Electroplating is fairly easy to understand chemically, provided you have the appropriate background information. Electroplating operates using what is called an electrolytic cell, which sounds more confusing than it is. In order to electroplate, a metal salt is required. This just means that in order to prepare an effective electroplating solution, you need to dissolve a chemical that breaks down in solution into positive and negative ions. For example silver chloride breaks down into $Ag^+$ and $Cl^-$ ions just as nickel sulfate breaks down into $Ni^{2+}$ and $SO_4^{2-}$ in solution. Now that you have metal ions in solution you can create the electrolytic cell. Since like charges repel each other and opposite charges attract, it is possible to pass a current through your solution. The current can control where the metal ions end up. By hooking up the metal solid you wish to plate to the negative terminal of a battery, and the positive terminal to the anode (usually stainless steal or a metal that matches your metal ions in solution) you will attract the positive metal ions to the negatively charged metal solid. This attractive force causes the metal ions to graft to your metal solid resulting in a nice electroplating. This is illustrated in the image below. Simple!! Although this explanation is simplistic, electroplating can take many complex turns.

**Why Do We Care??**

Electroplating is a widely used practice and can be done industrially or by the average Joe (including undergraduate chemistry majors.) people typically electroplate in order to provide protective coatings and/or to increase the longevity of a metal. It can also be used as a means of inexpensive decoration. Due to the chemical nature of electroplating solutions pretty much any metal in a salt form can be electroplated. Common metals include copper, silver, gold, nickel, zinc, brass and more. Electroplating techniques can be applied to things as large as cars, clocks, and furniture and as small as jewelry, buttons, or even stove-top burners. The basic principles of electroplating can even be used to repair tarnished jewelry. In most circumstances, the tarnished jewelry actually comes out looking better than new. For a ton of money it is possible for anyone to buy proprietary electroplating solutions from reputable vendors such as Krohn Industries. However, what they don’t tell you is that the solutions that you pay big bucks for online or otherwise, can easily be made for small costs with a little knowledge of chemistry. Plating comes in several types as well. The most common types of electroplating include brush plating, which allows for localized control of the metal deposition, pulse plating, which allows control of the “thickness” of the metal deposition, and immersion/strike plating, which allows for a small and fast coating of a metal with limited metal ions in situ. The plating taking place in this demo is immersion plating.

**Links and references**

- https://chem.libretexts.org/Core/Analytical_Chemistry/Electrochemistry/Electrolytic_Cells/Electroplating
- http://https://www.youtube.com/watch?v=z7f7dQF2KLA
- Atlanta Diamond Design
- Thermo-Fischer Scientific: How Gold plating Is Done Step by Step

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This demo will display electroplating on two different surfaces. We will be electroplating coins and jewelry. It is known that electroplating can be used to beautify old jewelry and other tarnished metals so we will be doing just that. Have you ever been to a hot spring and read signs instructing you to take of your jewelry? Well this is for good reason. Minerals in the springs can build up sulfur oxide layers on your jewelry rendering them aesthetically unappealing. We will be subjecting jewelry to mineral water from the Pagosa Hot Springs and attempting to not only remove the sulfur oxide layer, but also to electroplate and polish the jewelry. In addition we will be electroplating pennies. In order to do so we will wash them thoroughly and submit them to a nickel electroplating solution. After they have been electroplated they can look a little rough. To fix this problem we will then polish the jewelry.

**Instructions**

1. **Step 1**: Wash the coin in a soap solution to remove oils and dirt. You cannot electroplate the unclean! (Oils and dirt will not conduct electricity.)

2. **Step 2**: Attach the cathode to the stainless steel screw or solid nickel and the anode to the coin; Submerge the coin in an acid solution to dissolve any oxide layer on the coin. This should result in a very shiny looking finish on the coin. Almost is if it were new!

3. **Step 3**: Clean Both the Coin and Screw in Water. This will prevent the nickel sulfate electroplating solution from becoming contaminated.

4. **Step 4**: Submerge the coin and screw/solid nickel in the nickel sulfate solution in order to electroplate the coin. Then repeat the rinsing process. The coin may look a little bit ugly despite having gone from copper to silver in color. In order to make it shine we will commence step 5.

5. **Step 5**: Polish the coin using the provided polish cream.