Successful Soldering

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* Learn the basics of soldering by creating a solder sculpture and testing for continuity.
* The purpose of this activity is for students to learn proper soldering techniques in a low-risk environment before they being soldering actual electrical components.
* Suitable for any student above 6th grade who has little to no soldering experience.

**Learning Objectives:**

1. Students will be able to demonstrate soldering proficiency by creating an electronically sound soldered wire sculpture
2. Students will be able to measure continuity between different junctions on their sculpture
3. Students will demonstrate proper wire stripping technique before soldering

**Standards:**

**HS-PS3-B : Conservation of energy and Energy Transfer**

 **HS-PS3-3.**

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

**Materials Required:**

* Small gauge wire
* Digital Multi Meter
* Wire Cutters
* Wire Strippers
* Soldering Iron
* Solder
* Soldering station (stand, sponge)
* LED (optional)
* 100 ohm resistor (optional)
* Power supply (optional)

**Safety:**

**safetys:**

* Safety glasses must be worn at all times when soldering
* Solder that contains lead should be handled with care. Wash hands thoroughly after use.
* Soldering irons and components get hot, be careful when touching anything when soldering, always assume things are hot.

**References:**

Basic Soldering: <https://www.youtube.com/watch?feature=player_detailpage&v=BLfXXRfRIzY>

Detailed Soldering of PCB: <https://www.youtube.com/watch?v=fYz5nIHH0iY&feature=related>

Equipment and soldering PCB: <https://www.youtube.com/watch?v=QL86gO9mfT8&feature=player_detailpage>

Desoldering Techniques: <https://www.youtube.com/watch?v=j-_pnc-Qqm8>

**Activity:**

* Students will design and create sculptures using small gauge insulated wire and solder. Basics of soldering will be discussed beforehand with demonstrations to accompany the activity.
* Notes:
	+ Soldering: What is it?
		- Solder is typically an alloy of 60% Tin (Sn) and 40% Lead (Pb).
		- Lead poisoning can occur from inhalation, but the lead must be at much higher temperatures than what we will be dealing with when soldering. Lead poisoning does occur from ingestion, always wash hands when done and do not eat while soldering.
		- Soldering is the action of melting solder to create an electrical connection between two or more electrical components
		- Soldering can be undone
	+ Flux
		- Removes oxidation from metal surfaces to be soldered. It can be added, or be within the solder itself (known as rosin-core solder). Be sure to check what type of solder you have to see if flux is necessary
	+ Tinning:
		- The act of coating the tip of the soldering iron with a layer of solder
			* Prevents oxidation of the hot tip
			* Improves heat transfer from the iron to the electrical component
	+ Tips for good soldered connections
		- Insure you first have a good physical connection between the components before adding solder
		- Twist wires together
		- Bend components so there is good contact
		- Have a friend lend a hand when a third hand would be helpful
		- Use the proper procedure (demonstrate)
			* Tin the Iron
			* Wipe off excess
			* Tin Iron again
			* Use iron the heat COMPONENT to be soldered
			* Touch solder to hot component
		- Important: You are heating the components, and melting the solder with the hot components. You are not melting the solder directly with the iron. A good connection will be impossible if you do this. The soldering iron should be above 700 degrees Fahrenheit to form an adequate solder joint quickly without damaging the surrounding components.
	+ Other reminders:
		- Always assume irons, components, and joints are hot. NEVER JUST GRAB THINGS!! You cannot visually tell hot from cold!
		- Check iron tips, you may need to screw it in, file it, or replace it
		- If filing is needed, file until you see bright copper or silver. Do this before plugging the iron in
		- Check the cord
		- Do not hold the tip to the damp sponge when wiping excess solder off, you do not want to cool the tip.
		- Irons are either in your hand, or in the holder. Never anywhere else.

Requirements for the solder sculpture:

* Must be aesthetically pleasing
* It must be recognizable (not just a random clump of wire entitles “modern art”)
* It must demonstrate at least 10 good soldered joints
* It just have structural integrity (stand on its own)

To check for acceptable soldered joints, use a DMM set to check continuity. An alternative would be to use an LED and a power supply to energize the sculpture and make sure that all junctions will allow power to flow and light the LED.

**Quiz:**

**Traditionally, what is solder made of?**

1. **Aluminum and copper or aluminum and tungsten**
2. **Tin and lead or tin and copper and silver**
3. **Bronze and copper or bronze and tungsten**
4. **Pure aluminum or pure tin**

**What is the purpose of flux?**

1. **To clean the surfaces being soldered**
2. **To lower the melting point of solder so less heat is needed**
3. **Flux is only used when soldering flux capacitors**
4. **To bring honor to your family**

**What is the purpose of soldering?**

1. **To create an energy source for electrical components**
2. **To create a connection between non-metallic or semi-metallic components**
3. **To create an electrical connection between components**
4. **To ensure that wires don’t break when electronics are turned on**

**Can soldering be undone?**

1. **Yes, soldering can always be undone**
2. **Soldering can only be undone if the joint has been cool for less than 15 seconds**
3. **Soldering can only be undone if the joint has been cool for less than 15 minutes**
4. **No, soldering is a permanent process that cannot be undone**

**What is one benefit of tinning the soldering iron?**

1. **To control the amount of solder in the assembly**
2. **To increase aesthetics by creating a shiny tip**
3. **To transfer heat to the components more rapidly**
4. **To avoid creating harmful vapors**

**Where is heat applied when soldering?**

1. **Directly to the wire insulation**
2. **To the solder wire**
3. **To the electrical component(s) being soldered**
4. **Directly to the forehead**

**What is a cold solder joint?**

1. **A temporary joint using solder wire to connect two or more components**
2. **Solder that has cooled to room temperature**
3. **Solder that was not adequately heated when applied to components**
4. **A type of solder joint that requires no heating**

**What should be avoided when soldering?**

1. **Wearing safety glasses**
2. **Eating and drinking**
3. **Creating strong electrical connections between components**
4. **Using flux on non-flux capacitors**

**What temperature is the iron typically at when soldering with leaded solder?**

1. **200-400 degrees Fahrenheit**
2. **600-800 degrees Fahrenheit**
3. **900-1100 degrees Fahrenheit**
4. **1100-1400 degrees Fahrenheit**

**Where is solder applied once the electrical components have been heated?**

1. **Directly to the iron, then let capillary action wick the solder into the components**
2. **Directly to the components once the soldering iron has been removed**
3. **Directly to the components while keeping the soldering iron in place**
4. **Directly to the iron, letting drops fall onto the electrical connection to create a strong joint**

**Answers: BACACCCBBC**

**Reviewing Faculty Cohort Members:**

* Include at least two names and schools of reviewing faculty cohort members (refer to email list for faculty cohort member email addresses).