# Mandatory move united slide

Mass General Brigham
Spaulding Rehabilitation

Adaptive Sports Centers

# Breath to Bullseye

## Open - source design, build Sip and puff switch

April 2026

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

Spaulding Adaptive Sports Centers

# Plan for today

**Introduction and waiver**

**Lecture:**

Our experience of building the sip and puff switch

Today's lab plan

Hints and tricks

**Break**

**Lab :**

Pair off to build a sip and puff switch

Step by step process

Opportunity to test device

**Questions**

Always welcome at any time!

Poll at the end

# Nice to meet you.



Jennifer Packard, OTR/L, PP-MS OT

She/her

- North Shore Coordinator Spaulding Adaptive Sports Centers
- Clinical Occupational therapist 1997-present

Jillian Palacio, industry specialist

She/her

- Boston Lead Associate
- CTRS 2013-19 with 13 years in adaptive sports
- Ski & Ride Club specialty coach
- US Archery Level 1

# POLL

Who are you?

Why are you here?

Where do you work – in a medical setting, a community setting, or an academic setting?

Sip and puff switches are relevant for you because…

Do you have any learning needs you want us to know?

Did you complete the waiver?

# Goals for today

## Objective 1

**Assemble**
a plunger-style sip-and-puff switch interface

## Objective 2

**Integrate & adapt**
the switch interface into target-sport equipment.

## Objective 3

**Troubleshoot, customize, & scale**
the solution in their own adaptive sport or therapeutic-recrea tion setting.

# Our journey to this point

# Credit where Credit is due

Necessity is the mother of all

Rising tide collaborators

Curiosity

But...

# Our experience building a sip-n-puff switch

- Apprehension to understanding it- did not want to break it
- Use of components readily available
- Open-source  knowledge of electronics

# Cost money and time

All components added together is less than $100.00 itemized list comes later

Low tech – others on the market are high tech

Time to figure it out is less than 20 hours

Time to build is about 12 hours (2 people- will be made easier by the best tools itemized list later)

# Lab plan

1. Pair up, we would like to promote collaboration and encourage you to partner with someone you may not know or do not often work with
2. Tool/component review
3. Step-by-step instruction,
   - Stay with us as we will talk through each bit more thoroughly as we move through it
   - Some tools need to be shared, be kind
   - Questions are always welcome any time!!!
4. Practice operating

# Hints and Tricks

- Take your time!
- Some printed copies of our step-by-step instructions to refer to if we move forward
- We made some executive decisions about placement due to the parameters of our boxes
- More tips when we get to components
- Electrical supply not helpful

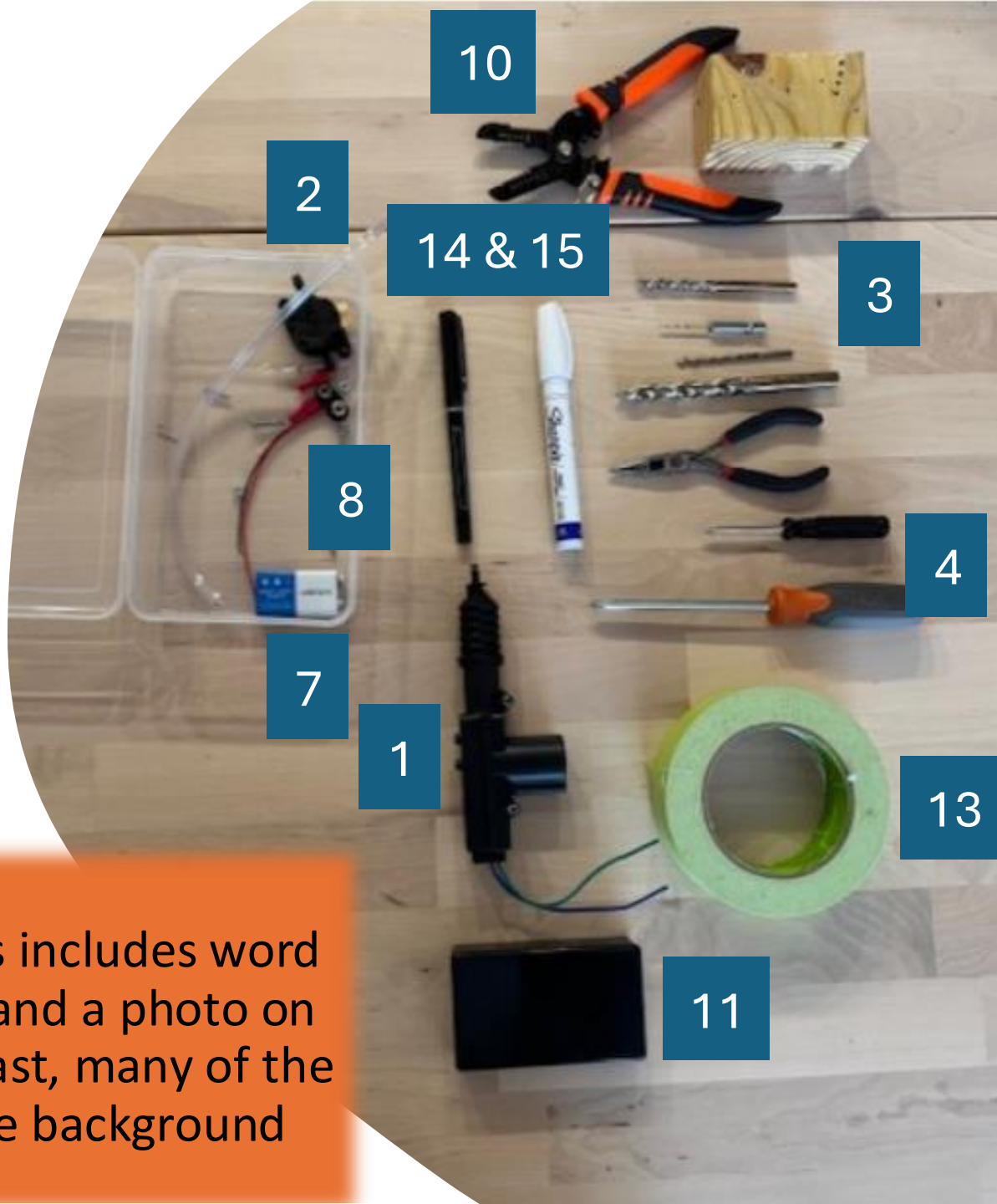
# Bio-break (5-10 min)

# Partner off

# Tools

1. Actuator plunger switch
2. “Mamco” switch
3. Drill / drill press / drill bits
4. Appropriate screw drivers
5. Screws
6. Aquarium tubing- NOT O2 tubing
7. 9-volt battery
8. Wire connector for  a nine-volt battery
9. Wire connectors (heat shrink type)
10. Wire strippers
11. Junction box
12. Heat gun
13. Painter’s tape
14. Pencil or pen
15. Paint sharpie

The next series of slides includes word description on the left and a photo on the right,  and for contrast, many of the photos have an orange background



# Actuator Plunger

- From the automotive switch world
- Used in the door of the vehicle to manage windows
- Sourced on Amazon

# ‘Mamco’ Switch

- From the plumbing world
- Used in underwater engineering
- Can be bought with your dictated parameters
- Sourced on MAMCO website
- Customer service by phone was helpful and kind

# Junction Box & Fasteners

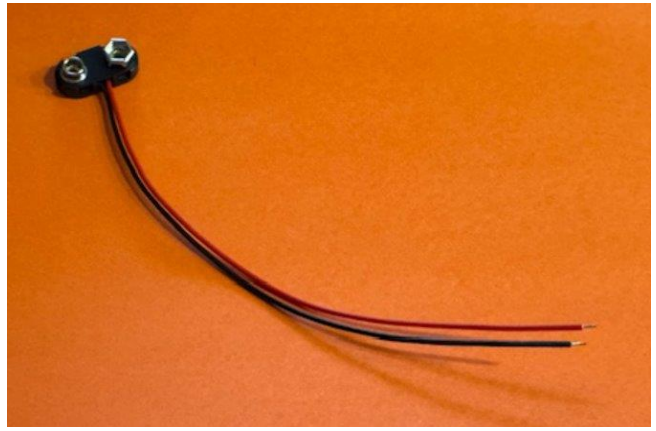
- From the electrical world

- How to drill holes:
  - Our failures
  - Pilot holes
  - Order of drilling matters
  - Wood stabilization block helps
  - Drill press makes it easy
  - Drill bit sizes to use

- Sourced easily on  Amazon

# Battery, Wires, and Connectors

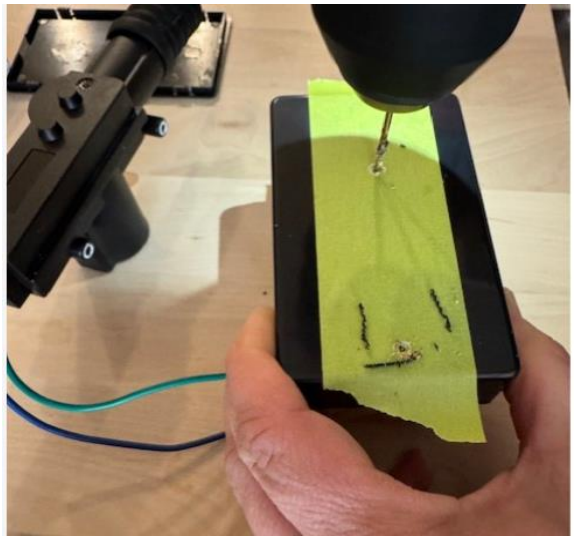
- Batteries – customary
- Battery connector with wires- customary electrical supply
- Sourced easily online or Amazon, local shops are not helpful
- Melting self soldering wire connectors – sourced online- not able to order just one- comes in pack of 100




# Prep Step One: Actuator Holes

This is pre-done for the session

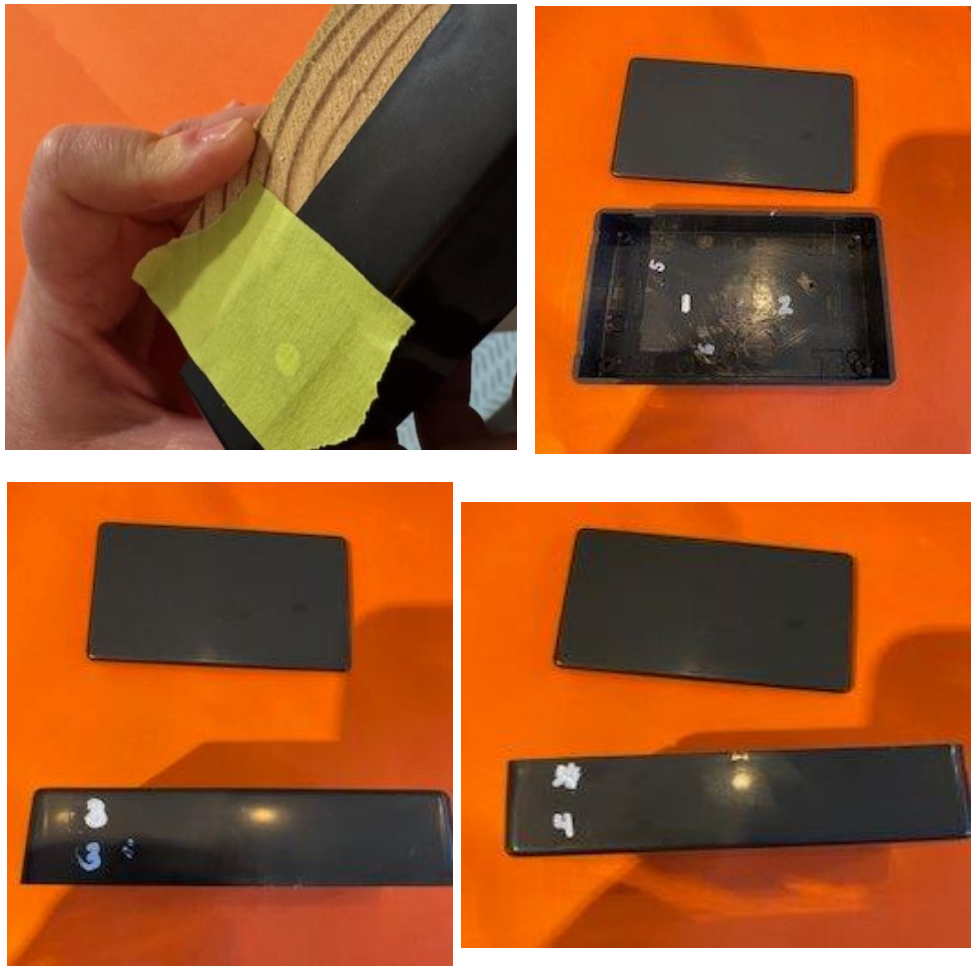
1. Mark the spot where the actuator plunger will be mounted in/on the junction box by utilizing a Oil-based Sharpie Paint Pen:
   - Box & the actuator should lie flush with the table
   - Consider orientation for direction of pull and mounting on an external device (i.e. air rifle stock)
   - Place painter's tape roughly at the height desired, put paint pen on holes of the actuator – press onto tape while wet
2. Once dried, drill pilot holes because of plastic type
3. Drill holes for screws 1 & 2



# Prep Step Two: Mamco Holes

This is pre-done for the session

1. First mark hole for sip/puff tubing connection
    - Consider where the mounting holes for actuator are located.
2. Mark mounting holes
3. Utilize a 3/8$^{th}$ drill bit to drill the hole for the sip/puff mechanism for the switch.
    - We did not use pilot holes for this due to placement
    - Check to see if the air tube can be attached through the hole
4. Drill screw holes – pilot drill bit



# Prep Step Three: Wire Holes

This is pre-done for the session

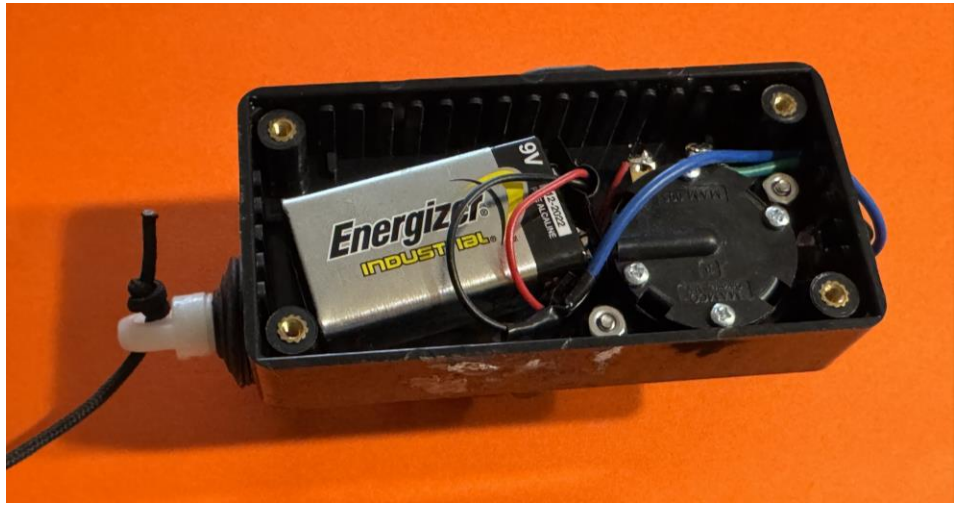
1. Mark the location of the wire hole
    - Hole location matters to match the actuator and pressure switch connection
2. Drill, baby, drill!

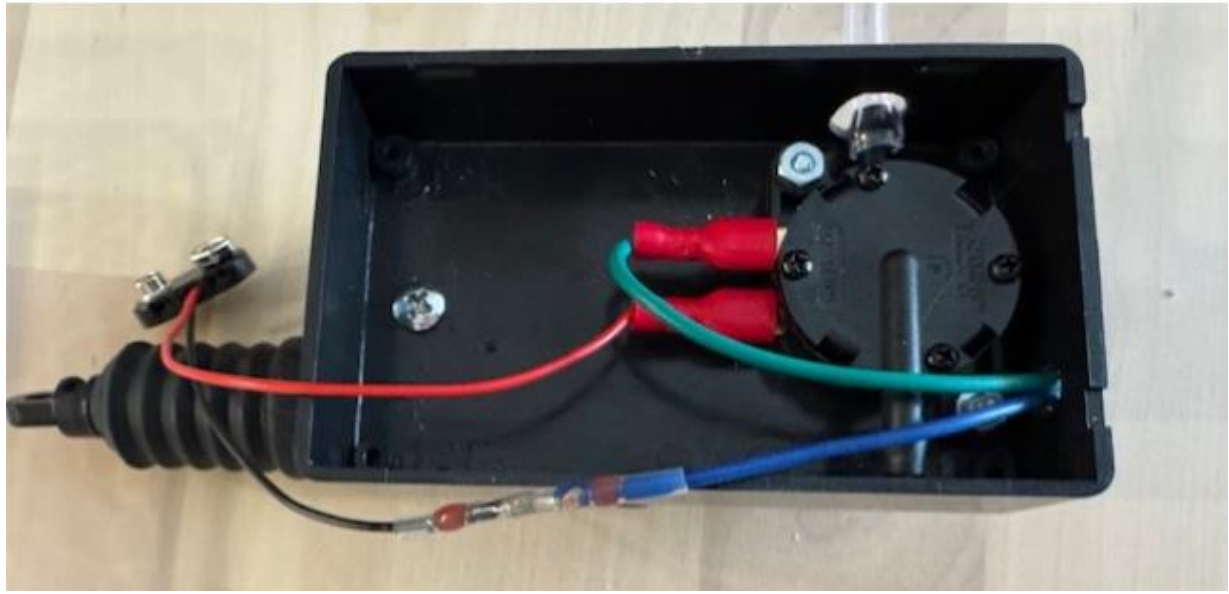
# Bio-break (10-15 min)

# building comes next

# Step-by-Step Overview: Attaching Parts

1. Screw  ‘hidden’ screw on Mamco switch
2. Screw the actuator in place
3. Screw the 2nd Mamco in place with the hose
4. Prep wiring
5. Connecting red & green wires to spades
6. Solder black & blue wires together and protect the connection
7. Creating your circuit
8. Place filter and tube – test it



# Let Us Build

## Step 1: 'Hidden' screw

- Place one Mamco bolt in place.
- Because junction box is small, the parts need to be layered into place.
- Eventually, it will be hidden by the actuator switch on the outside once the actuator is screwed into place

## Step 2: Secure actuator

- Screw the actuator in place on the outside of the junction box
- Use the provided screws that came with the actuator
- Be sure to orient your actuator correctly
  - Wires facing towards the hole cut for it.
  - Plunger of actuator facing away from the Mamco switch hole

# Step 3: Mamco switch

- Securely place a segment of aquarium hose on the switch to ensure best placement onto the bolt

- Slide Mamco switch onto placed bolt, sliding tubing out the appropriate hole

- Place 2nd bolt and finally secure Mamco switch in place with nuts

# Step 4: Prep wiring

We are using two different sized gauged wires which isn't typical for electrical work

- **Red** & **Black** wire: 9 v plug component
  - Cut insulation with 20 gauge, Strip with 18 gauge
  - Red – 2 cm, Black – 1.5 cm

- **Green** & **Blue** wire: Actuator wires
  - Cut insulation with 14 gauge, Strip with 12 gauge
  - Green – 2 cm, Blue – 1.5 cm

The next few steps are very basic electrical work for a low voltage electrical trigger switch system.  We are not giving electrical advice beyond these parameters and encourage you seek expertise if you wish to expand on these skills.

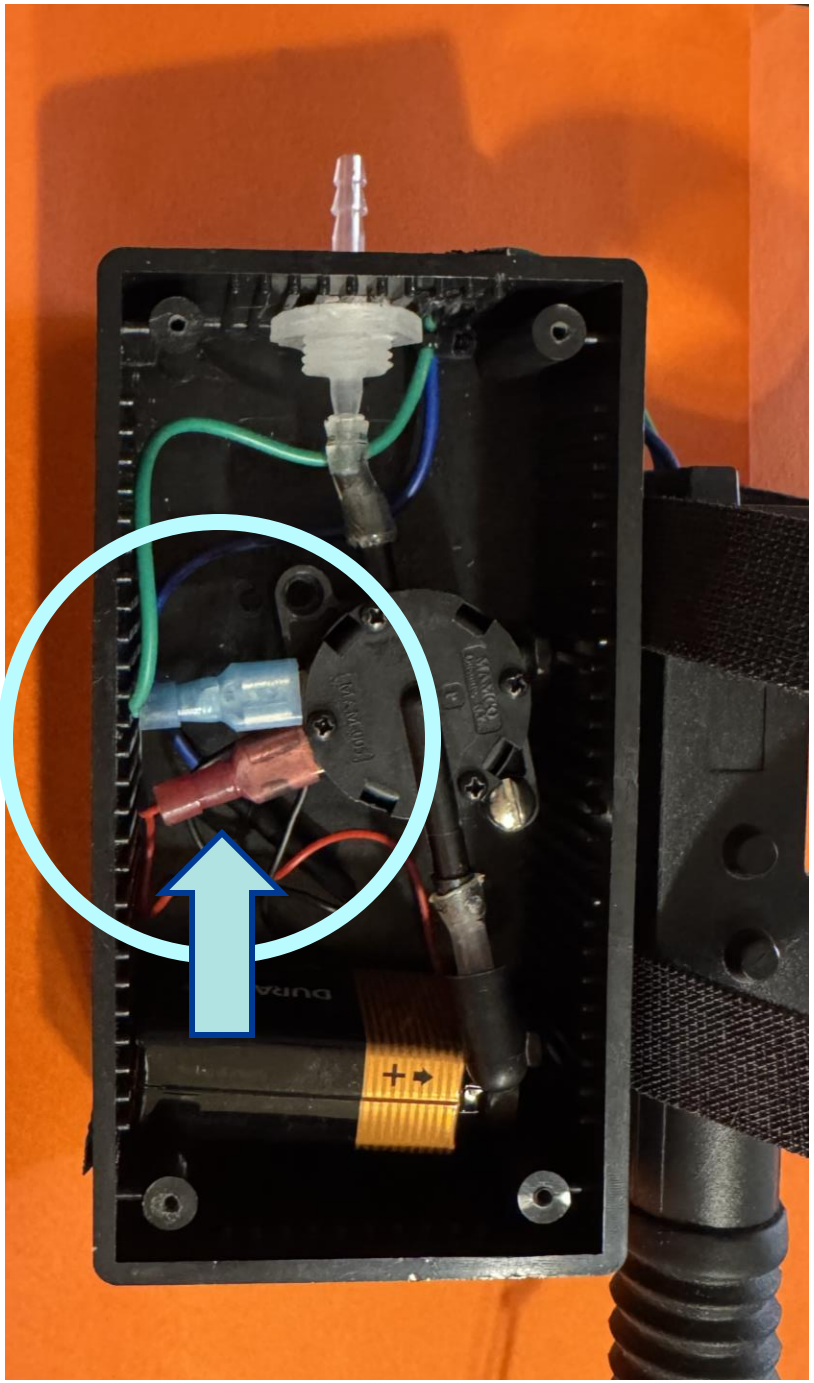
# Step 5: Spade attachments

- Starting with the exposed end of the **red** wire:
  - Twist that exposed wire
  - Bend it roughly in half
  - The goal is to make it 1 cm long & 2x thick

- Place the wire into the red spade and crimp the narrow “neck” around the wire to hold it into place

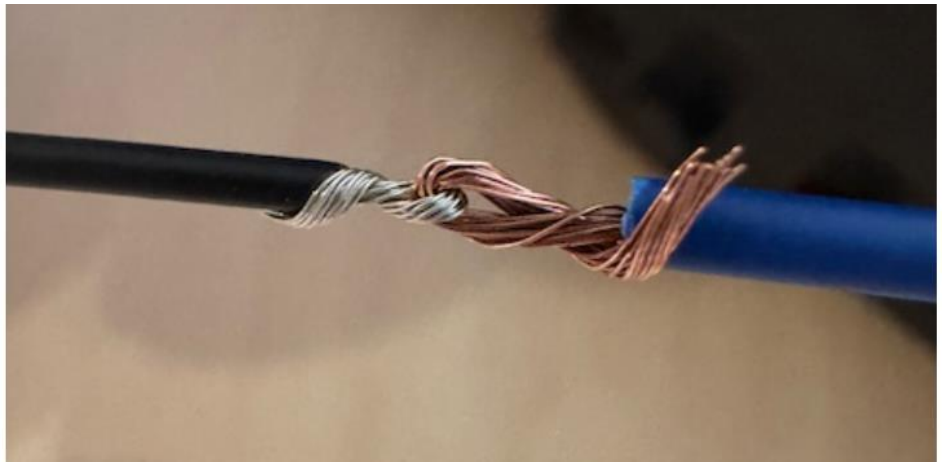
- Thread the **green** wire into the open hole remaining on the junction box

- Repeat the above steps



# Step 6: Soldered wire connection

- Feed insulator onto **Black** wire
- Thread the **blue** wire into the open hole remaining on the junction box
- Twist each of the exposed wire ends and bend them in 1/2, creating a hook
- Link the hooked ends together and twist them, creating a connection
- Slide the insulator down the wire until the metal ring is over the junction of the wires
- Use the heat gun to melt/shrink insulator thus soldering the wires together

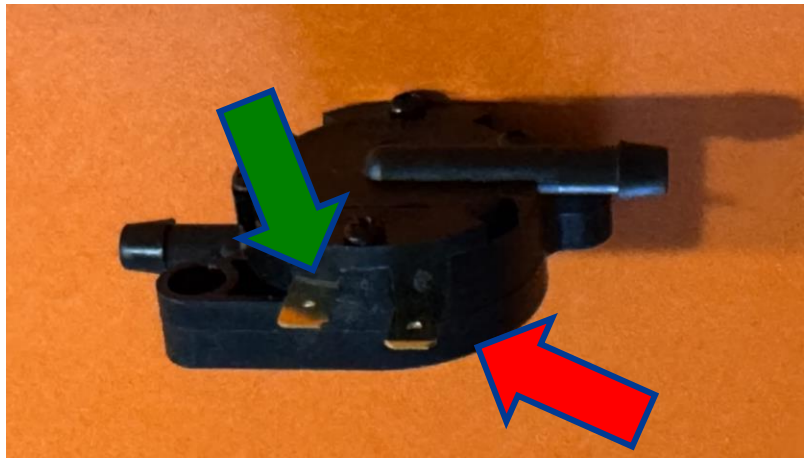


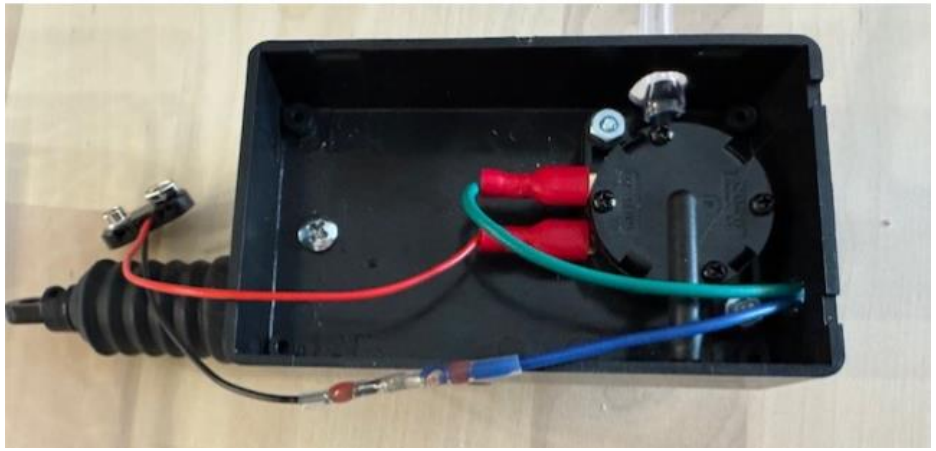
There are other wire insulators on the market, but we are fond of this one because of how solid of a connection it creates.

# Last few steps!

## Step 7: Creating the circuit

- Plug the red spades onto the Mamco switch by friction fit
  - **Red** wire in the down position
  - **Green** wire in the up position
- Plug the battery into the battery receiver
  - Place into you junction box
- Request Jennifer or Jillian to inspect it!





## Step 8: Place filter and tube – test it

- Place the cover on onto the junction box
- Place the filter in line
  - The filters can be tough and sometimes need to be “worked” some to allow for proper pressure for the switch
- Test it out!!!

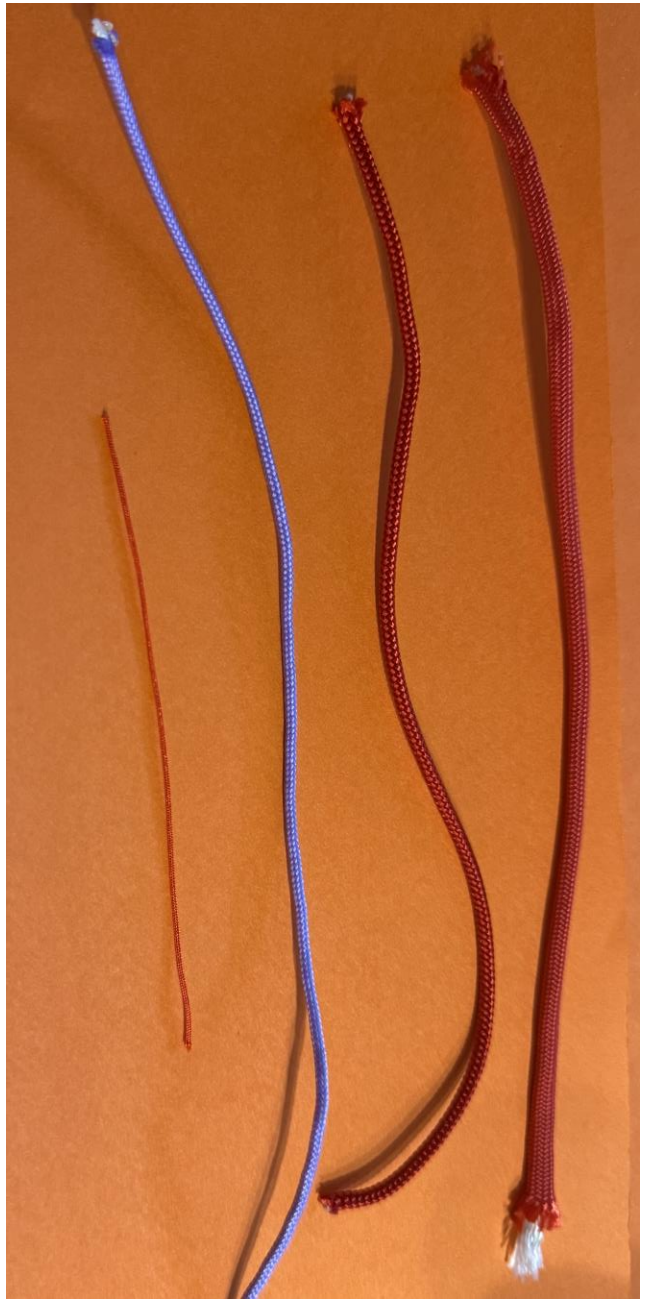
# Last but ’knot’ least

For our system, we use cordelette to connect the actuator to a trigger

- Cord size can vary and to the right we have 1 mm, 2 mm, 3 mm & 5 mm (left to right)
- We have found that too big (5mm) creates to much flex in the system and is inconsistent
- Our ideal is 2mm or 3mm

Knot options for actuator – square knot, overhand knot, any knot creating a loop

Knot options for trigger – Clove hitch (easier to adjust tension), overhand knot (tape for attachment)



# Placement & practice!

# Poll

Insert powerpoint poll QR code

- What did you find most helpful from today
- What went well
- What could be better
- How will you use this information
- Would you be interested in a follow up Q&A in about a month?