



# Learn to solder electronics with the Maker Shed Solder Badge!

How to assemble the Maker Shed Badge kit.

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## INTRODUCTION

The Maker Shed Learn to solder badge is a great project for beginner electronics enthusiasts. It teaches the fundamentals of electronics and soldering in a safe, fun, quick way.



### TOOLS:

- [Soldering Iron](#) (1)
- [60/40 Leaded Solder](#) (1)
- [Flush Cutter](#) (1)
- [Scotch tape](#) (1)
- [Heavy Object](#) (1)
- [Solder Sucker](#) (1)



### PARTS:

- [Learn to Solder Badge Kit](#) (1)

## Step 1 — What is solder? What is it used for?



- Solder serves somewhat as a glue for electronics. Soldering is a process of melting a metal "filler" material into a joint between two metal surfaces.
- Terminology:
  - Junction: A void between two metallic objects about to be filled with solder
  - Joint: An electromechanical connection formed by melting solder into the junction of two metallic materials.

## Step 2 — Check that you have the right parts!



- Make sure you have the following tools before beginning:
  - Soldering Iron
  - 60/40 rosin core leaded solder
  - Solder sucker
  - A Heavy Object: something with a small footprint, but still heavy enough to hold the PCB in place. We suggest a hockey puck.
- Scotch tape
- Diagonal Cutters

## Step 3



- ⚠ Do not use unleaded solder! This variant includes a special flux core which is toxic if inhaled.
- ⚠ 60/40 lead solder includes lead. Lead is a toxic element, and should be handled carefully. After handling leaded solder do not touch your mouth or any other mucus membranes (ear, nose, etc) before washing your hands.

## Step 4 — Get acquainted with the contents in your Learn to Solder kit



- Printed Circuit Board (PCB)
  - Pinhole
  - LED spots
  - Battery pad
- Pin and its backing
- RGB LED (2)
- Battery holder and CR 1220 Lithium battery

## Step 5 — Set up the soldering iron



- ⚠ This iron gets **HOT!** Use caution when handling the iron apparatus and anything it comes in contact with. When in doubt, assume the surface is hot.
- ⚠ The rubber handle of the iron should get hot (although it may become warm over time, this is not an issue). This is the safe location to handle the iron.
- ⚠ Any exposed metallic portion of the iron **WILL** be hot. The majority of the heat is located in the tip, but the base of the heating element (near the hand grips) is also hot enough to burn. **DON'T TOUCH IT. EVER. WE MEAN IT.**
- ⚠ Keep the iron in it's stand when not currently in use. Never leave a warm iron unattended. Before leaving a setup, ensure that the iron is **UNPLUGGED** and **COLD**. (Do not touch the tip of the iron to confirm this! If the iron is hot, this will be evident by observing radiating heat.)
- Make sure the soldering iron is properly plugged into the base unit and is powered on. (red power switch is located on the side of the base unit)
- Use the dial to set the temperature to read 600 degrees Fahrenheit. [photo]

## Step 6



- Soak the included sponge with water, then squeeze excess water out. [photo]

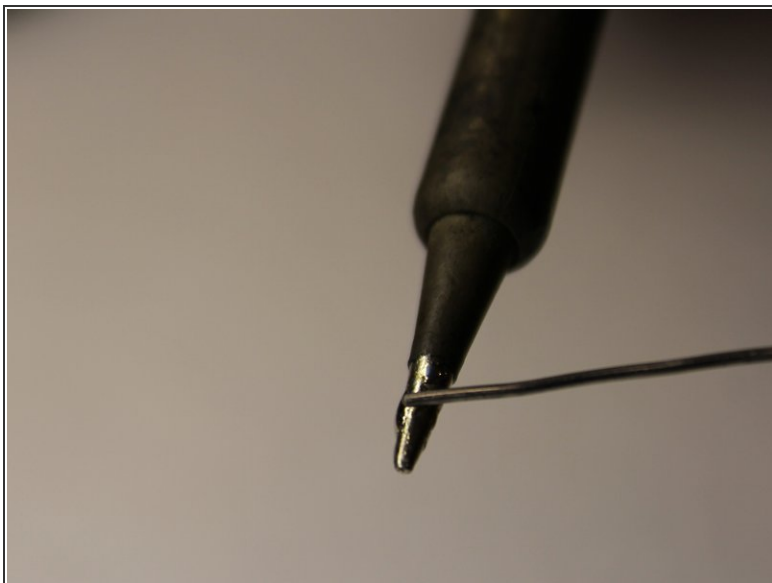
⚠ This sponge is in constant contact with leaded solder. Any water it comes in contact with is considered dangerously **CONTAMINATED** and should be handled accordingly. Ensure that there is no possibility of an individual consuming or otherwise coming in contact with the same water source as the sponge has.


⚠ Example of **POOR** procedure: dunking the sponge in a glass of water, then leaving the water out for an individual to accidentally drink.



⚠ Example of **SAFE** procedure: rinsing the sponge in a utility sink marked as unsuitable for drinking, in addition to ensuring that the sink has completely drained (drain disposal is okay for this quantity of lead).



## Step 7 — Tin the tip of the iron



 Always hold the iron over a durable surface, such as a table or workbench, which will protect your limbs (and others') in the event of a mishap.

- Hold the iron in your hand. Add a small amount of solder to the tip of the iron. It should melt instantly upon contact.
- Immediately wipe the solder off with the wet sponge on the iron stand. [photo]
-  Tinning of the soldering iron tip should be done regularly. It's good practice to tin the tip EVERY time you place the iron in its stand.
-  If the tip of the iron is ever NOT silver and shiny in color, it is in need of tinning ASAP.



## Step 8 — First melts



- Rest the soldering iron on the battery pad to heat it up.
- Once the pad is hot enough, begin adding solder.
- If solder does not flow immediately when it comes in contact with the pad, remove it and allow the pad to heat up longer.
- Apply a large gob of solder to the pad (as shown).
- Tin the iron and return it to its stand.

## Step 9 — Familiarize yourself with a desoldering tool



- Desoldering tools are great for cleaning up mistakes. They're really easy to use!
- Apply a copious amount of solder to the battery pad, as explained in the previous step. [photo with copious solder, iron, and desoldering tool in play]
- Depress the plunger in the desoldering tool until it clicks.
- Heat up the joint until the solder flows.
- Press the tip of the desoldering tool into the pool of solder. Simultaneously press the return button on the tool.
- Whoop! Away goes the solder! Press the plunger down again to release the solder it collected. [photo with iron and desoldering tool in play, solder gone]
- ❗ If at any point in this tutorial you make a mistake, just remove the solder from the joint with this method and start that step over.

## Step 10 — Position the battery holder



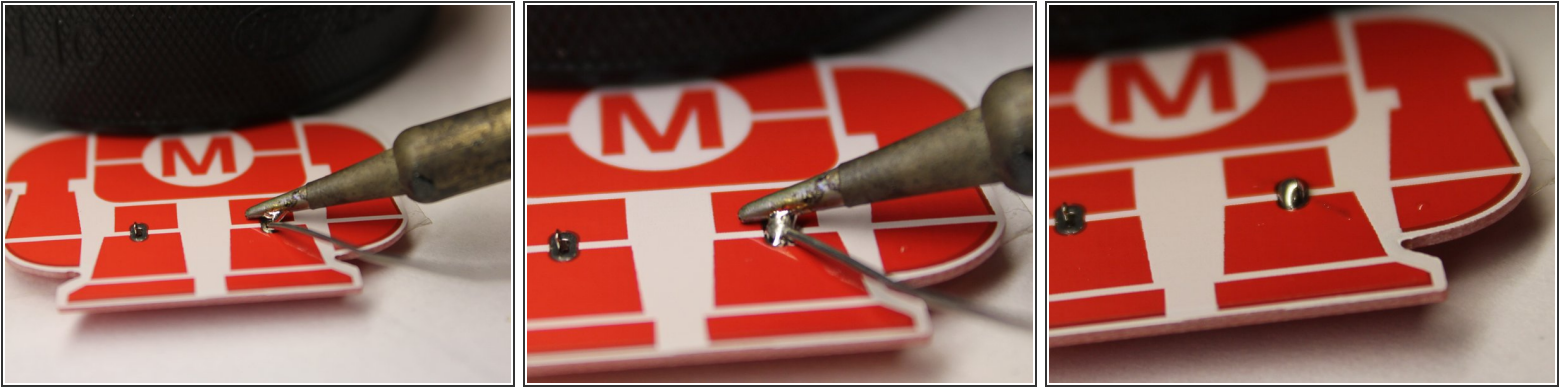
- Align the battery holder tabs with the white silkscreen outline on the PCB. Use tape to hold battery holder in place, if helpful.
- Invert the board. The battery holder tabs should extrude through the holes, as shown. If this is not the case, reposition the tabs accordingly.

## Step 11 — Solder the battery holder



- Place a heavy object on the board to keep it from sliding around on the table.
- Rest the iron between the extruding battery holder tab and the corresponding solder pad to begin heating them up.
- ⓘ The junction will not heat up immediately. It is necessary to hold the iron in place for about 20-30 seconds before sufficiently hot.
- ⓘ Applying pressure to the junction, as opposed to simply laying the iron, will improve heat conductivity. This will speed up the process and result in a better solder joint.

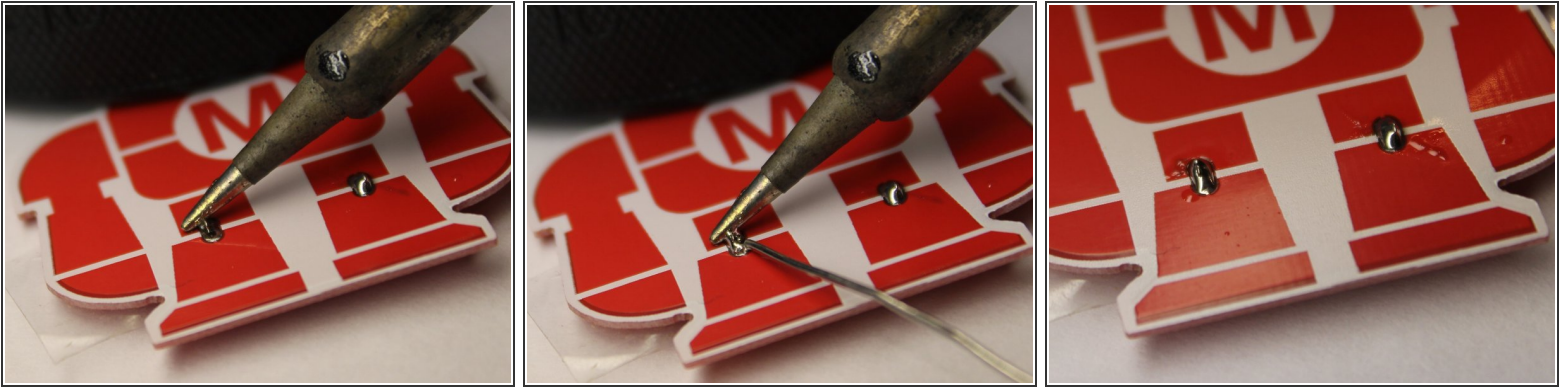
## Step 12 — asdf



- Check if the junction is hot enough. Without removing the iron, begin feeding solder into the junction between the tab and the pad. If the iron is on one side of the tab, feed the solder from the other side (as depicted).
- ⚠ Applying solder directly to the iron may appear sufficient, but will result in a cold joint. Always apply solder to a junction, not directly to the iron.
- ⓘ Smoke is a normal occurrence, and is safe to breath (but obviously not in a prolonged setting). The smoke is due to the rosin flux core burning off. It contains no additional toxins.
- ⓘ If solder melts immediately upon contact, the junction is hot enough!
- ⓘ If solder only partially melts, or does not melt at all, more time is required to heat up the junction.
- Apply a generous amount of solder to the junction. The resulting solder joint should be shiny and appear as shown. If this is not the case, lay the iron back on the pad and reflow the joint until the solder liquifies again.
- Tin the tip of the iron and then return it to its stand.



## Step 13



- Repeat the previous step and solder the second battery terminal.
- Tin the tip of the iron, then return it to its stand.

## Step 14 — Identify and fix any cold solder joints



- Cold solder joints, or "crappy" solder joints, aren't electrically or structurally stable. If a joint doesn't appear perfect, it's probably cold. Reflow the joint by applying the iron and allowing the solder to flow through the junction again.
- Cold solder joint
- Same joint, reflowed for perfection
- If ever a joint seems out of luck, feel free to start over. Use the solder sucker to remove the solder in the joint, then reheat the junction and re-add the solder.

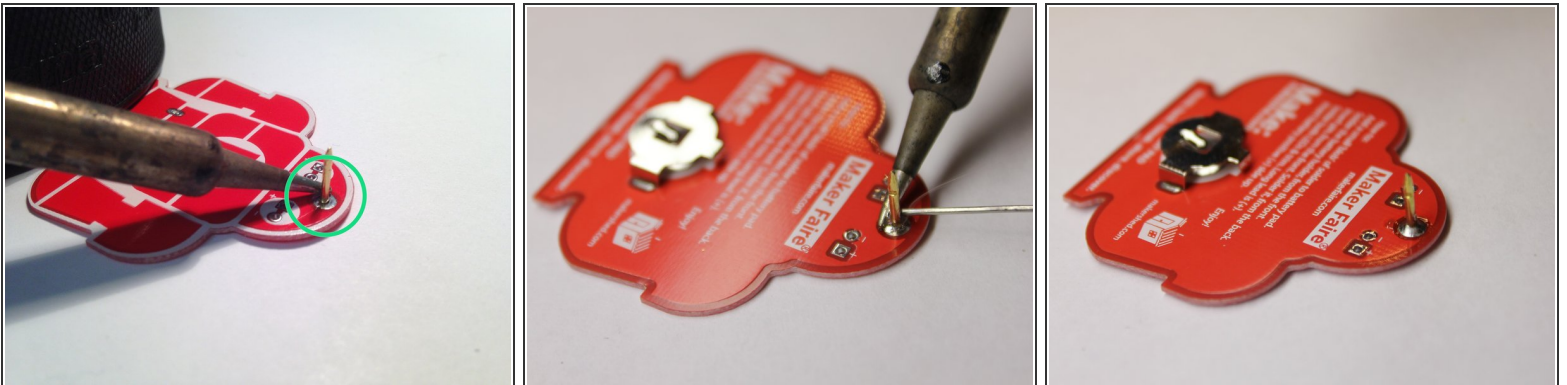


## Step 15 — Position the pin



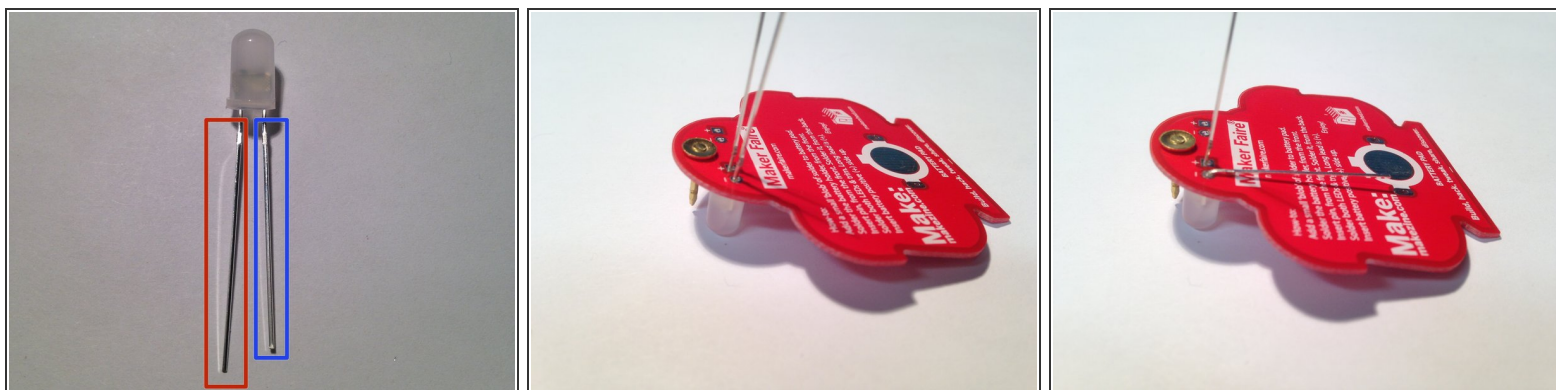
- Insert the pin from the front of the board.
- Place the board on the table so the pin is pointing upwards, as depicted.
- Begin heating the junction between the pin and the pad.

## Step 16 — Solder the pin



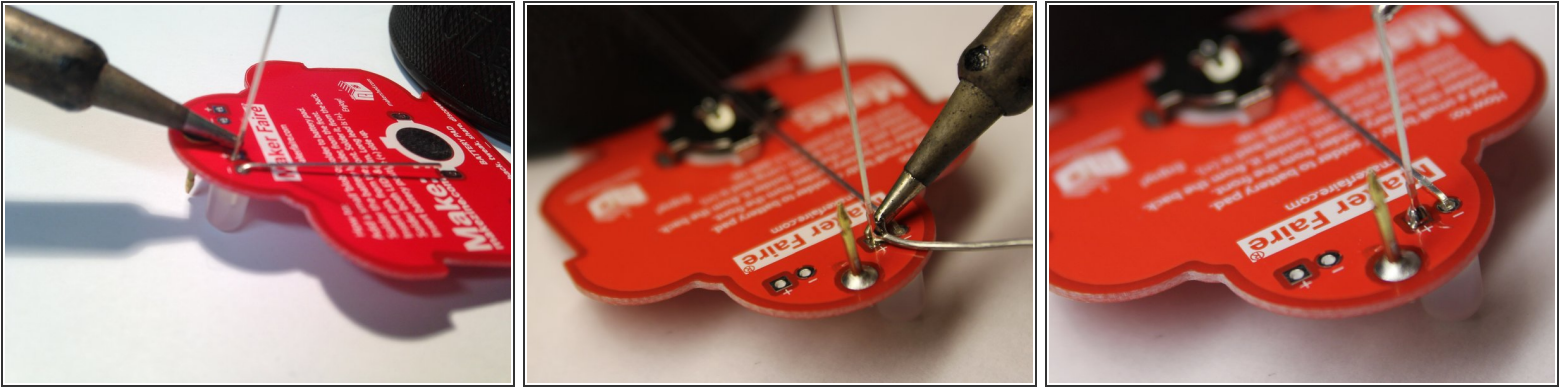
- Continue heating the junction by positioning the iron as previously instructed.
- i The material in this junction is sufficiently greater in mass than the battery holder, thus it will require more heat to raise it to the correct temperature. Leave the iron in place a little longer than previously, and check how well solder flows when you begin.
- Feed solder into the junction.
- ✦ Check for a cold solder joint. Reflow if necessary.
- Tin the tip of the iron and return the iron to its stand.

## Step 17 — Position the LEDs



- i** LEDs are polarized: one side of the diode is positive, the other is negative. It is typical convention for an LED to be manufactured with its positive lead longer than the negative lead.
- Positive lead (longer)
  - Negative lead (shorter)
  - Insert the LED into the PCB as illustrated. Be sure to match up the positive lead of the LED (the longer one) with the positive pad on the PCB (marked with a "+").
  - Bend one of the leads down tightly. This serves as a securement so the part doesn't fall away while you solder.

## Step 18 — Solder the LEDs



**i** It does not matter which lead of the LED you begin soldering.

- Begin heating up the junction between an LED lead and its pad by pressing the iron into the junction as illustrated.
- Once the junction is hot enough, add solder until the joint is strong enough.
- Tin the iron tip, then return it to its stand.

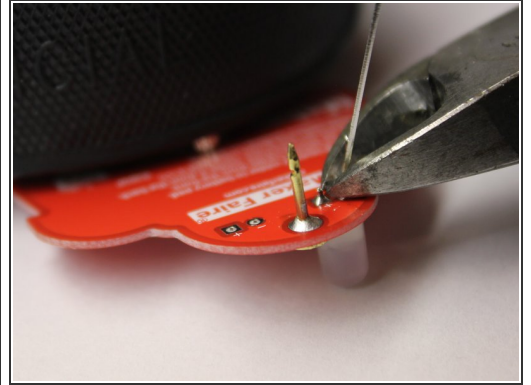
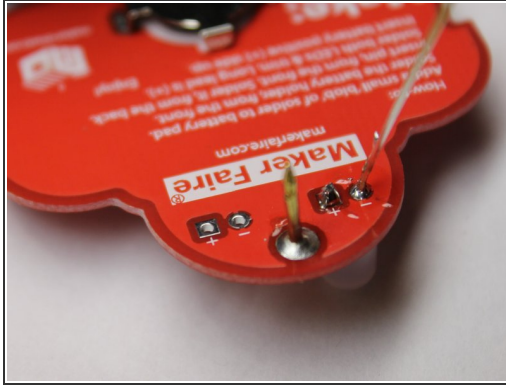
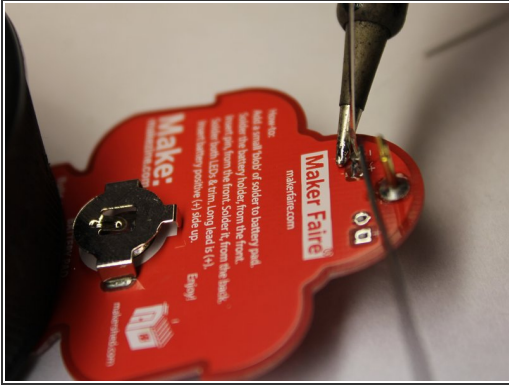
## Step 19



- ① Only cut off leads that you have already soldered in place.
- Use diagonal cutters to clip off the excess leads on the LED.
- Cut as far to the solder join as you can.

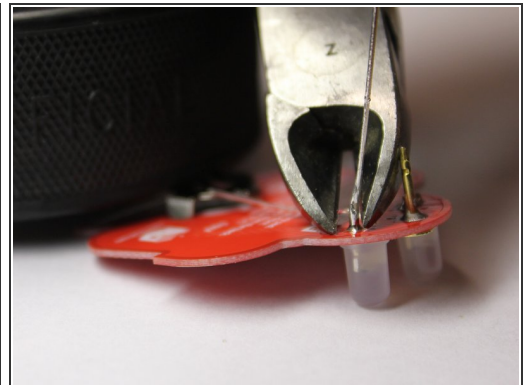
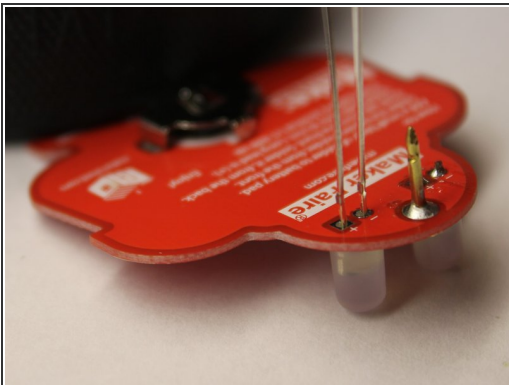


## Step 20 — Continue soldering the LED in place.



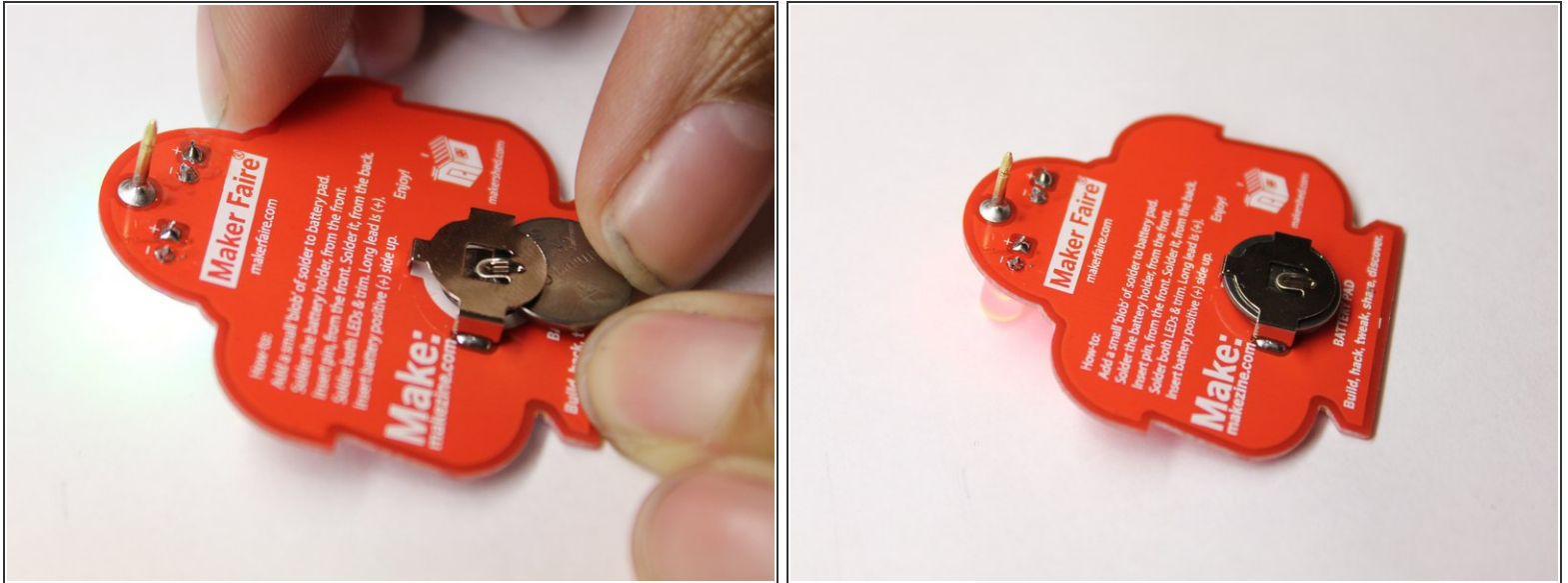
- Bend up the second lead and begin to heat it.
- When sufficiently hot, apply solder to secure the joint.
- Tin the tip of the iron, then return it to its stand.
- Cut the lead off when you're finished.

## Step 21 — Solder the second LED



- Repeat the steps taken previously.
  - Position the LED and bend one lead down to hold it in place.
  - Solder the other lead in place, then clip off the excess.
  - Bend the first lead back up, then solder in it place as well. Clip the lead when complete.

## Step 22 — Install the battery



- Slide the battery into the battery holder on the badge. One side of the battery has text -- this side should be facing up (away from the PCB) as illustrated.
- If the LEDs do not light up, chances are the battery was inserted upside down. Don't fret! The electronics are fine! Just flip the battery around and it should work.

## Step 23 — Attach the backing to the pin.



- With your thumb and forefinger, press the two levers on the pin-backing to release the clutch. Press the backing around the pin exposed on the board.
- Remove and reattach the pin when securing to clothing.



## Step 24 — Show off your sexy new blinky badge: a true fashion statement!



- [Insert photos of lots of people modeling learn to solder badge]