# Electrochemistry: Harnessing Electricity From Chemical Reactions

**Overview**

In this lesson, students review electricity and simple circuits. They will learn about connecting a circuit in series and in parallel. They will learn the definition of electrochemistry. They will be able to make a circuit and light up a small LED clock with potatoes, pennies and screws. . This activity is appropriate for grades $6^{th}$-$9^{th}$.

**Objectives**

Students should be able to:

- identify circuits in parallel and series
- Define electrochemistry
- Construct a working circuit using pennies, screws, and potatoes.

**Oregon State Science Standards 2009**

Interaction and Change
6.2P.2 Describe the relationships between: electricity and magnetism, static and current electricity, and series and parallel electrical circuits.

Engineering Design
6.4D.2 Design, construct, and test a possible solution to a defined problem using appropriate tools and materials. Evaluate proposed engineering design solutions to the defined problem.
6.4D.3 Describe examples of how engineers have created inventions that address human needs and aspirations.

**Student Pre-requisite Knowledge**

Students should be familiar with the definition of electricity. Students should also be familiar with the differences between circuits in series and in parallel.

**Materials**

Each group requires:

- 2 smooth tip alligator clips connected to regular alligator clips
- 1 regular alligator clip

- 1 LCD watch head
- 2 zinc coated nails or screws
- 2 pennies
- 1 plastic bowl

**Tea cher Preparation**

Make sure to read through the power point and be able to define the two main simple circuits. You should be able to define electricity as the movement of electrons. There is a You Tube video showing the construction of the clock http://www.youtube.com/watch? v=9B6-S8Lkkks and another video showing a close-up view of the watch here http://www.youtube.com/watch?v=Pc1ncAKJCEc.

**Procedure**

1**. Anticipatory Activity-** Start by holding up the watch and passing it around to students to look at. Ask the class if they could power the watch without using a battery. Start a short discussion about different ways to power the watch. Hold up a potato and ask the students if they could power the watch with the potato on hand. Lead into the Potato Clock PowerPoint.

2. Begin with the Potato Clock PowerPoint. Be sure to define electrochemistry and electricity. The potato battery utilizes the following redox reaction between copper and zinc.

$$Cu_{(s)} + Zn^{2+} \longrightarrow Cu^{2+} + Zn_{(s)}$$

Two electrons from copper are lost and combine with a zinc ion to form zinc metal. The reactant that loses electrons is oxidized (copper) and the reactant that gains electrons is reduced (zinc ion). A potato can serve as a battery is a circuit can be made between the copper and zinc. The tissue of the potato serves to complete this circuit. Talk about different ways we could connect the potato batteries, namely series and parallel. A flashlight is a good example for students to see batteries lined in series.

4. After the PowerPoint students may pair up. Describe the assembly of the potato clock. The nail/screw from potato battery #1 needs to be connected to the penny from potato battery #2. The penny from potato battery #2 needs to be connected to the watch battery terminal on the left. The screw from potato battery #1 needs to be connected to the watch battery terminal on the right. Be sure to tell students the smooth tip alligator clips need to be connected to the watch. The other alligator clips will not fit the tiny battery terminals. Please see the video posted above.

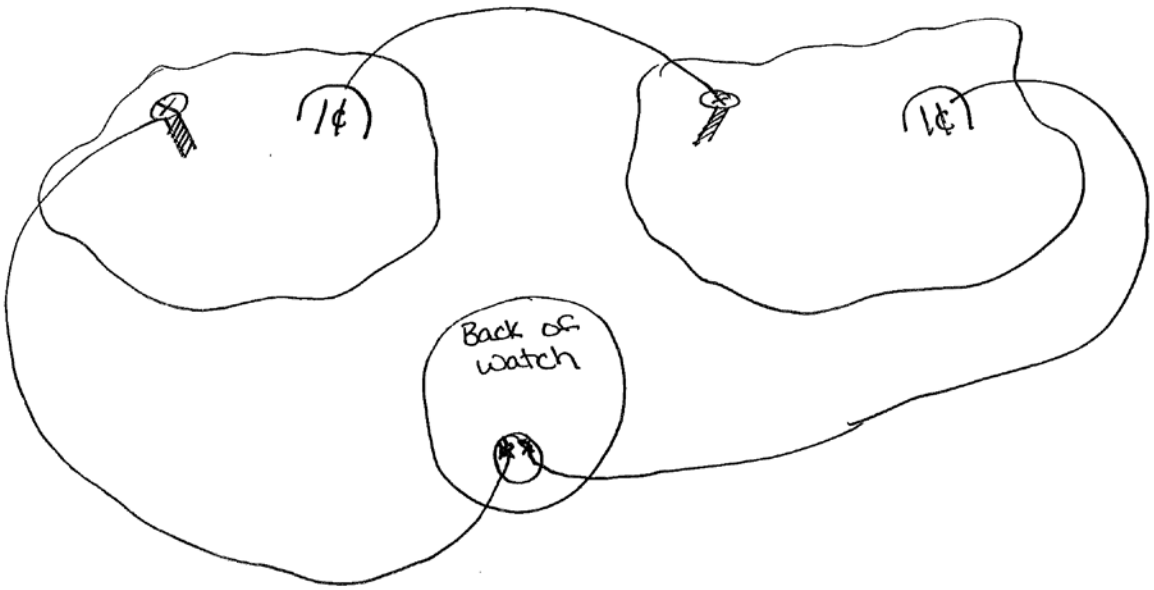
5. Have students assemble the potato clock. You may want to leave your example out for inspection or put it away and see if the students can figure out the configuration. Walk around the classroom and assist students as needed. Students will try to set the time on their clock and this is not possible. The buttons on the clocks do not function due to the low amperage of the potato battery.

6. **Closure –**This problem of low amperage leads to a closing discussion about possible improvements to increase the amperage. Wiring in parallel will increase amperage so the ideal potato clock would have

several potato batteries wired in both series and parallel. Also, the reaction will stop eventually, either the potatoes will rot or the penny will eventually lose its reactive copper. Talk about what engineers might do to help this problem.

7. **Clean up –** Have students take apart their potato clock and clean up all materials.

Diagram of a potato clock.




**<u>Extensions</u>**

This activity could be done in an inquiry based fashion. Instead of going over the wiring in detail, a challenge can be put to the class to power the LED clock with the available materials.