Toys For All

A Beginner’s Guide To Toy Adapting

Neil Squire

Makers Making Change
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Why Switch Adapted Toys?

Allows for more accessible play

- Many toys have hard to reach or small buttons
    - Requires fine motor skills
- Some toys need to be held or grasped
- Adding an assistive switch gives the user an easier way to control a toy

What kind of things do you need to be able to do to play with a traditional water gun?

Why Switch Adapted Toys?

Toys are how kids learn

- Learn to use AT for communication, environment, cause and effect
- Allows for independent play

A variety of toys can be switch adapted

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Why Switch Adapted Toys?

Commercial switch adapted toys are expensive

Buying a Toy:

$10 - $30

Buying an Adapted Toy:

$100+

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Felix Playing

Chester's Story

"We hunt for toys for him, and it's so hard," says his father Darren. *"Like the dinosaur is a toy I've seen at Walmart, but I would never buy it for him because he would never be able to press the buttons to control it. But once it's converted to be adapted to be a switch toy, he can play with it like any other kid would be able to press the buttons — he can now do that with an everyday toy,"* explains Cheryl

What To Look For in Toys to Adapt

Considerations when Choosing a Toy

- Must be battery operated
  - Avoid toys that plug into a wall
- Must have access to inside wires and components
  - Do you have the correct tools to open a toy?
- Look for toys with 1-2 buttons
  - The more buttons, the more difficult to adapt

Things to Avoid when Choosing a Toy

- Avoid toys that require physical contact
- Avoid complicated toys
  - Remote Control toys are more difficult
  - Avoid toys with a lot of buttons / joysticks

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Additional Considerations when Choosing a Toy

- Consider what a child would want
  - What's their favorite character?
  - What's their favorite animal?
- Consider the toy's features
  - Light
  - Sound
  - Music
  - Vibration
  - Bubbles
- Consider the toy's colors
  - Look for bright, fun toys

Bubble Machines!

- Large variety
  - Animals
  - Characters
  - Music
  - Lights
- Cost effective
- Easy to adapt
  - Great starting toy to learn
  - Can see wires between switches, motor and batteries

Tools & Materials

Required Tools

1. Soldering iron + solder
2. Wire strippers
3. Screwdrivers
4. Flush cutter
5. Drill + 1/8” + ¼” drill bits
6. Safety Glasses
7. Assistive switch

1.

2.

3.

4.

5.

6.

7.

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Nice to Have Tools

1. Multimeter
2. Electrical tape
3. Magnetic bowl for storage
4. Mat for Work Surface
5. Third hands, or helping hands
6. Hot glue gun + glue
7. Needle and thread

1.


2.


3.


4.


5.


6.


7.


Where To Buy these Tools

- Hardware stores
- Some department stores
- Amazon
  - Great way to get most of the supplies
  - Range between $20 - $50
  - Amazon Tool Kits

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Materials for Mono Jack Method

1. 3.5 mm Mono Jack
   - Can have various shapes
   - Digikey
2. Wire
   - Amazon Wire Link
3. Solder

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Materials for Mono Cable Method

- 3.5 mm Female Mono Cable
  - Have 2 internal wires
  - Amazon - 10 pack of Female mono cables ~$20

OR

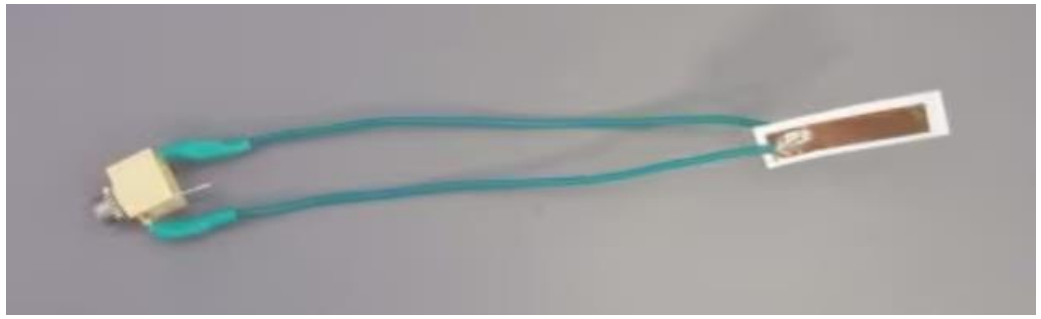
- 3.5 mm Female Stereo Cable
  - Have 3 internal wires
  - Twist two of the wires together
  - More steps, works the same!

3.5mm Cable Basics Resource

Materials for Battery Interrupter Method

- MMC PCB Battery Interrupter
  - MMC Battery Interrupter
  - Flat, Rectangular Mono Jack
  - 3D Print Files
  - Build Instructions

- DIY Battery Interrupter
  - Wire
  - Square Mono Jack
  - Copper tape
  - Paper
  - Build Instructions



Methods For Adapting

How Many Inputs to Add?

- Push buttons
  - Number of buttons = number of new inputs (assistive switches)
- Sliding switch
  - One input
    - Slide to what action is wanted and press switch to activate
  - Multiple inputs
    - Separate input (switch) for each option on slide switch
    - Different inputs do different actions

Methods For Adapting – Mono Jacks

Reasons To Use Mono Jacks

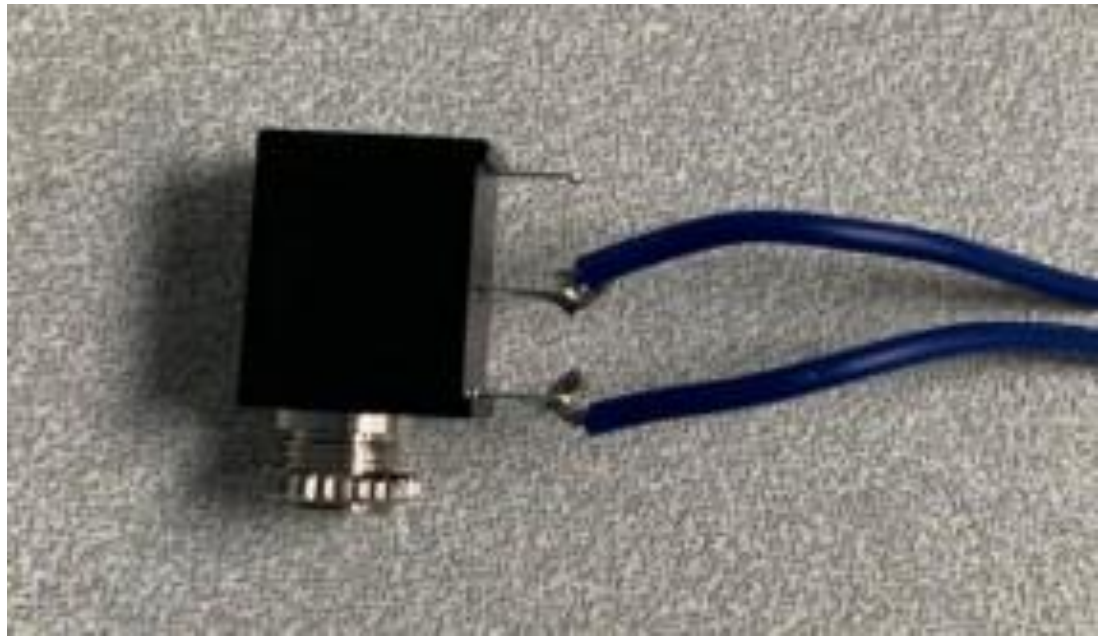
- Use with hard plastic toys
  - Drilled hole allows for all parts to be internal
- Length of wire varies with toy
- Greater variety of methods of adapting
- Variations in shape/size of mono jacks to help with fit

Downside:

- A lot of variations of parts can be confusing
- Need to find space for jack internally

How to Use Mono Jacks

1. Open the toy
2. Cut and prepare two pieces of wire
   - Wires need to be long enough to reach from jack to attachment points
   - Strip 0.5cm off the end of each wire
3. Solder wires onto mono jack
   - Solder onto the tabs closest to cable insert
4. Attach to inner components
   - Refer to the next few slides
5. Drill a hole in toy for mono jack
   - Make sure there's enough room on the inside for mono jack
   - Use a ¼" drill bit
   - Insert the ring on the outside of the toy

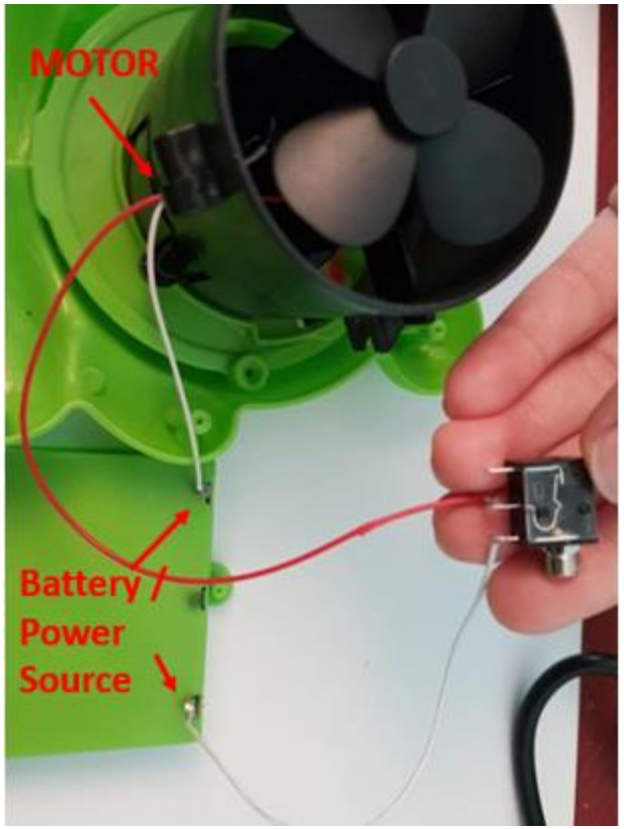


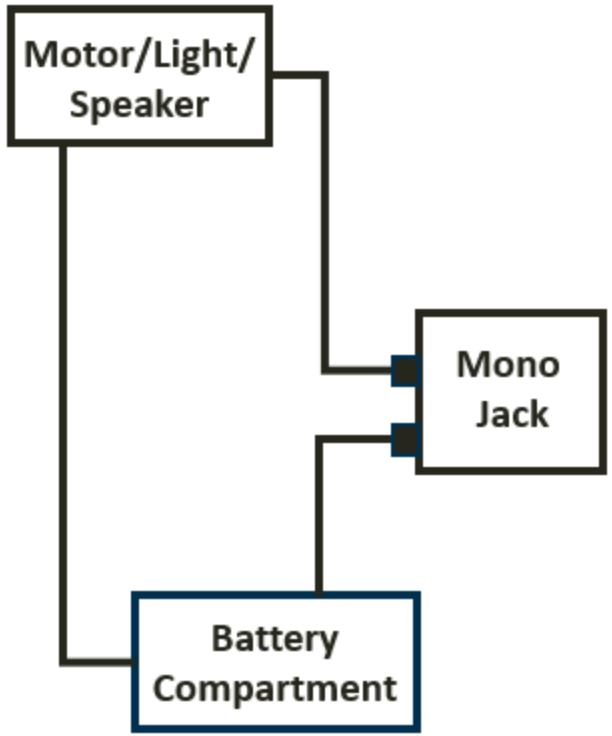
Replacing Switch with Mono Jack

- Toys with simple wiring: wires connecting switch to motor to battery
- Wires can be desoldered or cut from original switch and replaced with mono jack

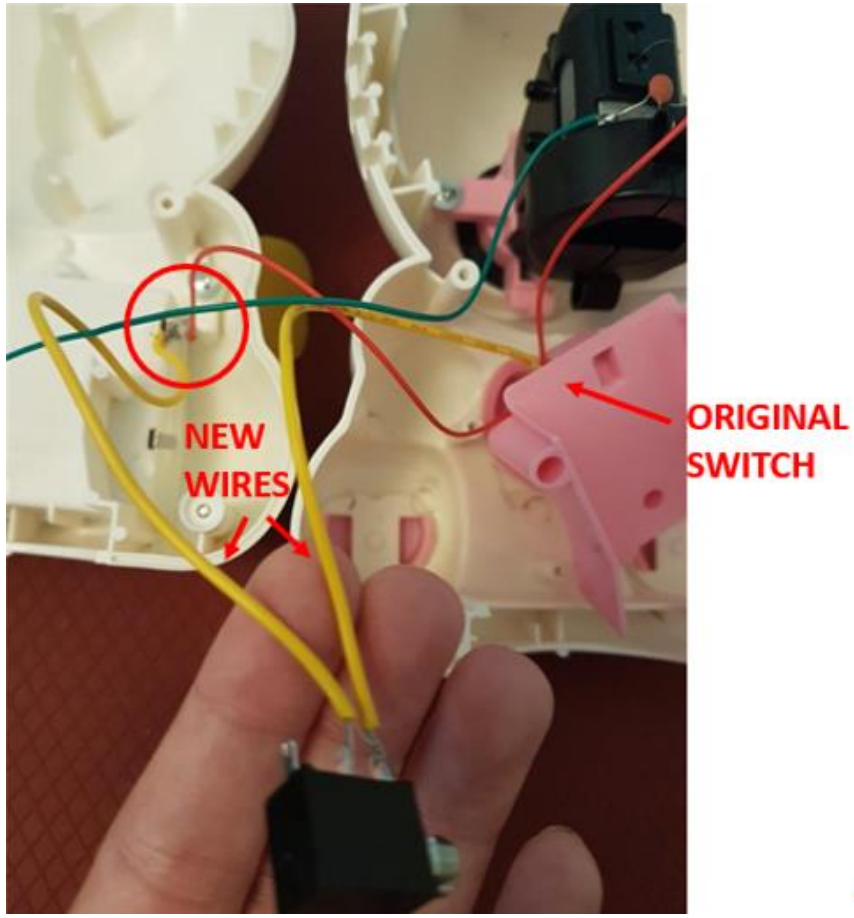
Note:

- Toy only works with an assistive switch, original function will no longer work

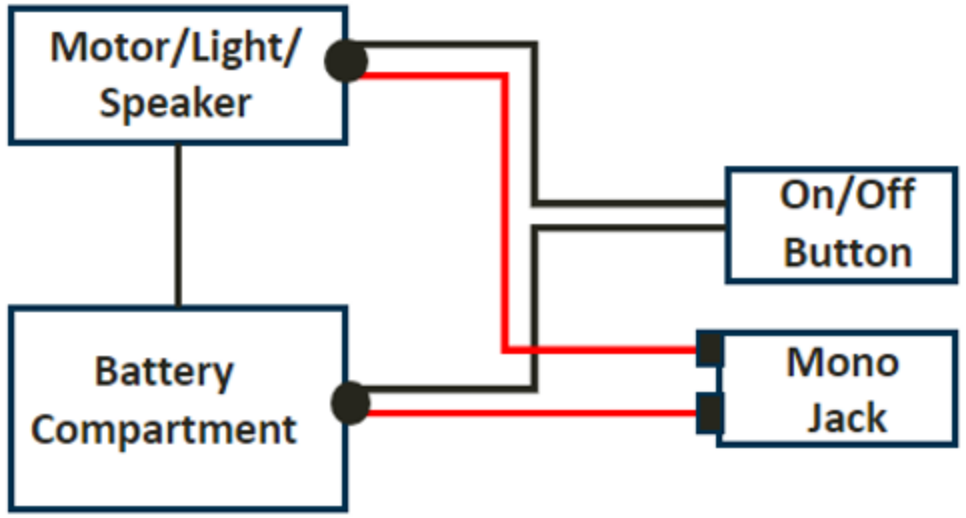




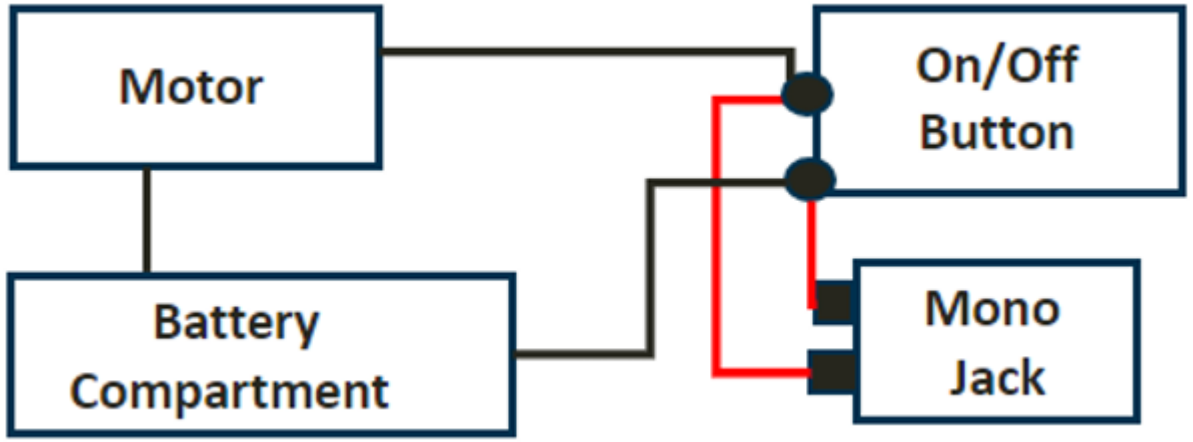
Using Mono Jack in Parallel – Method 1



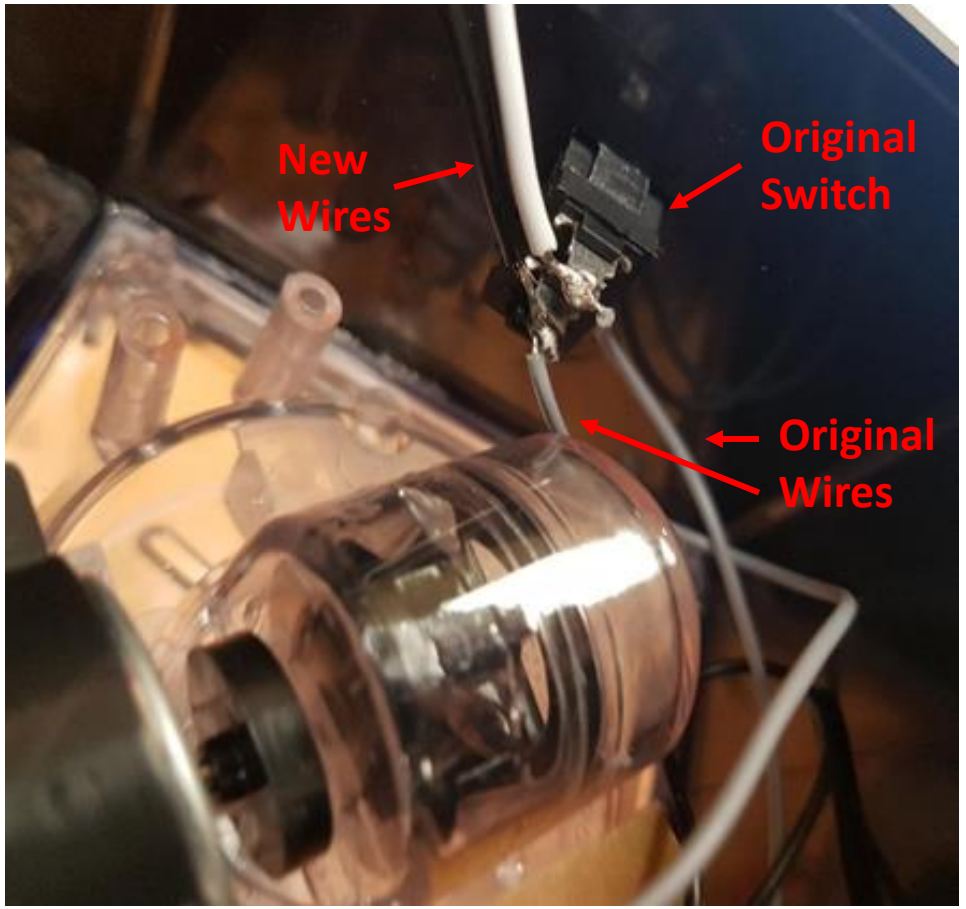
- Adding an input, or mono jack to the board/circuit, in addition to original button/switch
- Creating an additional loop or circuit that mirrors the original circuit



Using Mono Jack in Parallel – Method 2

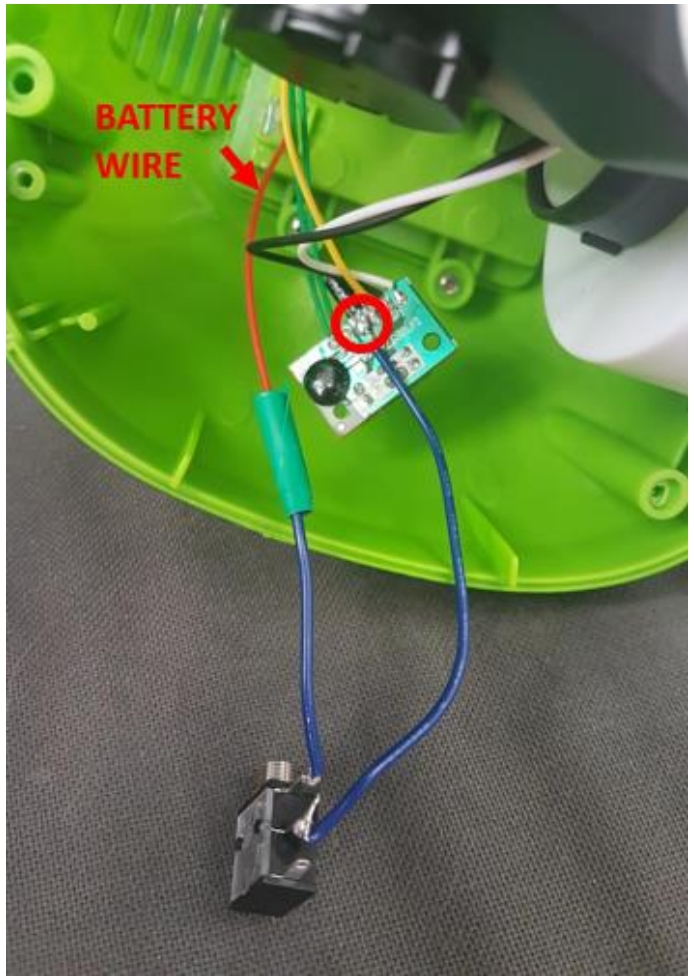


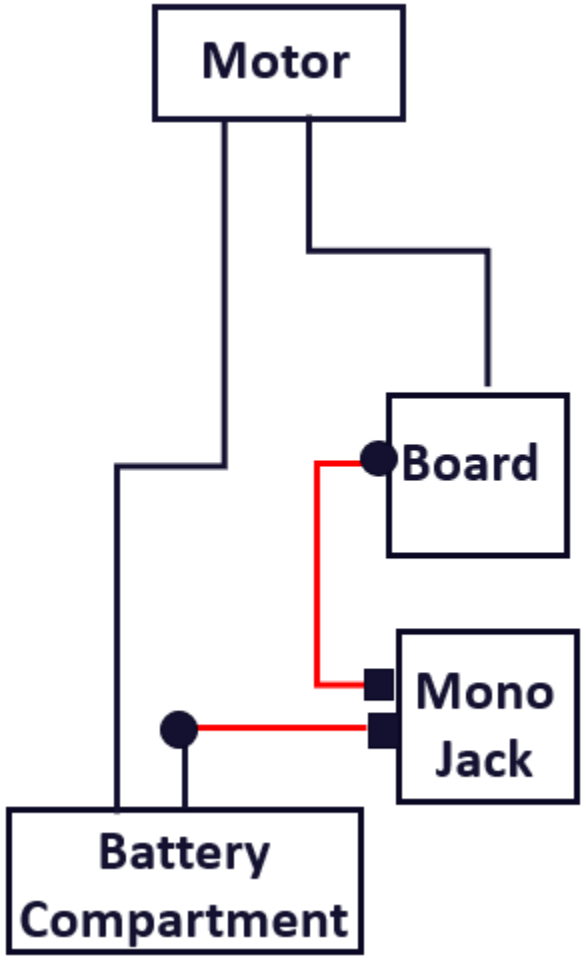
- Locate the original switch, or button: add new wires directly onto the switch on the connection spots where original wires are soldered
- Multiple wires on one solder spot or joint: original wire and new wire



Using Mono Jack in Series

- Remove battery wire from the board and adding a mono jack to the loop: extending the circuit
- Remove wire from board that is attached to battery
- Connect that wire to mono jack (that has two connected wires) and solder second wire to board where you removed the battery wire – closing the loop





Methods For Adapting – Mono Cables

Reasons to Use Female Mono Cables

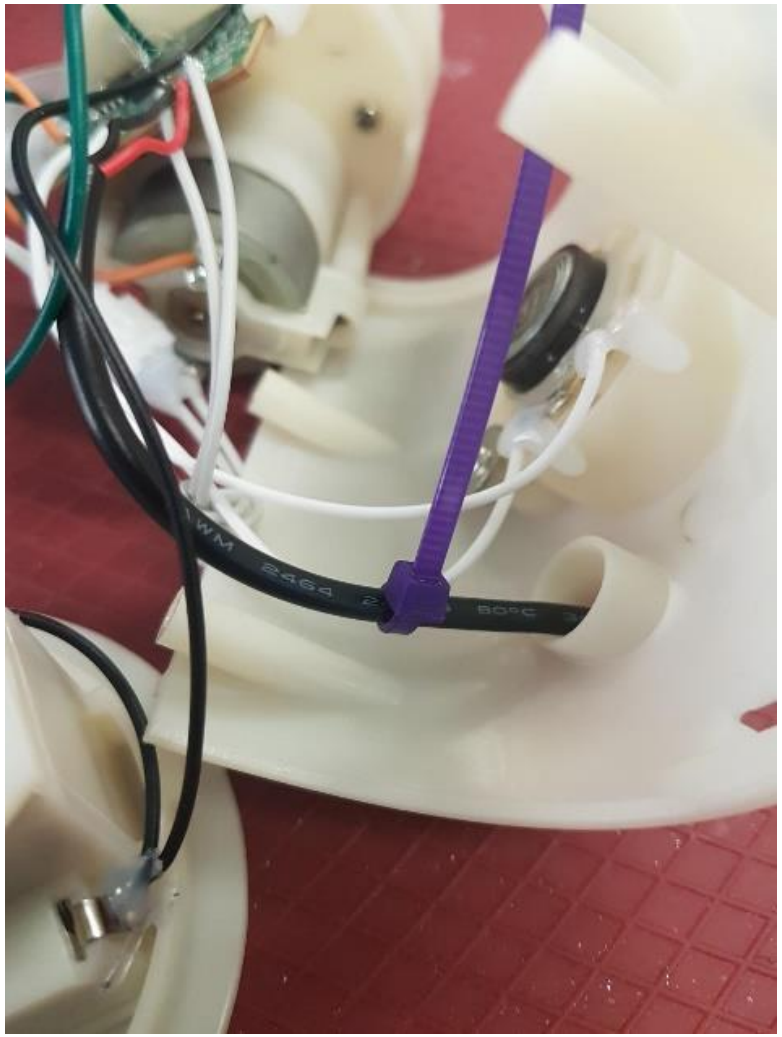
- Use with plush toys
  - These toys have an internal compartment
  - Cable used to plug in switch without opening the toy
- Ease of use
  - 1 part compared to jack + wire

Downside:

- Can have limited length or reach with mono cables

How to Use Female Mono Cables

1. Remove and open the toys inner compartment
2. Prepare your Mono Cable
   - If using stereo cable: twist two wires together
   - Tin ends of wires (see slide 50)
3. Attach to inner components
   - See next slide
4. Add a cable tie to the inside
   - Used for strain relief so cable cannot be pulled out
5. Drill a hole in toy for the cable
   - Use a 1/8” drill bit
   - Not necessary for a plush toy



Attaching a Mono Cable

The mono cable has the same function as a mono jack with two soldered wires

- Cable can replace original switch
  - Refer to slide 35
- Cable can be added in parallel
  - Refer to slides 36 and 37
- Cable can be added in series
  - Refer to slide 38
- Cable can be attached directly to board
  - See slides 53 and 54

Methods For Adapting – Battery Interrupters

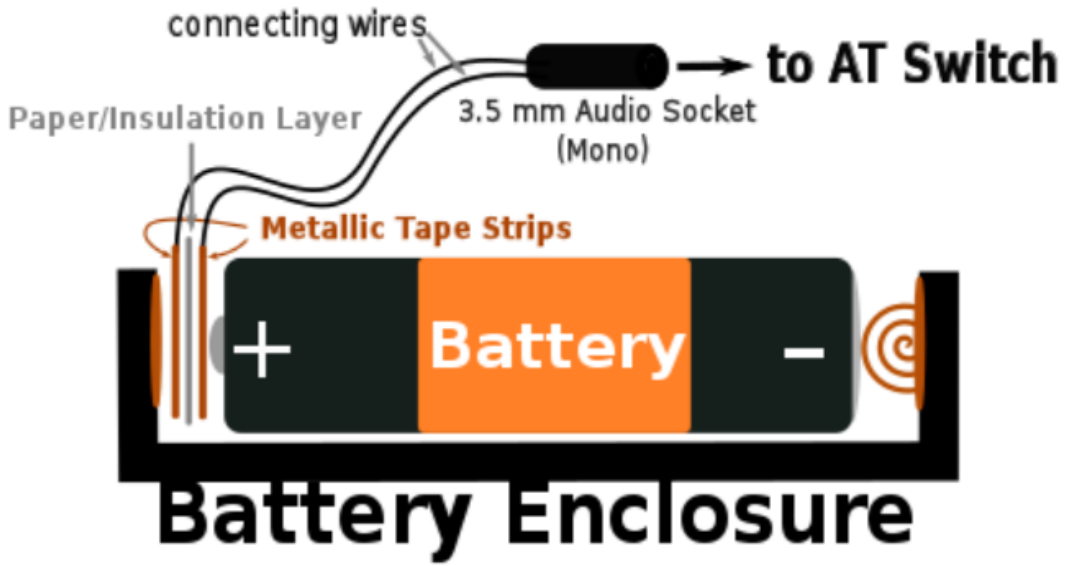
Reasons To Use Battery Interrupters

- Simple, not opening toy
- Toy can easily be left in an on position
- Internal switch/wires cannot be reached
- Toy is difficult to take apart or breaks easily

Downside:

- Can be pulled out or become loose
- Cannot be used with all toys

How Battery Interrupters Work



Toy must be left ON or stuck in ON position for interrupter to work

How to Use Battery Interrupters

Connect mono jack to PCB – or for DIY option, solder wires to mono jack and copper tape

Use scissors to cut the battery interrupter to match the battery size.

Insert end into battery compartment.
It should be pressed tight against the positive side of battery

Ensure the toy will stay in an ON position

Plug in an assistive switch to test. If it's not working, ensure the button is on and the interrupter is correctly positioned

Materials: Same Functions, Different Uses

Battery Interrupter ≈ Mono Jack + Wire ≈ Female Mono Cable

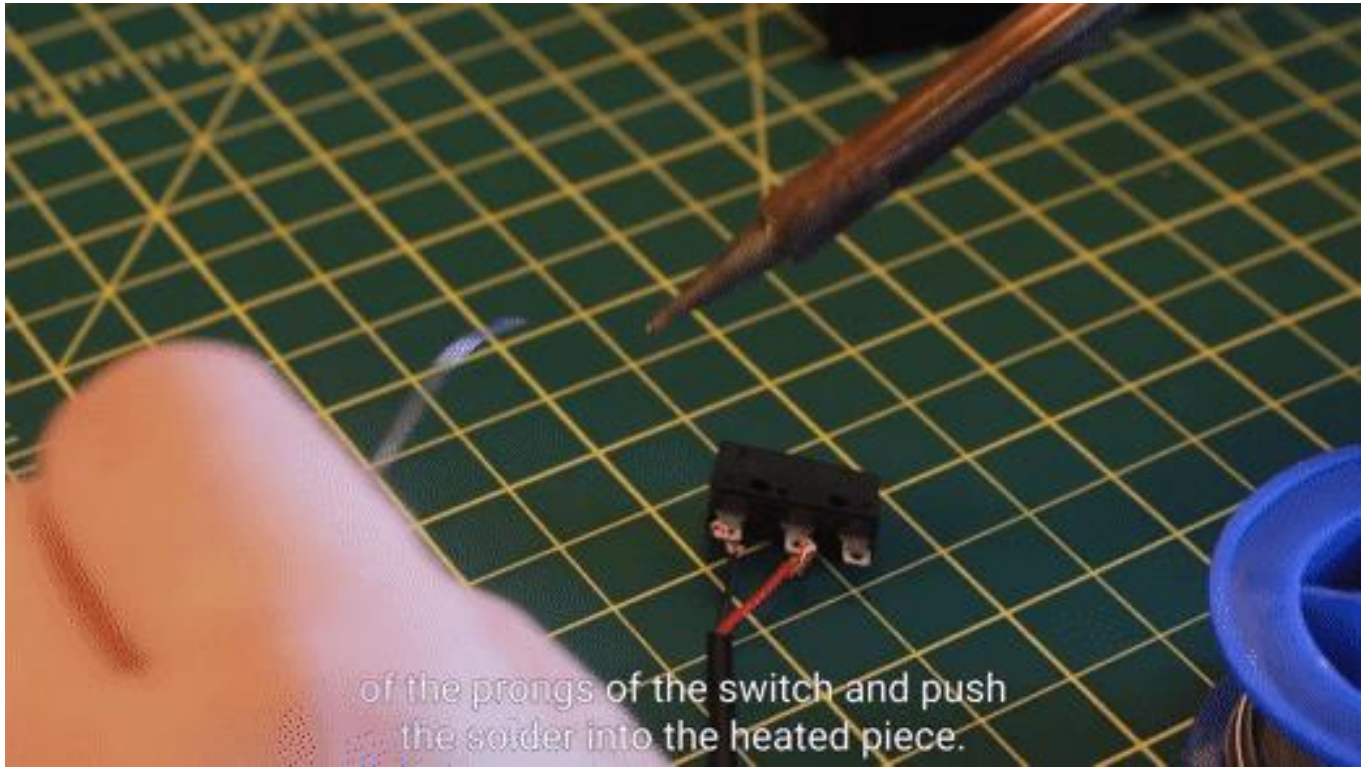
General Toy Adapting Notes

- Keep the packaging in good condition
  - Want the users to get the “new toy” feeling
  - Re-package the toy once adapted
- It’s best practice to keep the original switch functioning
  - This is done by adding the new switch in parallel

How To Adapt Toys: Skills & Concepts

Skills: Soldering

- Solder acts as a “glue” to connect electrical components together
- While not always necessary (exposed wires could be twisted together), it is the most durable

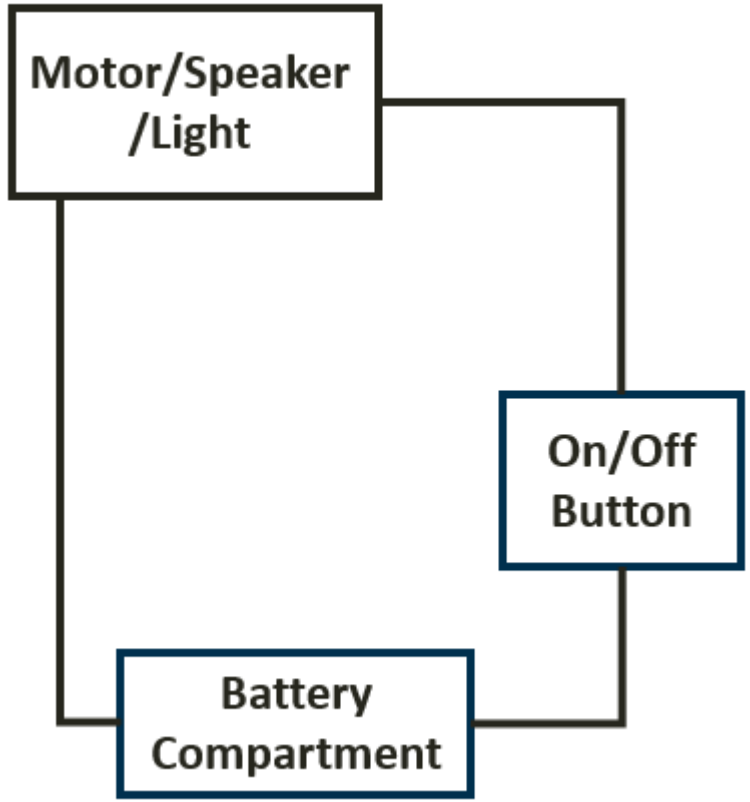


Skills: Tinning Wires With Solder

- When adding wires to spots, or joints, with existing solder on them – tin your wires
- Coat your exposed wire ends in solder first
- Then hold exposed tinned wire to area you want to solder to
- Hold iron to solder spot and tinned wire, reheating both the existing solder and newly soldered wire
- Allow both to dry, or harden, together creating a new connection

Concepts: Circuits!

- A loop that has something flowing through it: energy is flowing through the circuit connecting all components in the loop
- On/Off button, or switch, opens or closes the loop to either complete or break the loop
- When circuit is complete, or a full loop: the toy will be on (continuous energy)
- When the circuit is broken, the toy will be off as the energy cannot flow to connect all components



Using a Multimeter

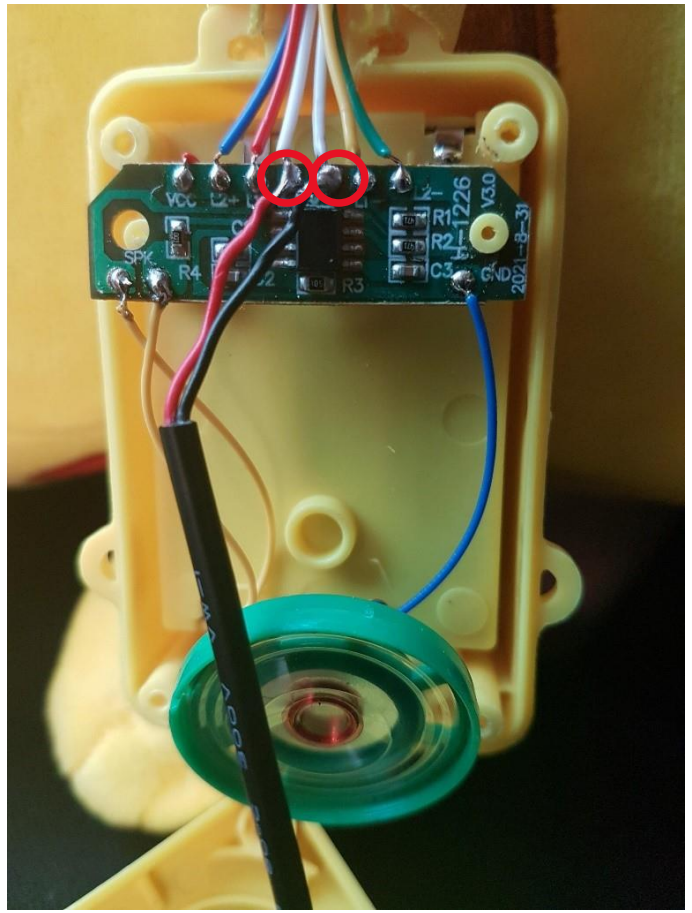
- Used to find appropriate solder joints on a circuit board
  - Can be difficult to trace where wires are connected
  - Adds power to the circuit to activate the toy
- Useful for a toy that has multiple features
  - Example: The Pikachu toy has lights and sounds
    - Find the connection on the board that activates both these features

Video

How to Use a Multimeter

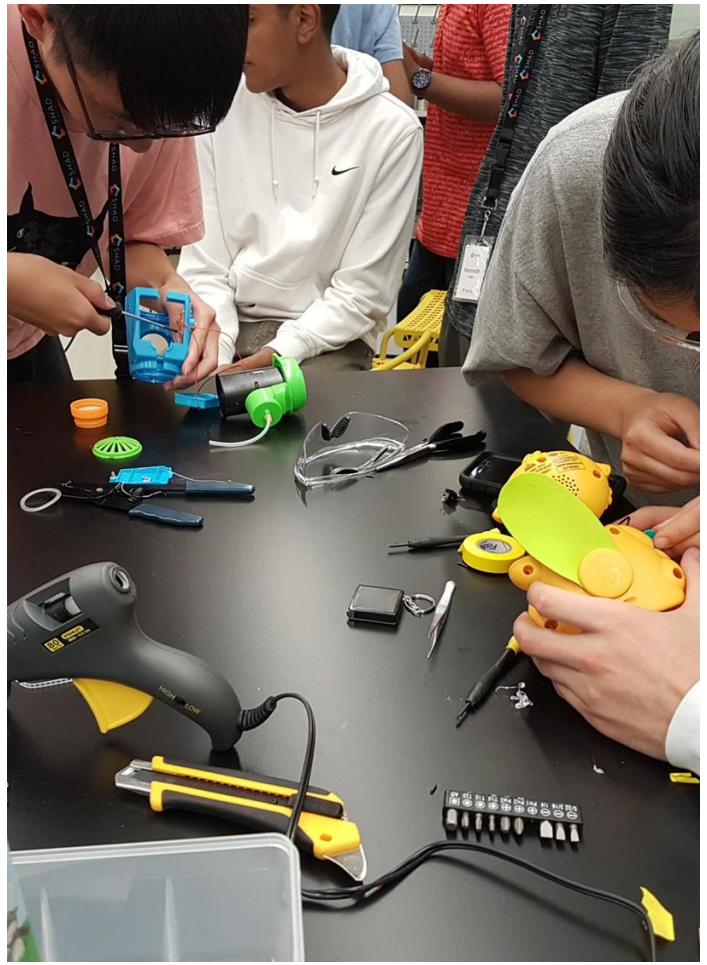
1. Access the board inside the toy
2. Insert batteries into the toy
3. Turn multimeter to Continuity Beeper or symbol

   - Test leads will beep when touched together
4. Use the leads to find connection joints
   - Move the leads around the solder points
   - Toy will activate when appropriate joints are touched
5. Solder the new wires to these joints
   - This step can be tricky
     - Space on board is typically small
     - Boards are sensitive



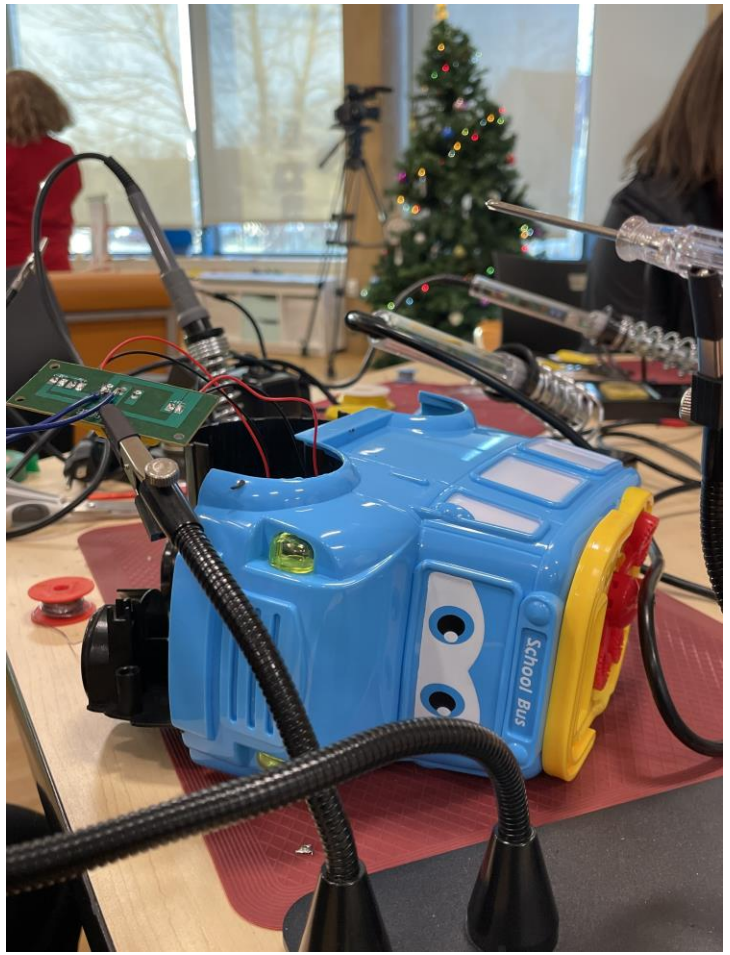
Considerations

- Take pictures or video to remember what parts you are removing when you are putting the toy back together as some parts may move or shift as you are working
- Be gentle when opening toy and working with parts, you may pull off existing wires accidentally
- Check that space exists for mono jacks or cables, and length of wires for reaching all joints and location of drilled hole for output
- Keep the packaging in good condition



Reassembling

- Check that added or new wires do not interfere with existing mechanisms, like a fan
- Check that wires are not pinched when reassembled or detach from boards when reassembling
- Check that batteries are secure
- Test before and after reassembling



Which Toy Seems Easier To Adapt?

Train Toy

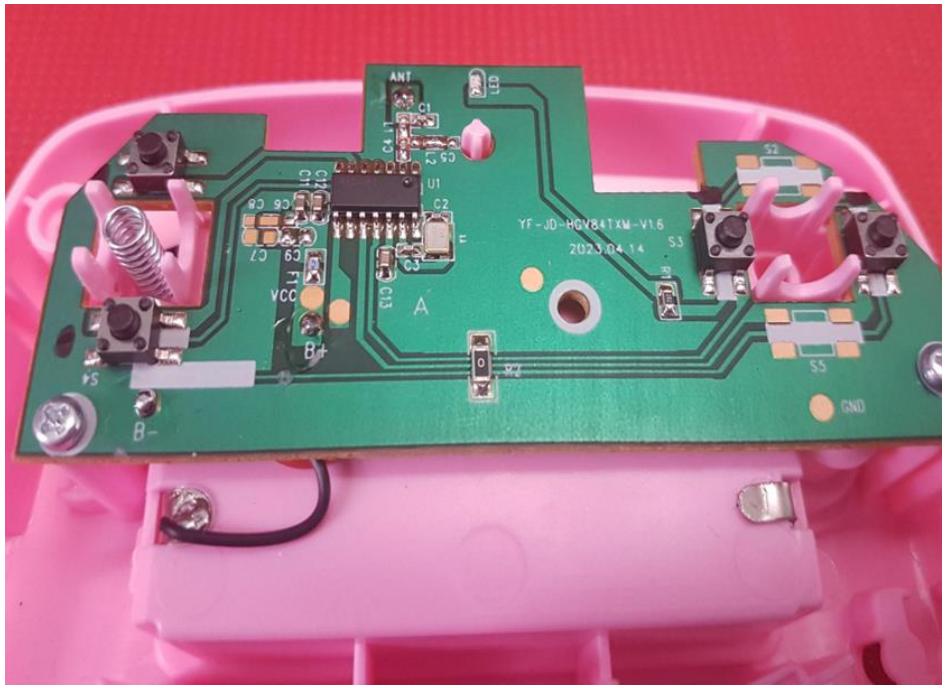
Barbie Remote Control Car

Surprise!

Simple Wiring between components

Train Toy

Complicated PCB



Barbie Remote Control Car

Resources

Community

- Makerspaces
- Schools
  - Tech Ed classes
  - STEM and Robotics clubs
- Universities:
  - Engineering
  - Occupational Therapy
  - Education
  - Student Makers
  - Design Labs

- Look at People in your Life: Many have skill set & knowledge, just need to be introduced to the concept of switch adapting!

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Adapted Toys GitHub Repository

- Toys Instructions
  - Specific toy instructions
  - Templates for creating instructions
- Equipment
  - Component list
  - Toy List
- Complete guide to toy adapting
- Link to GitHub page

Social Media & YouTube

Switched Adapted Toys Youtube

Santa's Switch Adapted Toys Youtube

Instagram: @Adapted Design3D

Where You Can Ask Questions

Assistive Technology Discord with Toys Thread

- Admins: Tom & Alanna from TechOWL PA
- https://discord.gg/uKV3wHMa

Makers Making Change

- MMC Assistive Devices Library: Adapted Toys
- Makers Making Change: How To Switch Adapt Toys

Make Play Accessible For All
Hacking For The Holidays Campaign

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