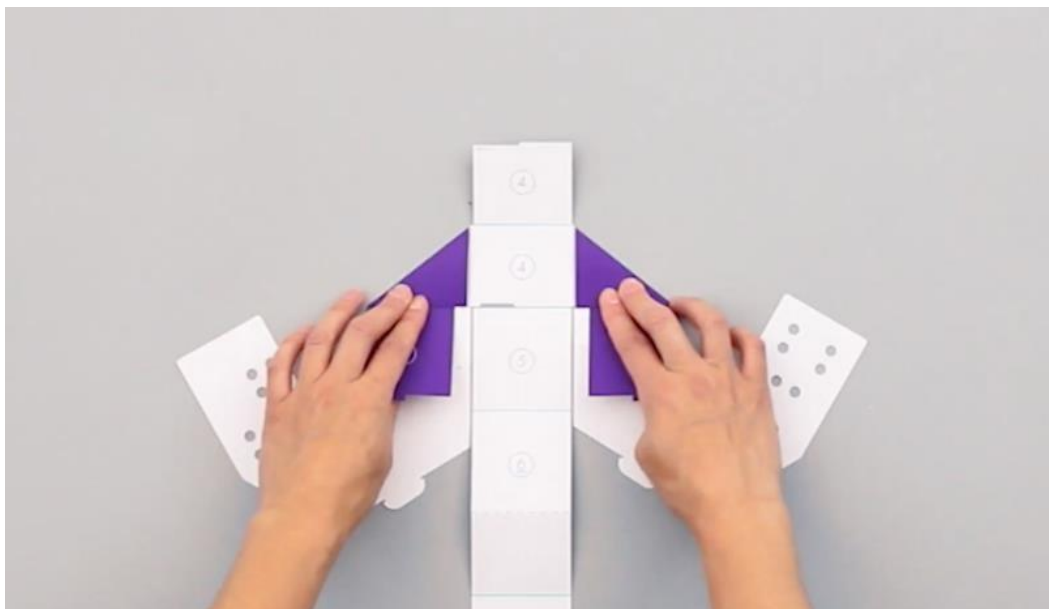
Step 4: Then start folding and unfolding all the solid lines upward.



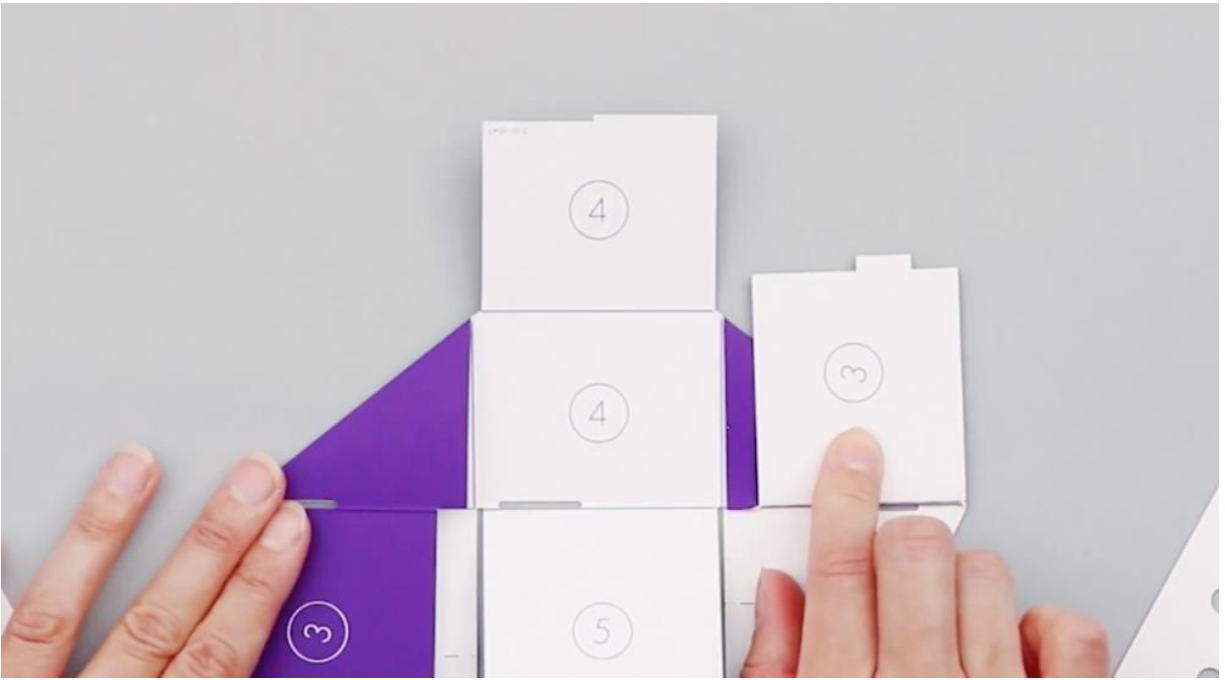
Step 5: Next, start folding and matching the numbered faces in order from #1 to #7.



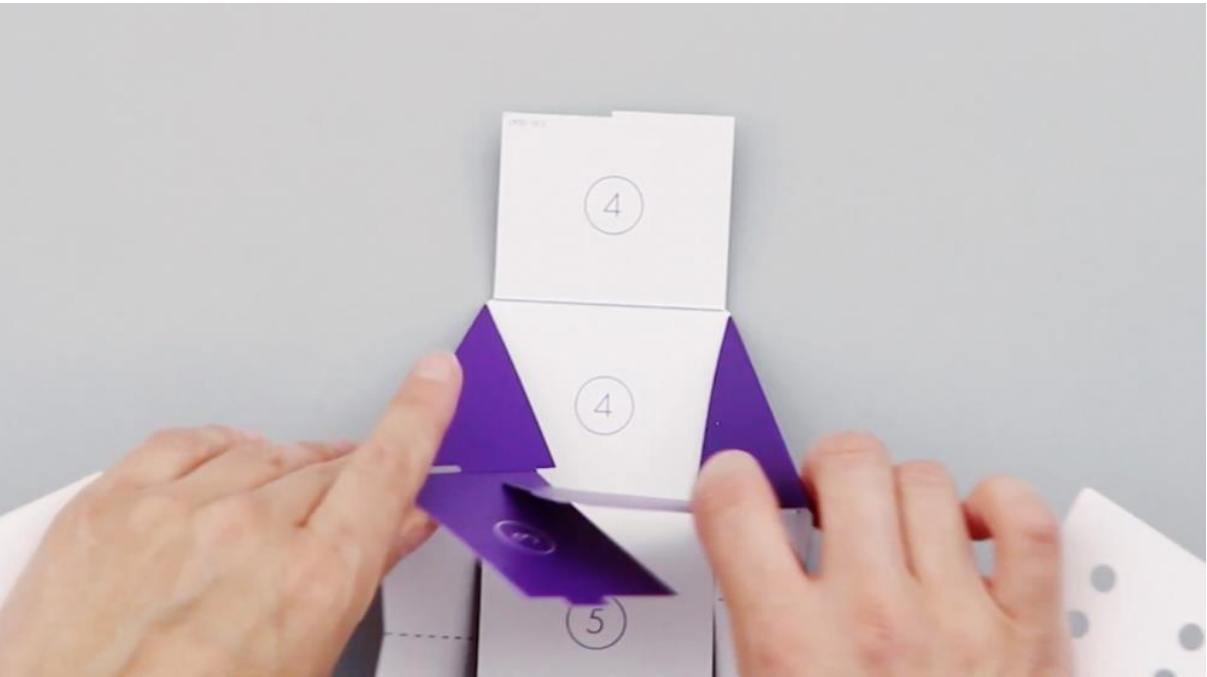
Step 6: See how Face #1 and #2 are folded onto their matching faces.



Step 7: Now, let's fold together Face #3 to match with the other Face #3.



Step 8: Fold numbered faces #3 together like so.



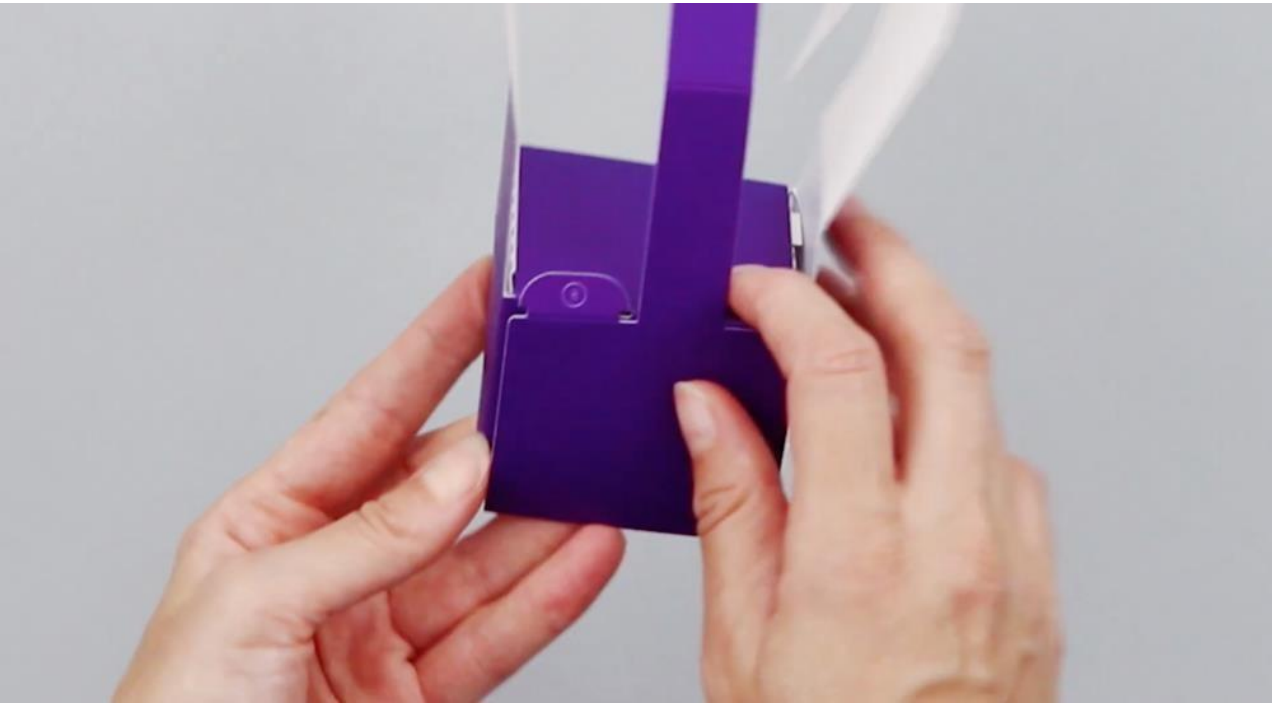
Step 9: Fold Face #4 to match with other Face #4.



Step 10: Continue folding face #5, #6, #7 by matching/folding them along with their opposite faces.



Step 11: Next, insert tab #8 into slot #8.



Step 12: Now, let's fold the face #9 together.



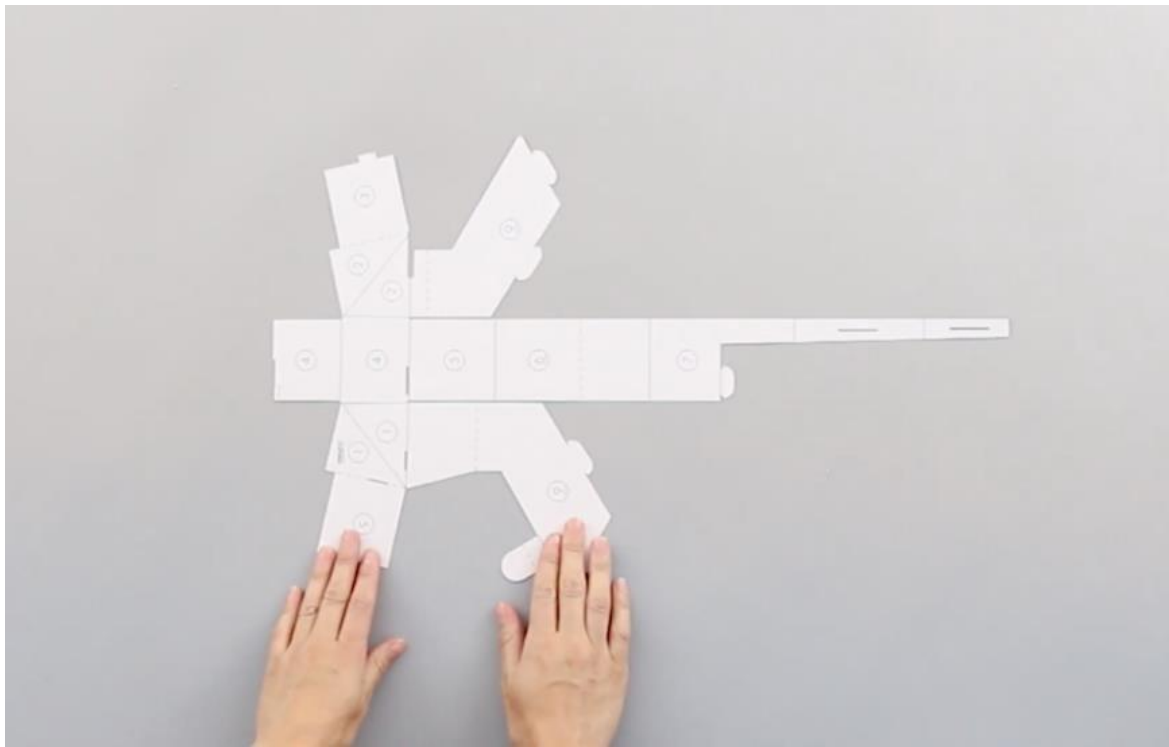
Step 13: Hold the faces together and insert the tabs and the slots to hold in place.



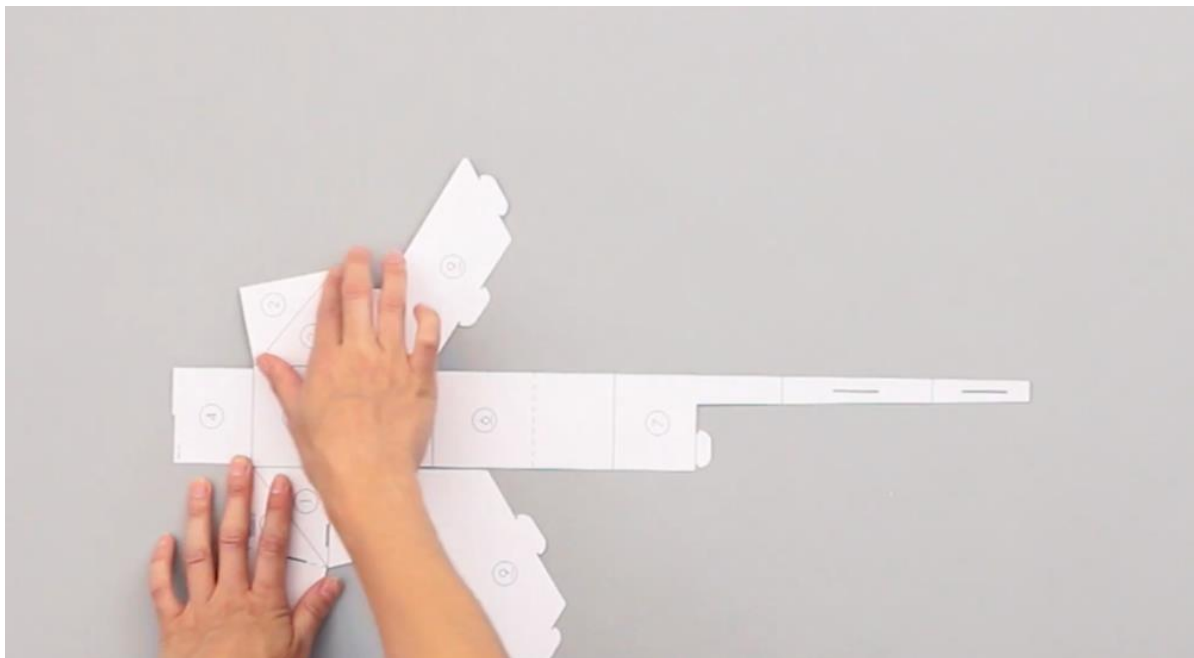
Step 14: Now you have completed one side of the invention (the Gripper). Let's move onto the next template.



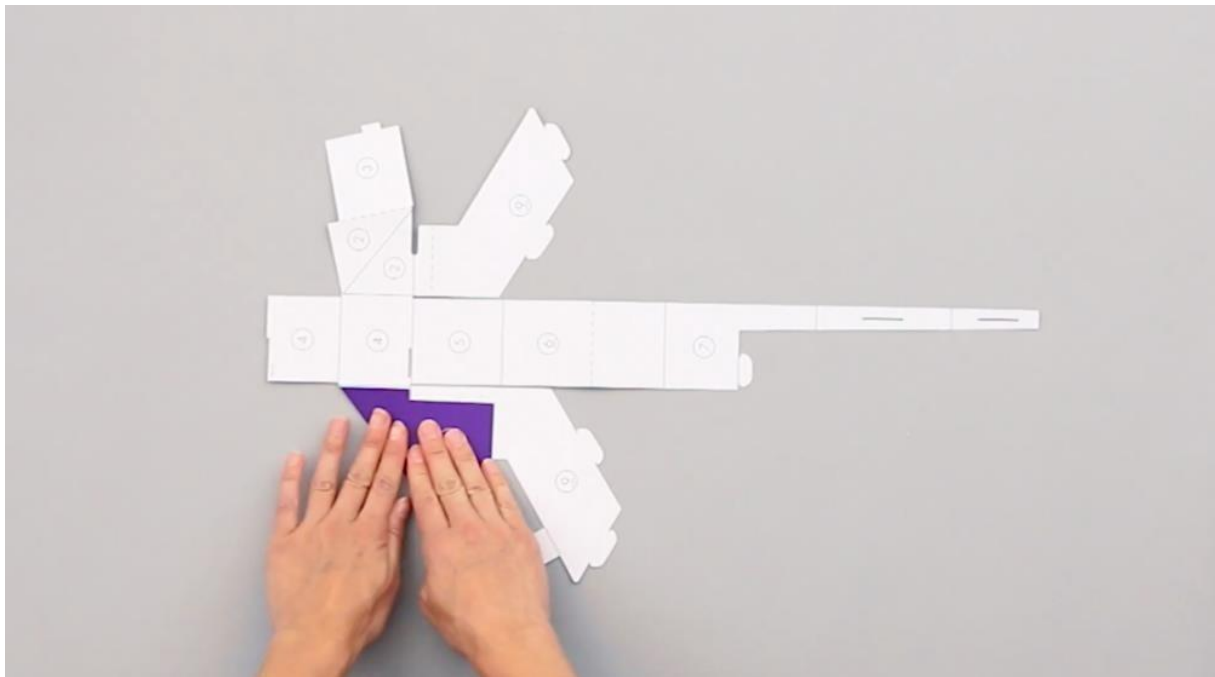
Step 15: This time, we will be working with Template #1.



Step 16: Fold and unfold all dotted lines downward.



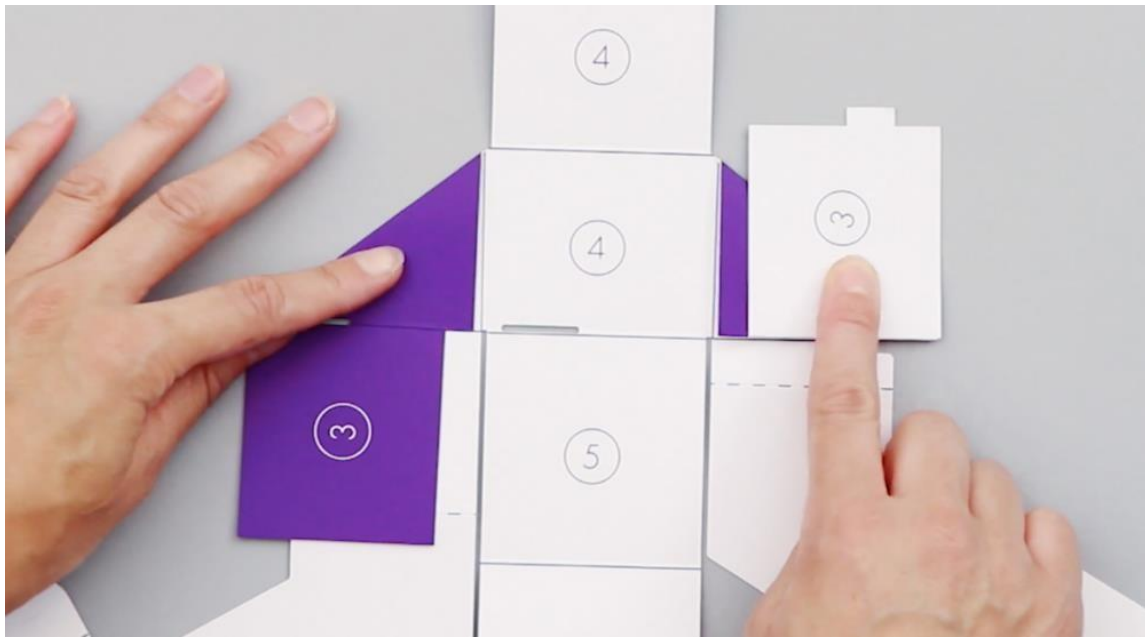
Step 17: Fold and unfold all solid lines upward.



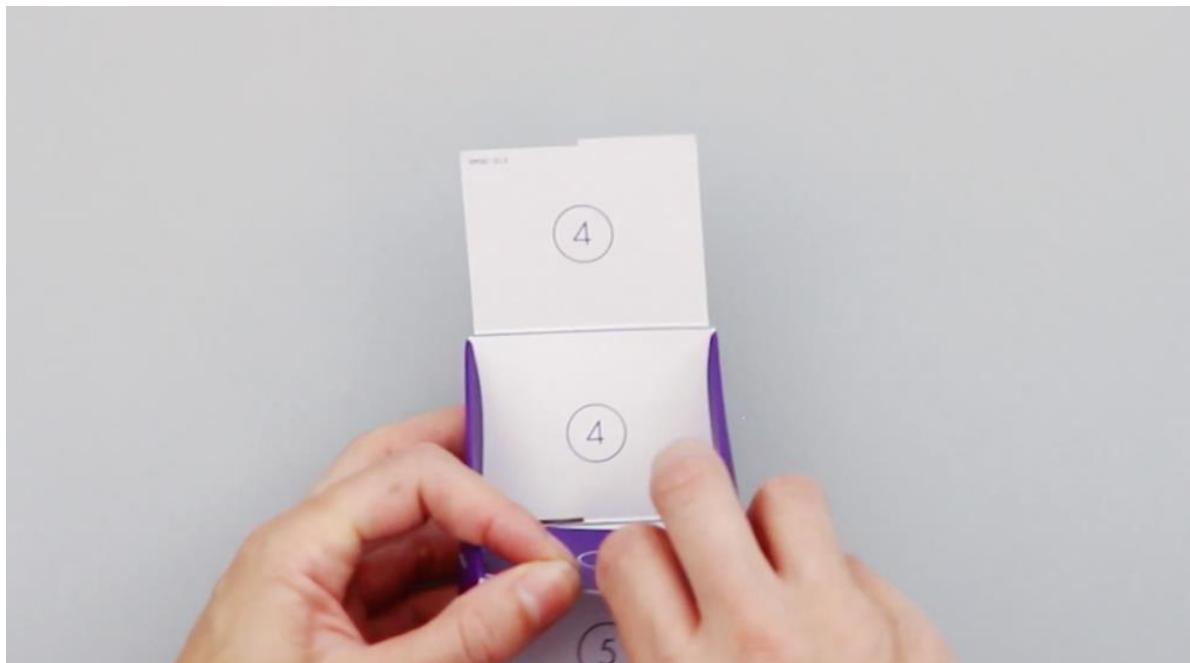
Step 18: Now, start folding and matching the numbered faces in order from #1 to #9.



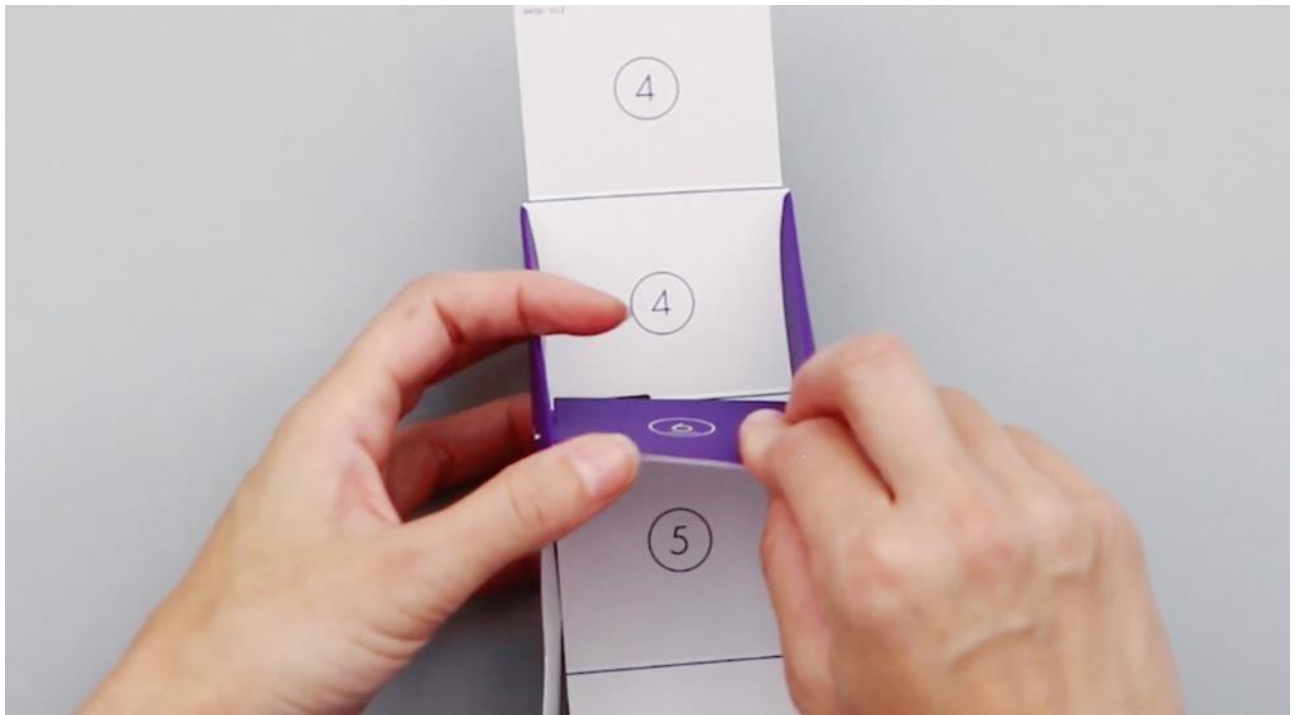
Step 19: Next, fold together and match numbered Face #3 with other face #3.



Step 20: See how the face #3 is folded together with the other face #3.



Step 21: Fold and match numbered face #4 with the other face #4.



Step 22: Fold and match numbered face #5 with other face #5.



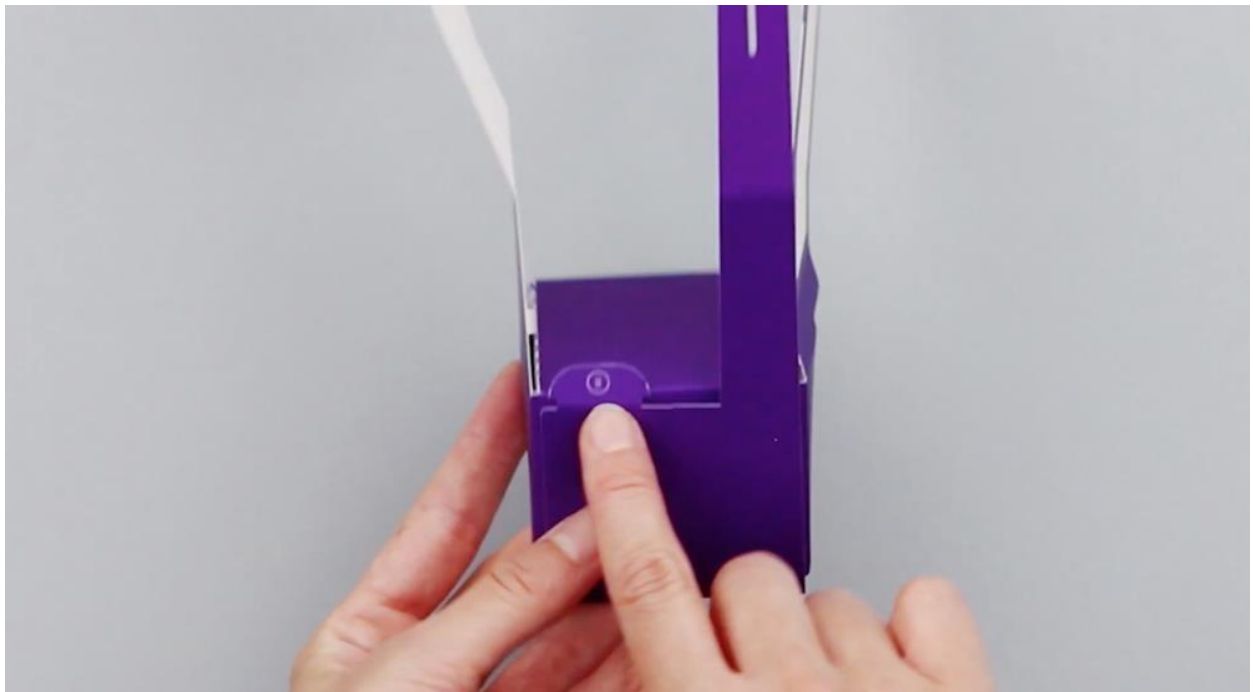
Step 23: Fold and match numbered face #6 with other face #6.



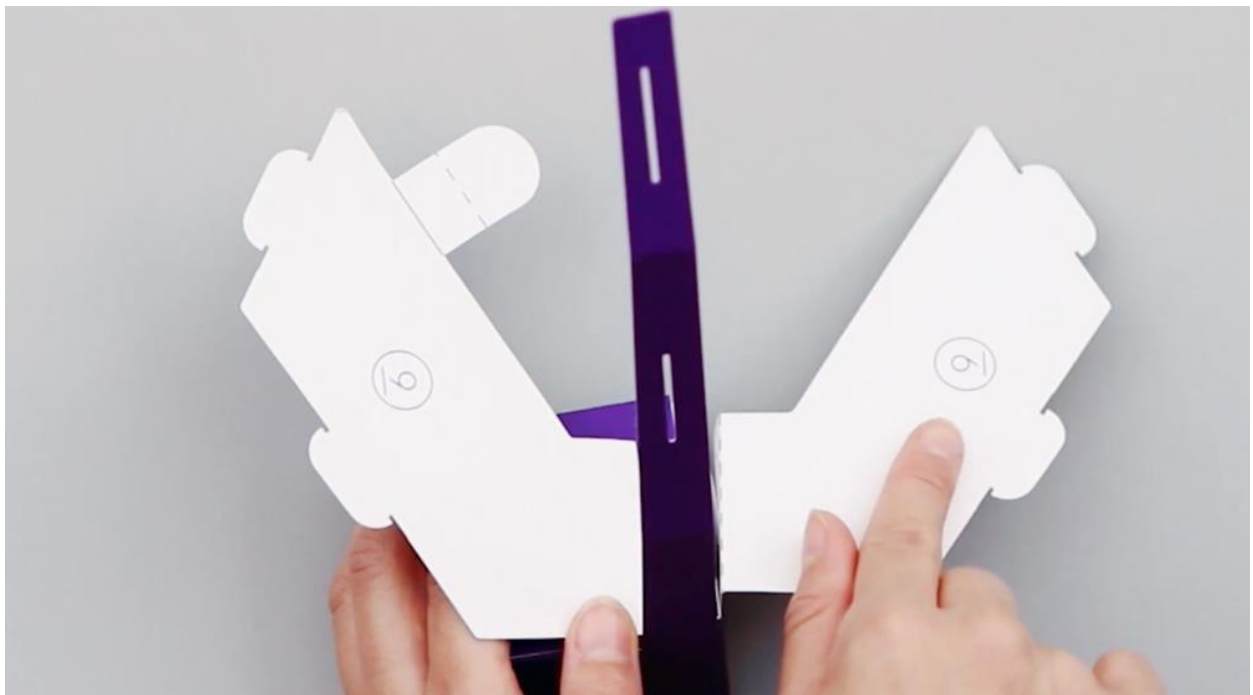
Step 24: Fold and match numbered face #7 with other face #7.



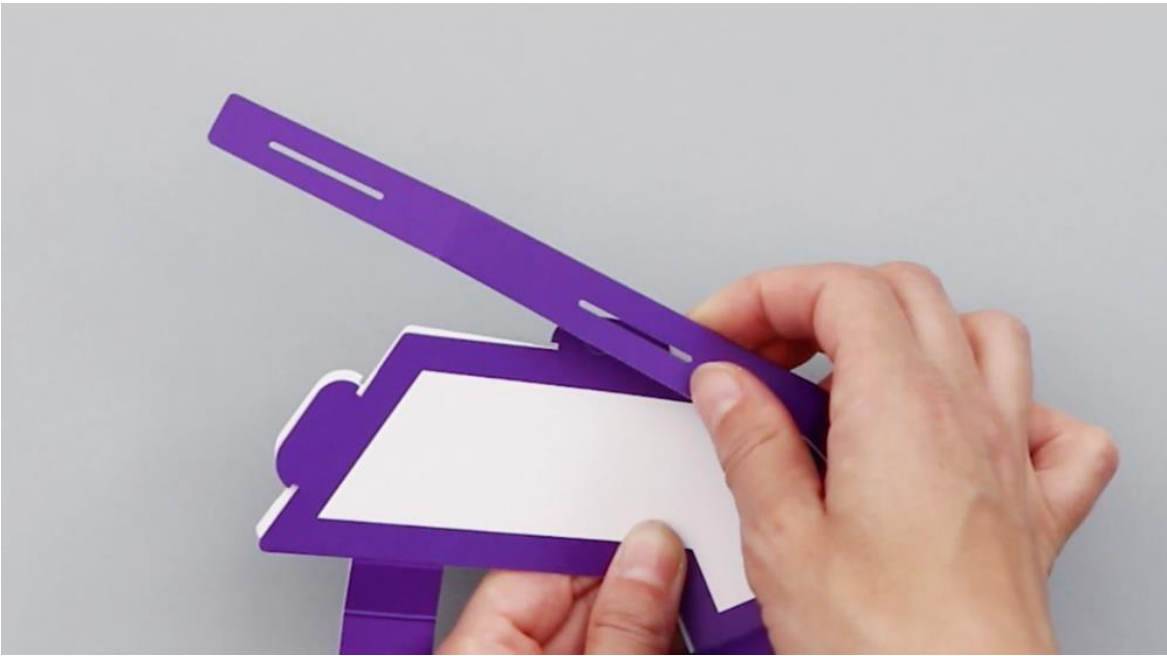
Step 25: Insert tab #8 into slot #8.



Step 26: Fold together and match face #9 with the other face #9.



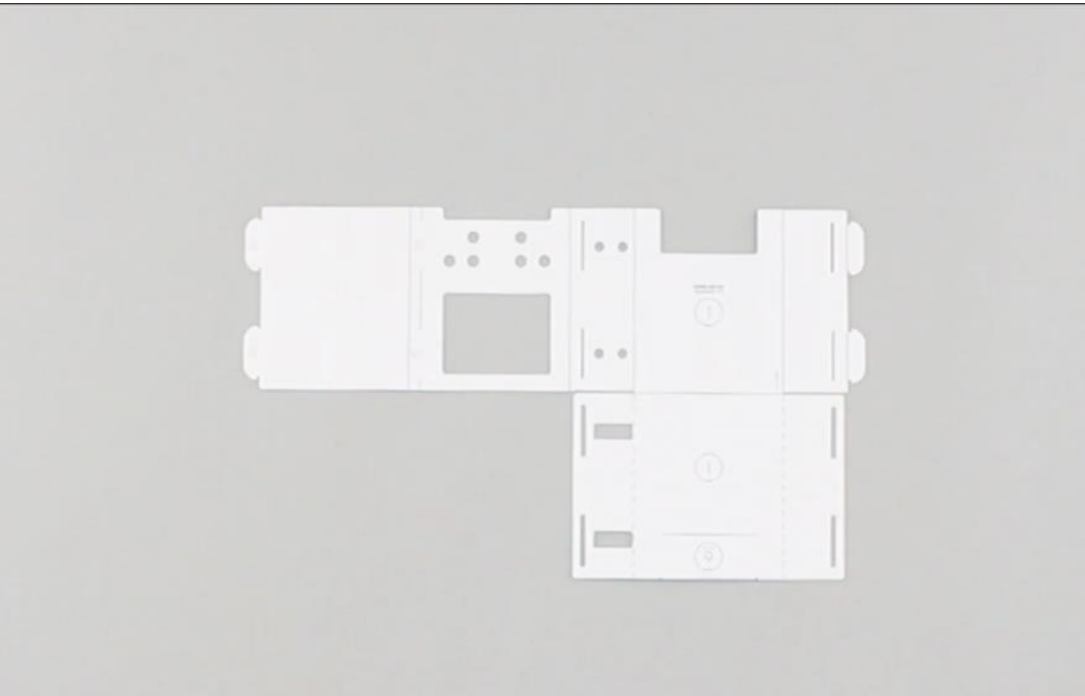
Step 27: Hold the faces together and insert tabs into the slots to hold in place.



Step 28: Now, your second piece is finished. Next, we will move onto our last template to build for our invention.



Step 29: The last template we will build is Template #3.



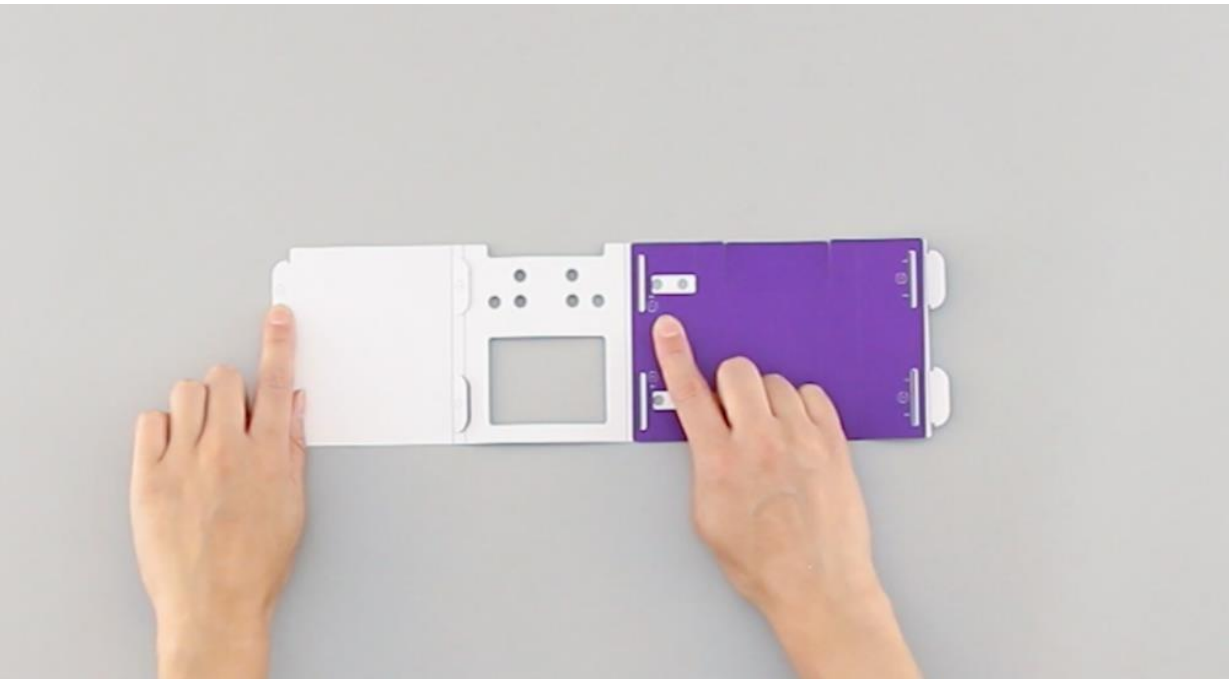
Step 30: Start by folding and unfolding all dotted lines downward and solid lines upward.



Step 31: Next, fold and match numbered tabs and faces in order from #1 to #6.



Step 32: Next, insert tabs #2 and #3 into slots #2 and #3.



Step 33: Fold at the solid line to insert the tabs #2 and #3 into the slots like so.



Step 34: Pull the tabs and lock them into place like so.



Step 35: Insert tabs #4 and #5 into matching slots #4 and #5.



Step 36: Then fold the tabs facing upwards into the slots to hide them.



Step 37: Flip over the template and fold face #6 over other face #6.

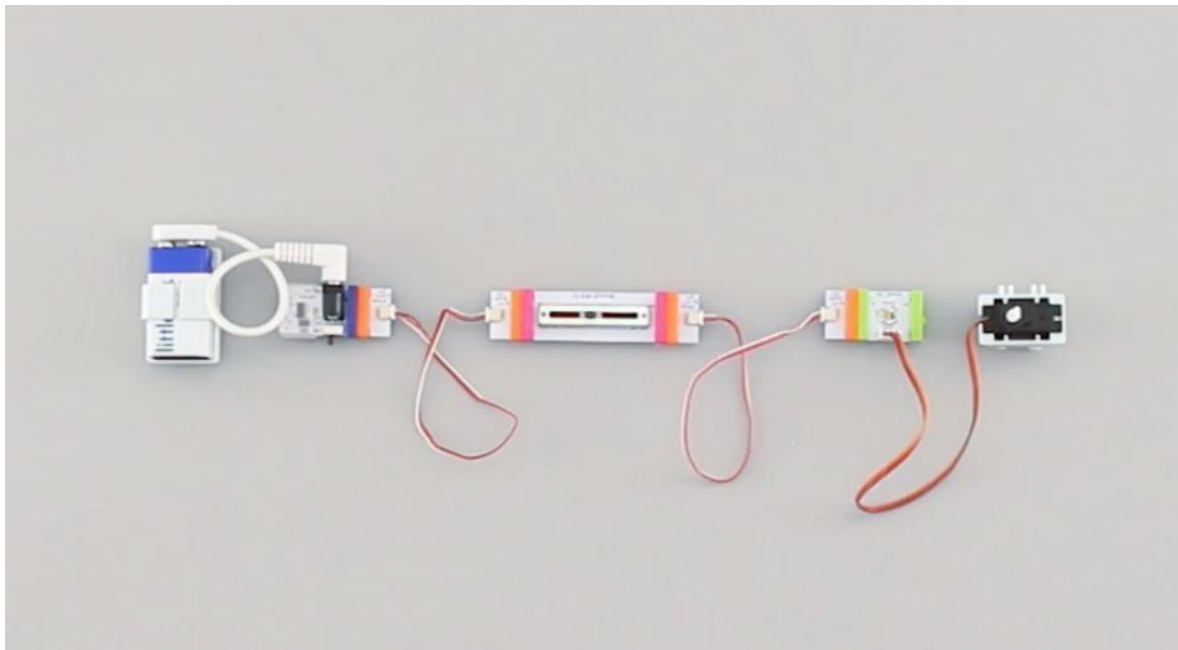


Step 38: Now, you have the last finished template. Now time to build our circuit for our invention.

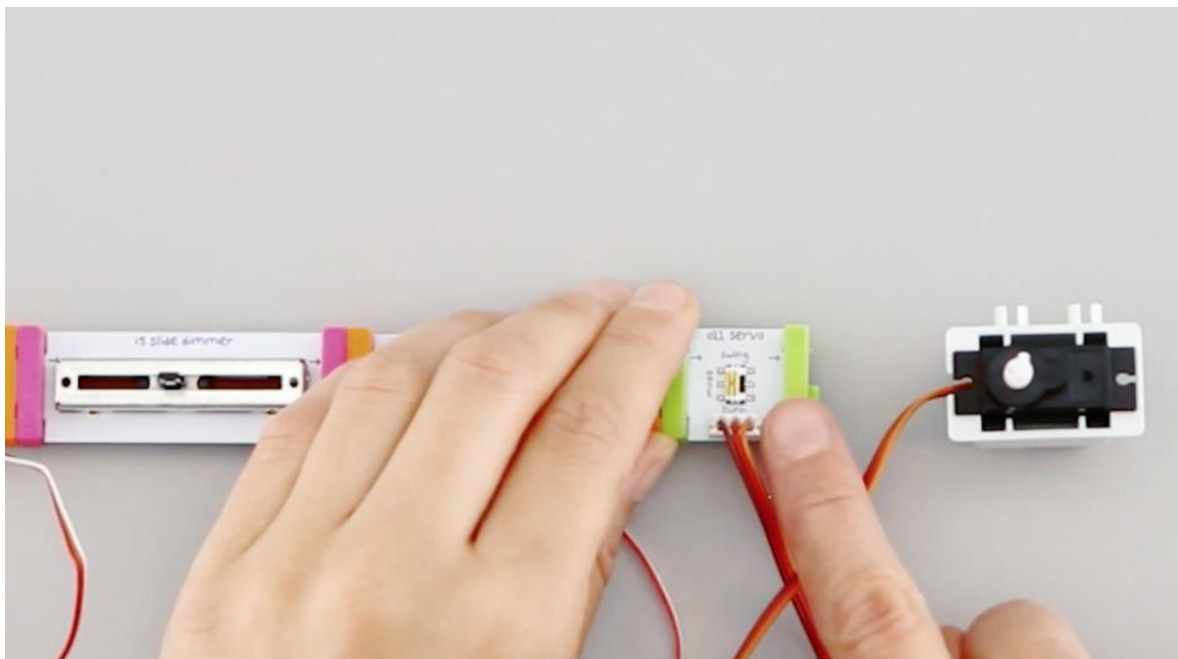


Building our Circuit

Step 1: Attach the battery, power bit, wire bit, slide dimmer bit, wire bit, and servo bit together.

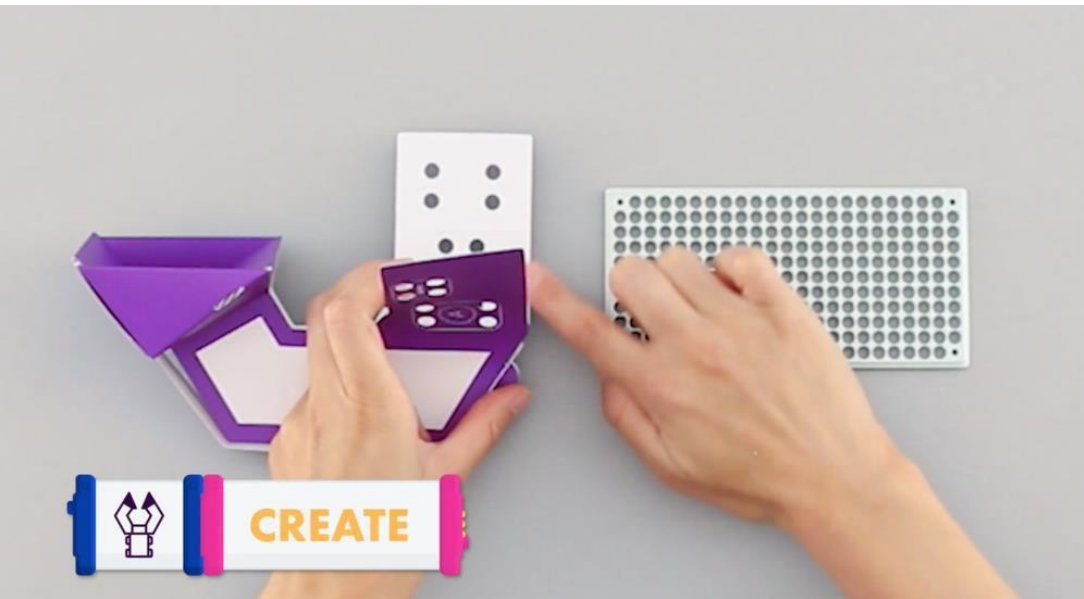


Step 2: Set the servo bit to TURN mode for this invention.



Building our Invention

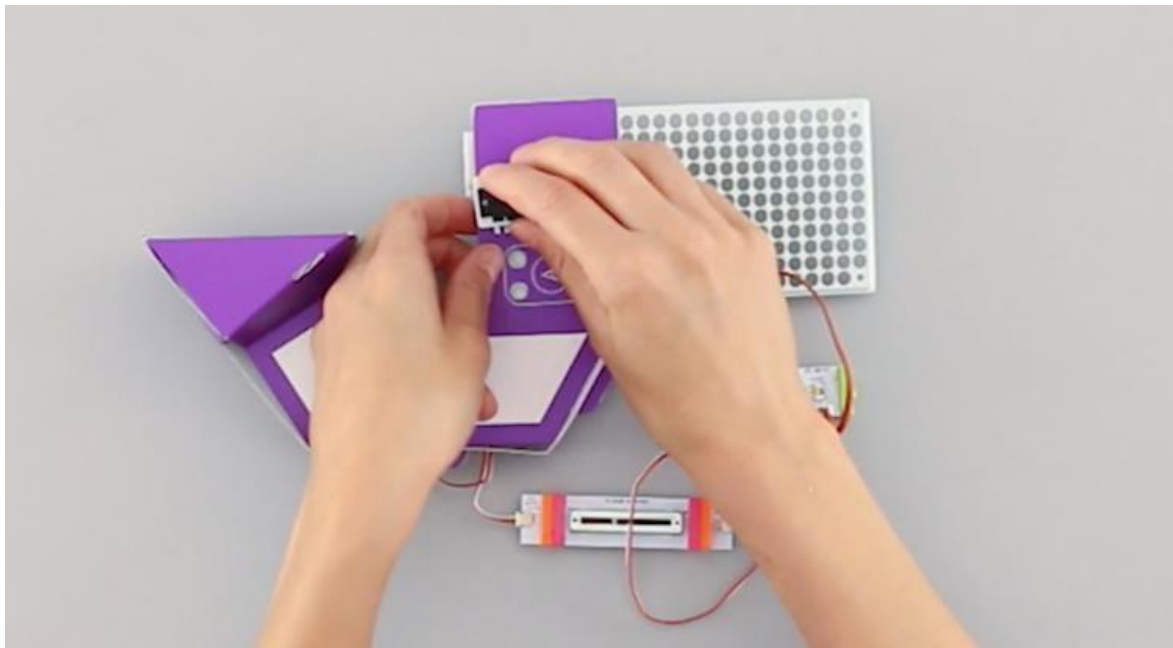
Step 1: Start by sliding your mounting board into the two flaps with bit holes of the first gripper arm you made (Template #2). Make sure the lines are lined up with the holes on the mounting board.



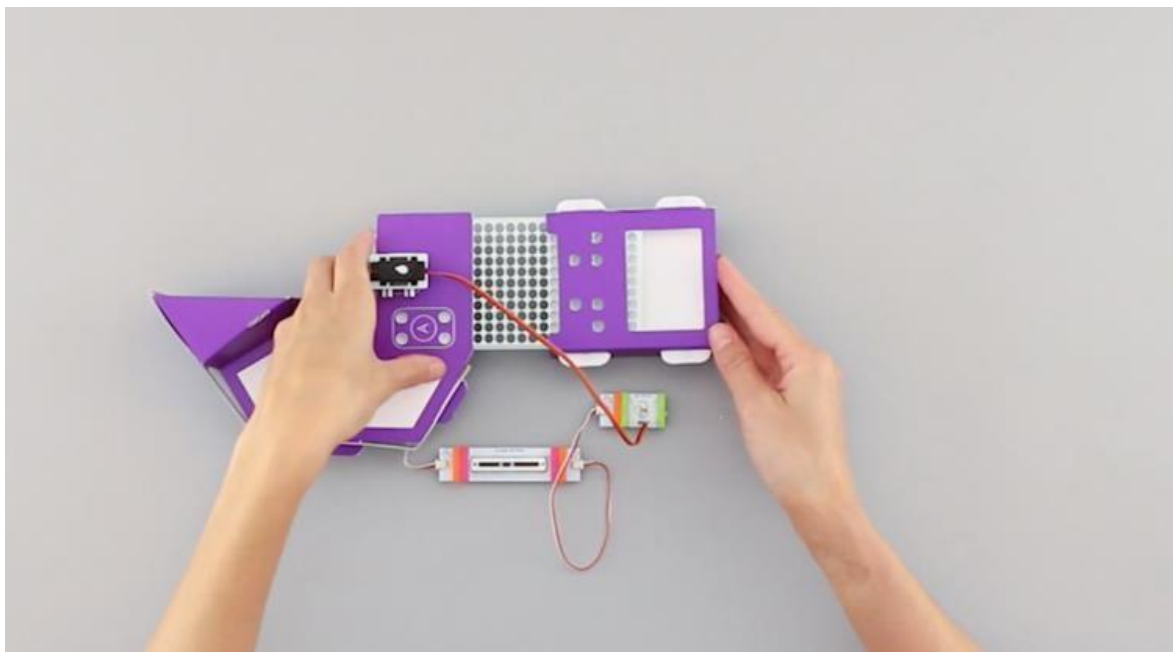
Step 2: Attach the battery onto bit holder “C” and attach power bit onto bit holder “D” like so.



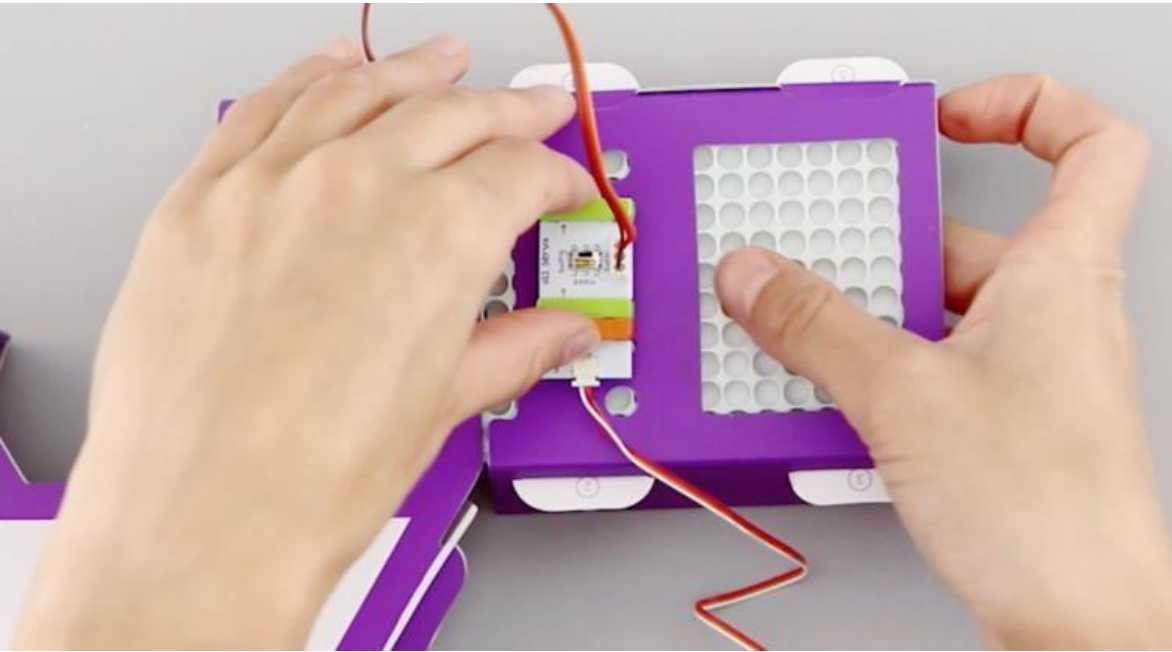
Step 3: Flip over the template and attach the servo motor (not green servo bit) onto the bit holder labeled SERVO.



Step 4: Slide the mounting board into the hand bound (purple box).



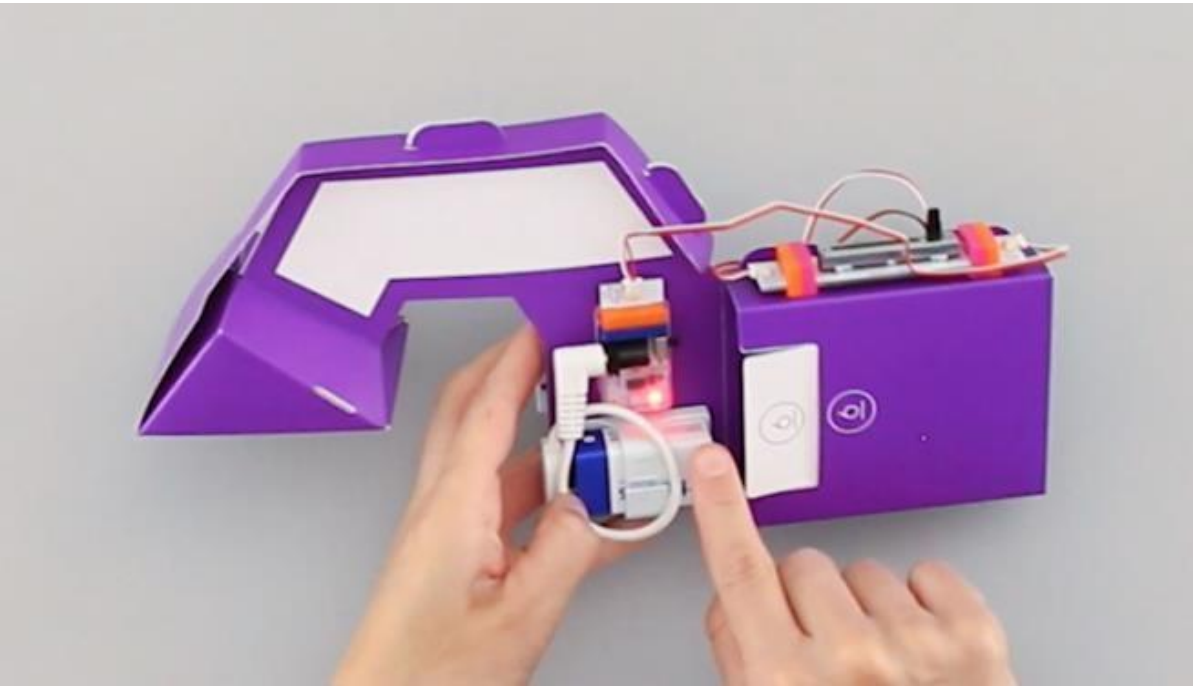
Step 5: Attach the green servo bit onto the bit holes of the hand mound like so.



Step 6: Push the slide dimmer into the bit holes on the side of the hand mould like so.



Step 7: Now power on the power bit.



Step 8: Slide the switch all the way to side marked “Wire In,” this sets the servo in a neutral/resting position.



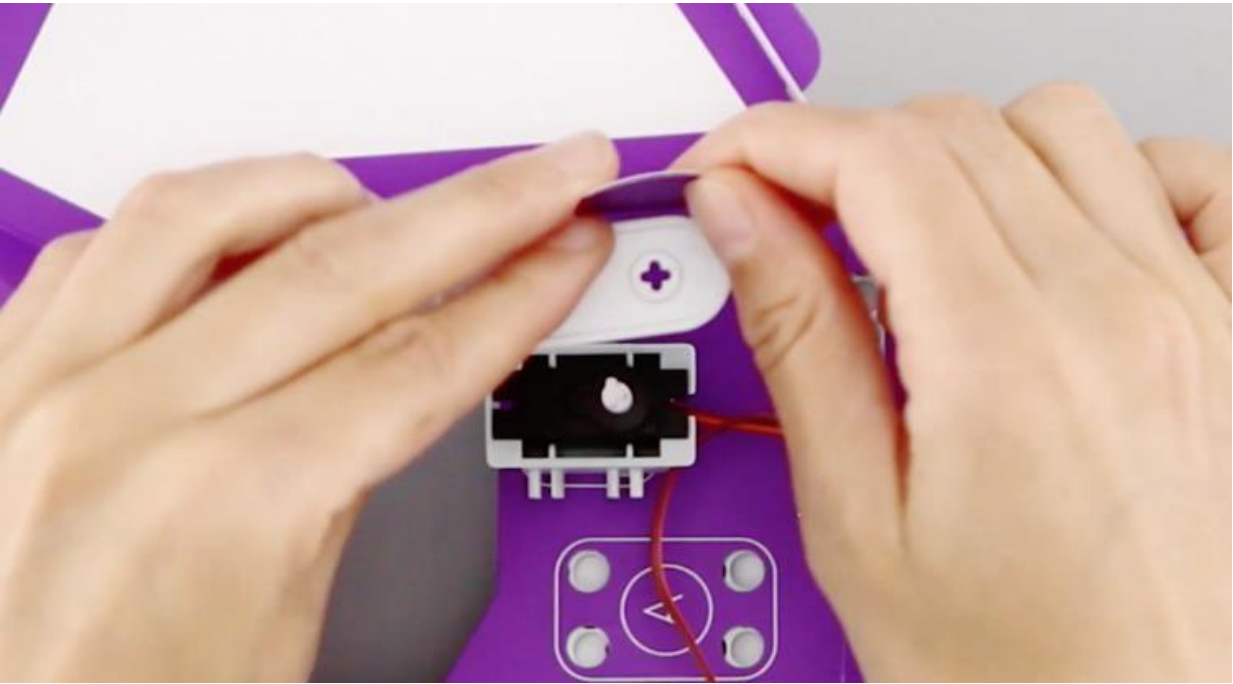
Step 9: Now that the servo has been zeroed out, we can now assemble and attach the moving arm.



Step 10: Slide the moving arm into the other template gripper arm like so.



Step 11: Then attach the end of the arm onto the black motor below. Matching the cross of the arm onto the black motor bit.



Step 12: Now, your invention is finished.



Play

PLAY: Try out your invention!

Watch Here: <https://youtu.be/-I5it--hOYI>

Remix

REMIX: Update or Improve your Prototype

How can you use Bits and craft materials to improve or customize your invention?

Here are some more ideas:

- **Make it Automatic with the Sound Sensor and Latch Bits** ◦

Watch the following video playlist for a guided remix:

- Create Auto Gripper
- Play Auto Gripper
- About the Latch
- [Watch Here at this Link.](#)

- **Add Bits** ◦ How could this change or improve your invention to help someone complete a task?

- Can you add a long LED to make it easier to pick things up in the dark? How about a buzzer Bit?

- **Add Other Craft Materials** ◦ Give your gripper some personality - does it look like an animal or part of a superhero suit?

- Use stickers or add other craft materials and get creative here.

- Are there other materials you can add to change or improve functionality?

- Can you make the scoop bigger or add a pipe cleaner to create a hook?
 - Try out different materials that are available to you.
-

Share

SHARE: Share your invention with friends or family!

Here are some ideas how you can share about your invention:

- Create a story about your invention.
- Talk about the updates or unique features you added to the original prototype and why you decided to make these changes.
- Snap photos of your final invention and send to your site coordinator!

CONGRATULATIONS, YOU HAVE COMPLETED YOUR PROJECT!

Resources

Helpful Links:

[DCI Stem STEM Kit Overview](#)

[DCI Stem STEM Kit Bit Index](#)

[littleBits Basics](#)

[littleBits Invention Cycle](#)

[littleBits Troubleshooting](#)

Inspirational Links: [Nose](#)

[Blowing Machine](#)

Tips & Tricks:

[Servo Modes](#)

ChangeMaker Challenge Part 1

Solve a problem for someone you know through invention!



Inspire

Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

[RUTH ROGAN BENERITO EVA RAMON GALLEGOS](#)

INSPIRATIONAL INVENTION VIDEOS OF THE DAY

These videos show examples of inventions made with littleBits that were designed to make a positive impact on the world. Take a look!

Medicine machine dispenses water, medicine, and helps track how much you take.

[Epilepsy Dog Collar](#): helps dog notify others if their owner is having a seizure.

[Javer Glass](#) (Improved Google Glass): Jerich Lee, 11, noticed that his dad was frustrated by not being able to turn off the head-up display on his Google Glass. Jerich designed a new and improved version of Google Glass, called Javer Glass, that has a heads-up display that can rotate out of the way when not in use. His design also includes a bonus feature: an LED light to help navigate through the dark and read in bed!

[Social Cat](#): Each year 1.5 million cats are euthanized. Max set out to change this with his invention, SocialCat. The goal of SocialCat to make cats more social, more friendly, increase their chances for adoption, and help reduce the number of cats that are euthanized every year. One of the main reasons a cat doesn't get adopted is because it is scared of humans and not friendly. SocialCat helps socialize cats by playing calming human voices and soothing music when a cat eats. The cat learns to associate human voices with the positive experience of eating.

[A blinker system for bicycles](#) to improve bike safety.

[Eco paper towel dispenser](#) that helps you not take too many paper towels.

Create

ChangeMaker Challenge:

Solve a problem for someone you know through invention.

Brainstorm:

- Create a list of ideas for a product.
 - Start by thinking of someone you know (parent, neighbor, teacher, friend) and reflect on what their frustrations or difficulties are.
 - For example, a neighbor that is hard of hearing might need a way to know if someone is knocking at their door.
 - Come up with 3-5 ideas and write them down. No idea is a bad idea!



Choose an Idea:

- After making a list of 3–5 ideas, choose the issue that you want to work on for now.
 - It could be the idea that sounds the most fun to solve, or creates the biggest difference in someone else's life.
- You can always come back to the other ideas later.



Explore your Bits and Materials:

- Look through your Bits and think about how each one could help.
 - Could motion, light, or sound help you achieve your mission?

- Test out different Bit combinations to see if you can achieve the interactions you want.
- Use the [DCI Stem STEM Kit Bit Index](#) for more info about each Bit.
- Think about other materials available to you that might be helpful?

- Are there everyday objects you could make better with Bits?

- For example, if you wanted to design an invention that makes doing chores more fun, you could start with a broom.

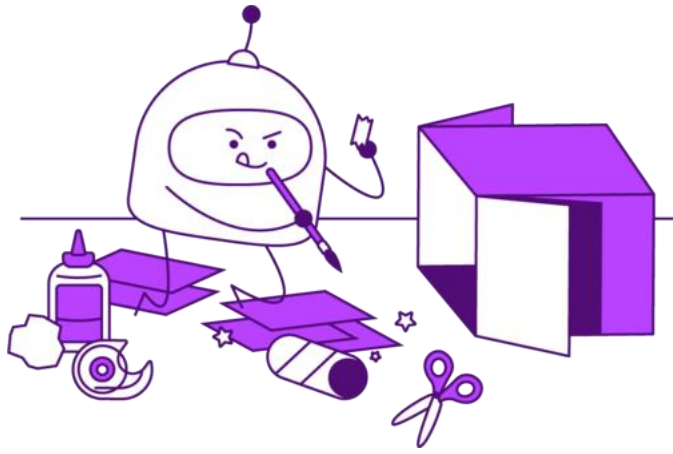


Sketch Out Your Idea:

- Make a sketch of your idea paper
- Describe the #1 goal for the invention
- How does it work?
- What qualities are important for the invention to have?
- Label what Bits and materials you plan to use
- What do you want your invention to look like?



SAVE THIS SKETCH FOR REFERENCE IN THE NEXT PROJECT



Create your First Prototype:

- A prototype is a simple model that lets you test out your idea!
- This is a time for you to dig into the Bits and materials and start to bring their ideas to life.
- Use your sketch as inspiration for your first prototype.
- Don't worry about getting everything right on the first try! The important thing is to just get started and experiment. Building a physical model of your idea makes it easier to share with others and collect feedback on your design. This is a time to dig into the Bits and materials and start to bring your ideas to life.

Tips and Tricks:

If you are working with a servo in your prototype, check out these helpful tips and tricks!

[Video 1:](#) The servo is a type of motor that can move to exact positions. Use the slide dimmer to control it

[Video 2:](#) In swing mode, the servo motor can make things move back and forth, like these waving hands

[**YOU CAN NOW MOVE ON TO PART 2 OF THIS CHALLENGE HERE!**](#)

Resources

Inspirational Links:

DCI Stem STEM Kit Bit

is empathy?

Think it up - Start empathy

Helpful Links:

DCI Stem STEM Kit
Overview

[Index What](#)

[littleBits Basics](#)

[littleBits Invention Cycle](#)

[littleBits Troubleshooting](#)

[Prototyping Tips & Tricks](#)

ChangeMaker Challenge Part 2

Solve a problem for someone you know through invention!



As you work through the session, make sure to review all Bit diagrams to learn how Bits work and how they relate to the real

world. You can also find information about each Bit in the [DCI Stem](#).

Inspire

Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

[BARBARA LISKOV](#) [MARIA KLAWE](#) [HELENE DILLIARD](#)

Play

Play: Test out your prototype!

- Come up with criteria for success ◦ How will you know if your invention works?

- Take notes on what works and what doesn't. You can make changes in the next version.
- Keep in mind that the inventions might not work the first time; failure is part of the process.

Remix

Remix: Now's your chance to experiment with fixes and improvements

- Could adding a new Bit add important features?
- Would craft materials make it stronger or give it a new look?

Test the invention again after a few improvements have been made:

- Work with another person - if possible, try to find the type of person you're designing it for.
 - Ask the person you are working with what their favorite features are and what suggestions they have to make it better.
 - Use their suggestions to create an even better version of your invention.
 - As you make changes to your invention, try to remember what you are changing on your prototype and the results (good and bad).
 - Continue to test and remix the prototype until you are happy with the result.
-

Share

SHARE: Share your invention with friends or family!

Here are some ideas how you can share about your invention:

- Make a presentation and show how your invention works.

- Talk about the updates or unique features you added to the original prototype and why you decided to make these changes.
- Snap photos of your final invention and send to your site coordinator!

CONGRATULATIONS, YOU HAVE COMPLETED THIS PROJECT!

Resources

Inspirational Links:

[What is empathy? Think it up - Start empathy](#)

Helpful Links:

[DCI Stem STEM Kit](#)

[Overview](#)

[DCI Stem STEM Kit Bit Index](#)

[littleBits Basics littleBits](#)

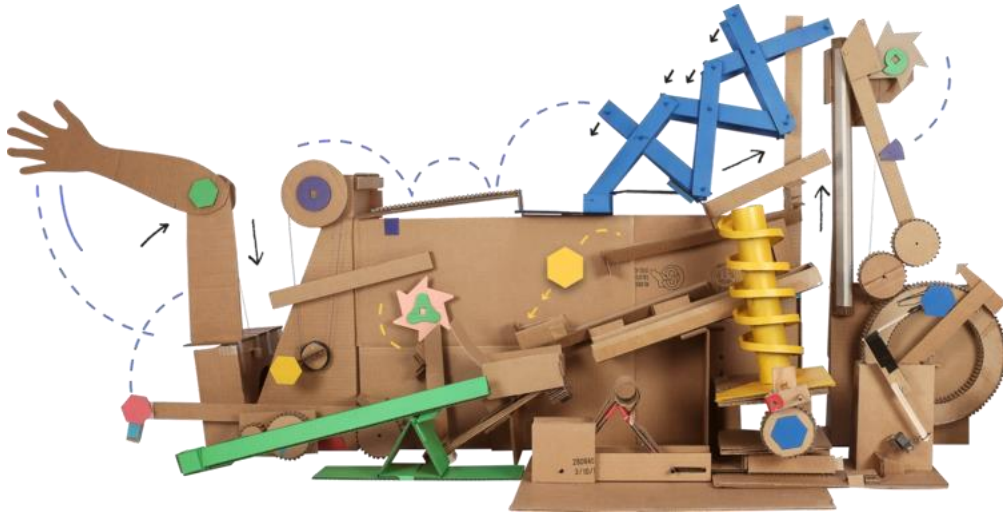
[Invention Cycle littleBits](#)

[Troubleshooting](#)

[Prototyping Tips & Tricks](#)

Chain Reaction Challenge Part 1

Invent a wacky multi-step machine to complete a simple task.



As you work through the session, make sure to review all Bit diagrams to learn how Bits work and how they relate to the real world. You can also find information about each Bit in the_DCI Stem.

Inspire

Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?

- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

[RUTH ROGAN BENERITO EVA RAMON GALLEGOS](#)

INSPIRATIONAL INVENTION VIDEOS OF THE DAY

[Rube Goldberg](#) was a cartoonist, engineer, and inventor who created chain reaction contraptions to perform simple tasks. He inspired many inventor's to make their own Rube Goldberg machines. Here are some examples:

[Video 1](#) - Joseph Hersher: An easy way to be more productive at lunch time

[Video 2](#) - OK Go - Giant Rube Goldberg

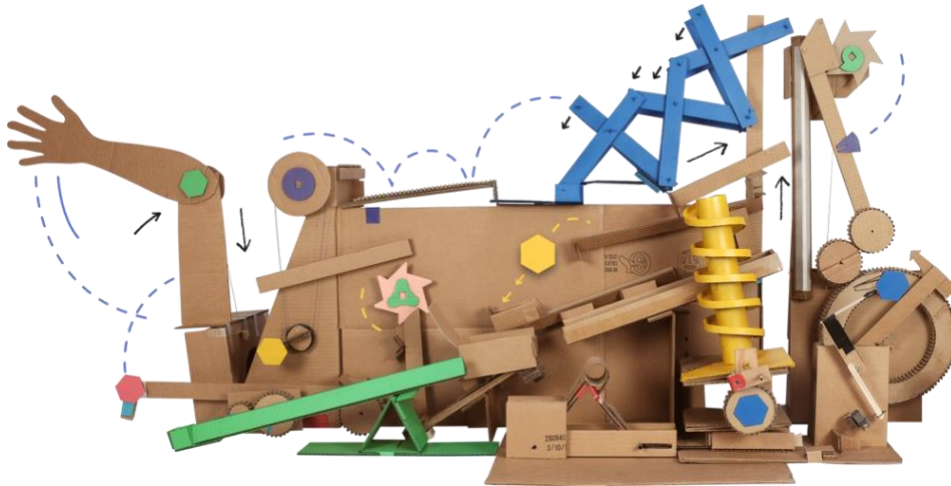
[Video 3](#) - Rube Goldberg Machines made with littleBits

[Video 4](#) - Six Rube Goldberg Machines

Create

Change Reaction Challenge

Invent a wacky multi-step machine to complete a simple task.



Brainstorm:

- Create a list of everyday activities that only take one step.
 - For example, dropping a can in the recycling bin, flipping on a light switch or opening a book.
 - Record these ideas on a piece of paper to refer to as you build.
- Come up with 5-10 ideas and write them down. No idea is a bad idea!

Choose an Idea:

- After making a list of 5–10 choose the everyday you want to accomplish.
 - It could be the idea the most fun to solve most accessible at location.
- You can always come back to the other ideas later.



ideas,
activity that

that sounds
or is the
your

Explore your Bits and Accessories:

- Look through your available Bits and accessories to see how they could (or couldn't) be combined to help solve your problem.
 - For example, how could a servo trigger a slide dimmer?
 - How could a buzzer trigger a sound sensor?
 - Could the latch play a role?
- Test out different Bit combinations to see you can achieve the interactions you want.
- Use the [DCI Stem STEM Kit Bit Index](#) for more info about each Bit.



Experiment with Materials to Create Simple Machines:

How could other materials (e.g. books, cardboard, cups) serve as triggers?

Here is some inspiration. Get started by watching these intro videos:

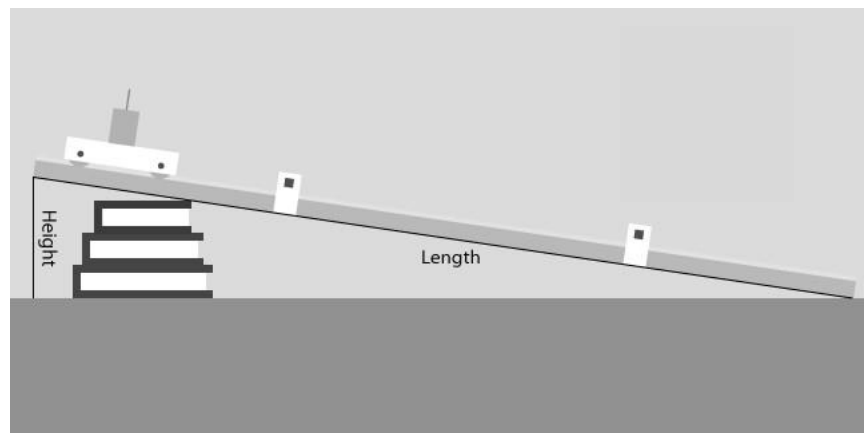
MACHINE BASICS

Watch the video below on how to build machines below:

[Video 1](#) and [Video 2](#)

INCLINED PLANES / RAMPS

Watch the video below on how to build an inclined plane/ramp: [Video 1](#)



MINI CHALLENGE #1

Build two simple inclined planes. You can use cardboard or found objects. Test rolling a small ball down the ramps. Which ramp is faster?

MINI CHALLENGE #2

Create a marble run by building a series of book ramps. See how many levels you can create.

LEVERS

Watch the videos below on how to create levers:

[Video 1](#) and [Video 2](#)

MINI CHALLENGE #3

Build a lever out of cardboard or found materials. Place an object on one end of the lever and experiment with what weight you need to cause it to tip.

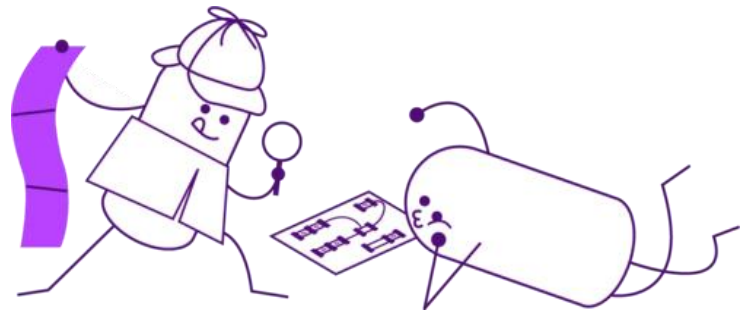
MINI CHALLENGE #4

Create a marble run that uses both inclined planes AND levers. Try to come up with as many actions as possible for your ball to move through.

SAVE THESE PARTS AND PIECES FROM YOUR EXPERIMENTS

Sketch Out Your Chain Reaction Prototype:

- What task are you trying to complete?
- Label what Bits and materials do you plan to use (***Note: your machine must use littleBits**)
- How do you plan to combine different elements?
- How does it work?
- What do you want your invention to look like?



SAVE THIS SKETCH FOR REFERENCE IN THE NEXT SESSION

[YOU CAN NOW MOVE ON TO PART 2 OF THIS CHALLENGE HERE!](#)

Resources

Inspirational Links:

[Rube Goldberg](#)

[Six Rube Goldberg Machines](#)

[OK Go Rube Goldberg Machine](#)

[littleBits Rube Goldberg
Machines](#)

[The Lunch Feeder](#)

Helpful Links:

[DCI Stem STEM Kit Overview](#)

[DCI Stem STEM Kit Bit Index](#)

[littleBits Basics](#) [littleBits](#)

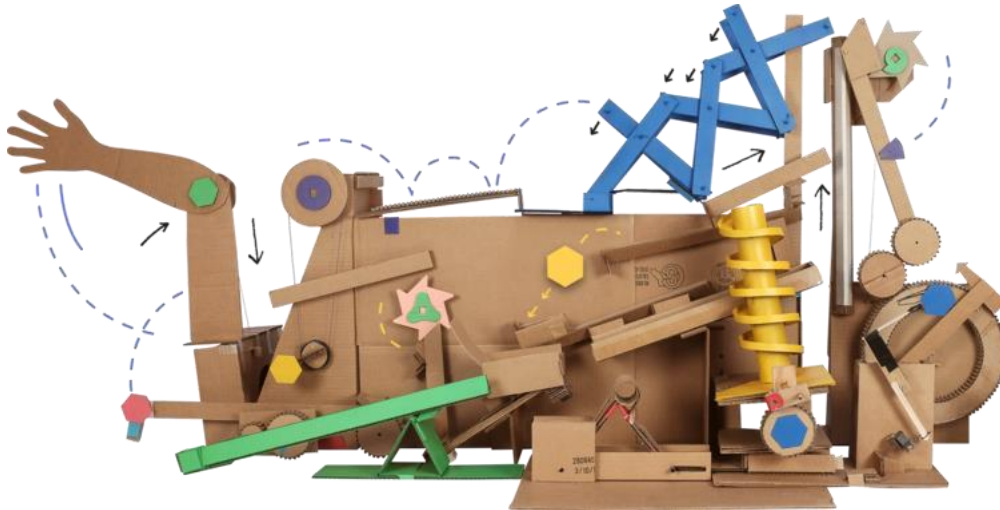
[Invention Cycle](#) [littleBits](#)

[Troubleshooting](#)

[Prototyping Tips & Tricks](#)

Chain Reaction Challenge Part 2

Invent a wacky multi-step machine to complete a simple task.



As you work through the session, make sure to review all Bit diagrams to learn how Bits work and how they relate to the real world. You can also find information about each Bit in the [DCI Stem](#).

Inspire

Career Exploration

Explore these women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

[BARBARA LISKOV](#) [MARIA KLAWE](#) [HELENE DILLIARD](#)

Create

Create a prototype of your machine that combines Bits and your simple machine experiments.

- Use your sketch and any simple machine prototypes you experimented with in Part 1.
 - A prototype is a simple model that lets you test out your idea!
 - Don't worry about getting everything right on the first try!
 - The important thing is to just get started and experiment. Building a physical model of your idea makes it easier to share with others and collect feedback on your design.

Play

PLAY: Test out your prototype!

- Once the prototypes have been constructed, observe your creation.
 - Does it complete the task?
- Getting all of the moving pieces to work together is going to be a challenge; failure is part of the process.
 - Don't be afraid to make adjustments on angles, connections and materials.
- Take notes about what works and what doesn't.
 - You can make changes in the next version!

Remix

REMIX: Now's your chance to experiment with fixes and improvements

- Could adding a new Bit add important features?
- Would craft materials make it stronger or give it a new look?

Test the invention again after a few improvements have been made

- Work with another person - ask them what their favorite features are and what suggestions they have to make it better.
 - Use their suggestions to create an even better version of your invention.
 - As you make changes to your invention, try to remember what you are changing on your prototype and the results (good and bad).
- Continue to test and remix the prototype until you are happy with the result.

Share

SHARE: Share your invention with friends or family!

Here are some ideas how you can share about your invention:

- Make a presentation and show how your invention works
- Talk about the updates or unique features you added to the original prototype and why you decided to make these changes.
- Snap photos or videos of your final invention and send to your site coordinator!

CONGRATULATIONS, YOU HAVE COMPLETED THIS PROJECT!

Resources

Inspirational Links:

[Rube Goldberg](#)

[Rube Goldberg Machines Index](#)

[OK Go Rube Goldberg](#) [littleBits Basics Machine](#)

[littleBits Rube Goldberg Machines](#)

[The Lunch Feeder](#)

Helpful Links:

[DCI Stem STEM Kit Overview](#)

[DCI Stem STEM Kit Bit Six](#)

[littleBits Invention Cycle](#)

[littleBits Troubleshooting](#)

[Prototyping Tips & Tricks](#)

Carnival Games Challenge Part 1

Design an interactive game!



Inspire

Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

[TERRY WINSTON EDITH CLARKE](#)

INSPIRE IN ACTION

Students will now have a chance to describe and draw themselves in their future STEM career.

- Please fill out this **online only survey** to follow up the postcard activity: [My Future Self Survey](#).
- Please print the [My Future Self Worksheet](#) and complete the activity.

If you are able to share photos or scanned copies of the picture worksheets – please send to our team at snapthegap@ucdavis.edu or to your site coordinator!

INSPIRATIONAL INVENTION VIDEOS OF THE DAY

These videos show examples of interactive games invented with littleBits and other materials. Take a look!

[Video 1](#) - Invent a game that puts a new spin on an old arcade favorite: The Pinball Machine. Use the slide dimmer to bounce the ball all over this invention. But watch out, the ball will bounce and bump all over the box like it's out of control!

[Video 2](#) - This project is created with littleBits by BONEVET makers to show the glorious moment when Majlinda Kelmendi won the gold medal at the Rio Olympics Women's Judo Final. The game can be played by two players.

[Video 3](#) - Marble Mission: an arcade game made with littleBits!

[Video 4](#) - Arcade game made with littleBits: you can make targets with prizes behind them that are released when hit by a coin.

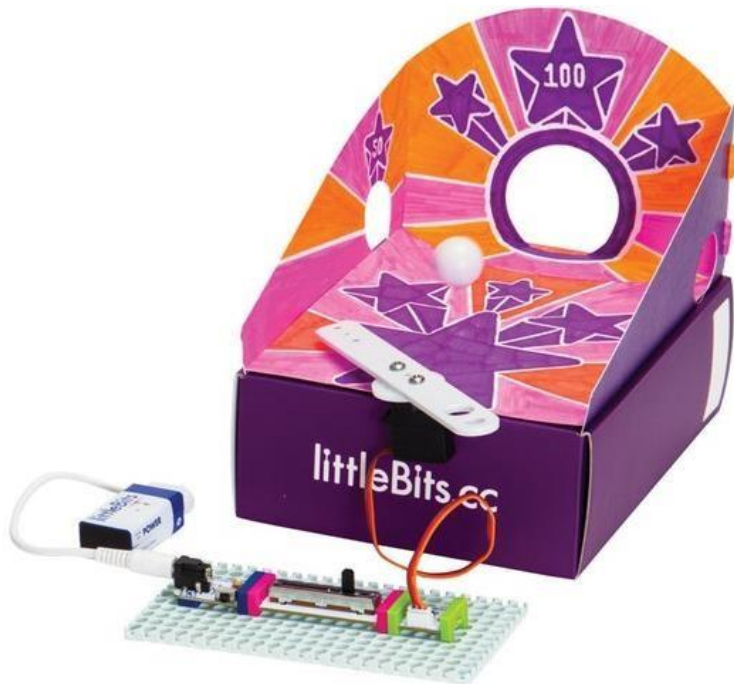
[Video 5](#) - littleBits Wrestling Game

[Video 6](#) - Tech Table Tennis

Create

Carnival Games Challenge

Design an interactive game!



Brainstorm:

- Create a list of carnival games you would like to create.
- Sketch out or write down three ideas.

Choose an idea:

Choose one idea to bring to life.

- What are the constraints?

- Constraints are the limits and requirements that need to be considered in the invention process. ◦ Examples include time, materials, weight. Detail any constraints that you may need to keep in mind as you work.
- What are the criteria for success?
 - What is the number-one goal for the invention? What qualities are important for the invention to have? ◦ How will players know when you win or lose the game? What are the rules players should follow?
- If you are designing a brand-new game, consider some things:
 - COMPONENTS: Whether it's the players that make the game, little wooden pawns, or extraterrestrial obstacles, your game needs items.
 - PLAYERS: Is it an individual or multi-player game?
 - SPACE: Well, it all needs to happen somewhere, right?
 - MECHANICS: The actions that you take in the game. Think of verbs like jumping, pushing, swinging!
 - GOALS: Make your game have multiple goals that allow your players to make interesting choices.
 - STRATEGY: Even if you are making a very simple game, make sure that it allows for some strategy so that, if played again, the game will not give the same outcomes. Bottom line: If the same person is winning over and over, something is wrong.
 - SURPRISES: You might not be the surprise type, but a game is no fun without some unexpected moments.



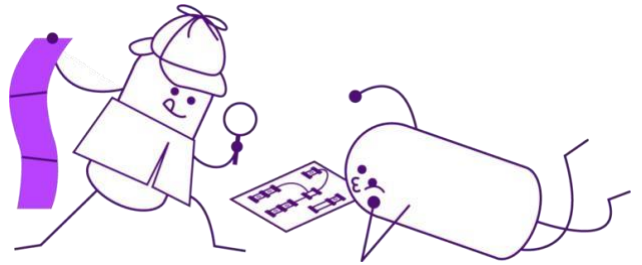
Explore your Bits and Materials:

- Look through your available Bits and materials to see how you could (or couldn't) help solve the problem.
- For example, how could a servo trigger a proximity sensor?
- How could a buzzer give feedback about the game? How could other materials (e.g. books, cardboard, cups) serve as triggers or targets? ◦ If you get stuck, try snapping a Bit into a circuit or read through the [DCI Stem STEM Kit Bit Index](#)



Sketch Out Your Idea:

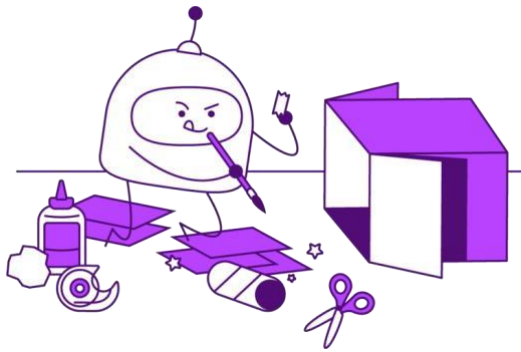
- Create a drawing(s) of your first prototype, labeling Bits and any important features. A description of how the prototype is supposed to work can be included.
- Describe the #1 goal for the invention
- What do you want your invention to look like?



SAVE THIS SKETCH FOR REFERENCE

Create your First Prototype:

- A prototype is a simple model that lets you test out your idea!
- This is a time for you to dig into the Bits and materials and start to bring their ideas to life. Think big!
- Use your sketch as inspiration for your first prototype.



Don't worry about getting everything right on the first try! The important thing is to just get started and experiment.

Building a physical model of your idea makes it easier to share with others and collect feedback on

your design.

Make a plan for next session

- In the next session, you will test, and improve your carnival game. You will also make a poster of how it works and the rules for winning.
- Are there any special materials you would like to use?
- Make a plan to gather these materials for next session!

[MOVE ON TO THE NEXT PAGE HERE!](#)

[Arcade Game](#)

[littleBits Target Game](#)

[littlebits Wrestling Game](#)

[littleBits Tech Table Tennis](#)

Resources

Inspirational Links:

[Caine's Arcade](#)

[DIY Carnival Games](#)

[Carnival Games Kids Love](#)

[Sample littleBits](#)

[game inventions](#)

[littleBits Bumperball](#)

[littleBits Judo Game](#)

[littleBits Marble Mission](#)

Helpful Links:

[DCI Stem Overview](#)

[DCI Stem STEM Kit Bit](#)

[Index](#)

[littleBits Basics littleBits](#)

[Invention Cycle littleBits](#)

[Troubleshooting](#)

[Prototyping Tips & Tricks](#)

Carnival Games Challenge Part 2

Design an interactive game!



Inspire

Career Exploration

Explore these two women who have made significant contributions to STEM fields. Please take a few minutes to read their stories in the postcards below and think about the following:

- Can you see yourself in her job?
- Are you interested to learn more about her job?
- What inspires you about this role model?

Download Women in STEM postcards here:

[MOLLIE ORSHANSKY MALALA YOUSAFZAI](#)

Play

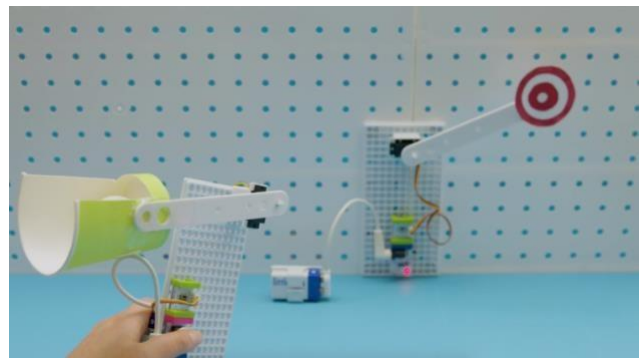
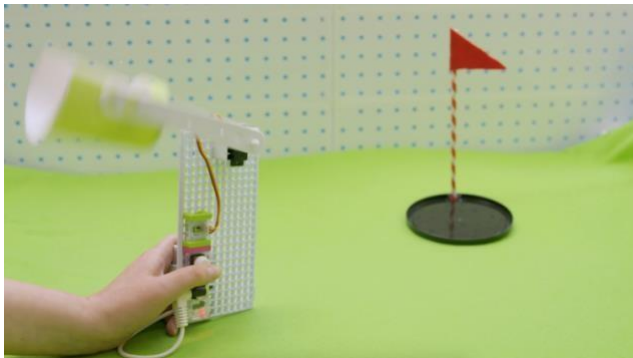
Play: Test out your prototype



- Test your invention to make sure it works and to see what you can learn. Keep in mind that your invention likely won't work perfectly the first time; failure is part of the process.
 - Some questions for you to think about:
 - What is one thing you like about your prototype?
 - What is one area you can improve about your prototype?
 - Take notes about what works and what doesn't, so you can make changes in the next version.
-

Remix

REMIX: Update or Improve your Prototype



This is the opportunity to experiment with fixes and improvements.

- Could adding a new Bit add important features?
- Would craft materials make it stronger or give it a new look?

Continue Play Testing

- Getting feedback during the design process will help you make even better versions of their prototype.

- Ask others what their favorite features are and what suggestions they have to make it better.
- Test the invention after a few improvements have been made.

Continue the Remix phase until the prototype has been modified until the you are satisfied with the final invention.

Prepare for your Carnival Showcase

Preview of the next session:

- In the next session, we will celebrate your Carnival Invention by hosting a carnival to showcase the game(s) the you created. ◦ To prepare, you will need to make a poster explaining how your game works.

Prepare: Create an informational card/poster

- Information should include:
 - Name of the game
 - Bits & materials used
 - The goal of the game
 - Any rules the player should know about



ONCE YOU ARE READY FOR THE SHOWCASE, CLICK HERE FOR THE NEXT PROJECT!

Resources

Inspirational Links:

[Caine's Arcade](#)
[DIY Carnival Games](#)
[Carnival Games Kids Love](#)
[Sample littleBits
game inventions](#)
[littleBits Bumperball](#)
[littleBits Judo Game](#)
[littleBits Marble Mission
Arcade Game](#)
[littleBits Target Game](#)
[littleBits Wrestling Game](#)
[littleBits Tech Table Tennis](#)

Helpful Links:

[DCI Stem STEM Kit
Overview](#)
[DCI Stem STEM Kit Bit
Index](#)
[littleBits Basics littleBits
Invention Cycle littleBits
Troubleshooting](#)
[Prototyping Tips & Tricks](#)

Carnival Showcase

Host a celebratory carnival with interactive games!



Post Survey

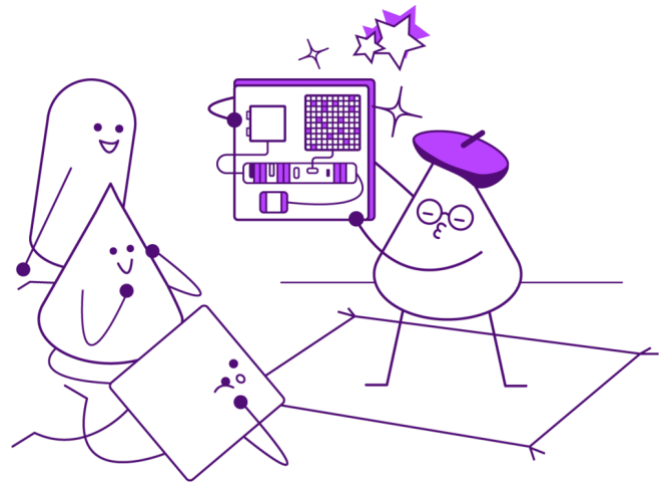
Please complete the Student Post Survey to tell us more about your experience:

[Click here for the Post Survey](#)

Share

SHARE: Present your Final Carnival Invention to friends and family!

- Friends and Family can help document the final presentation by taking photos.
 - Send to your site coordinator!
- During the presentation, explain to your audience these few things:
 - Name of the game
 - Bits & materials used
 - The goal of the game
 - Any rules the player should know about



Play

PLAY: Have your audience interact with your Carnival Inventions!

- Set out your poster next to your invention and have your audience take turns playing your game.



CONGRATULATIONS, YOU HAVE COMPLETED ALL THE PROJECTS!!