

# **Electrical Circuits**

**Vanderbilt Student Volunteers for Science**

**Training Presentation**

**2018-2019 VINSE/VSVS Rural**

# Important!

- Please use this resource to reinforce your understanding of the lesson! Make sure you have read and understand the entire lesson prior to picking up the kit!
- We recommend that you work through the kit with your team prior to going into the classroom.
- This presentation does not contain the entire lesson—only selected experiments that may be difficult to visualize and/or understand.

# **Why is the science in this lesson important?**

Computer engineers are largely responsible for developing computer chips and circuit boards that are found in all of our technology. These chips and boards are made of complex electrical circuits just like the ones the students learn about in this lesson.

Scientists are developing robotic exoskeletons – the circuits in the machinery are responsible for the sensors and motors that strengthen the wearer.

# I. Introduction

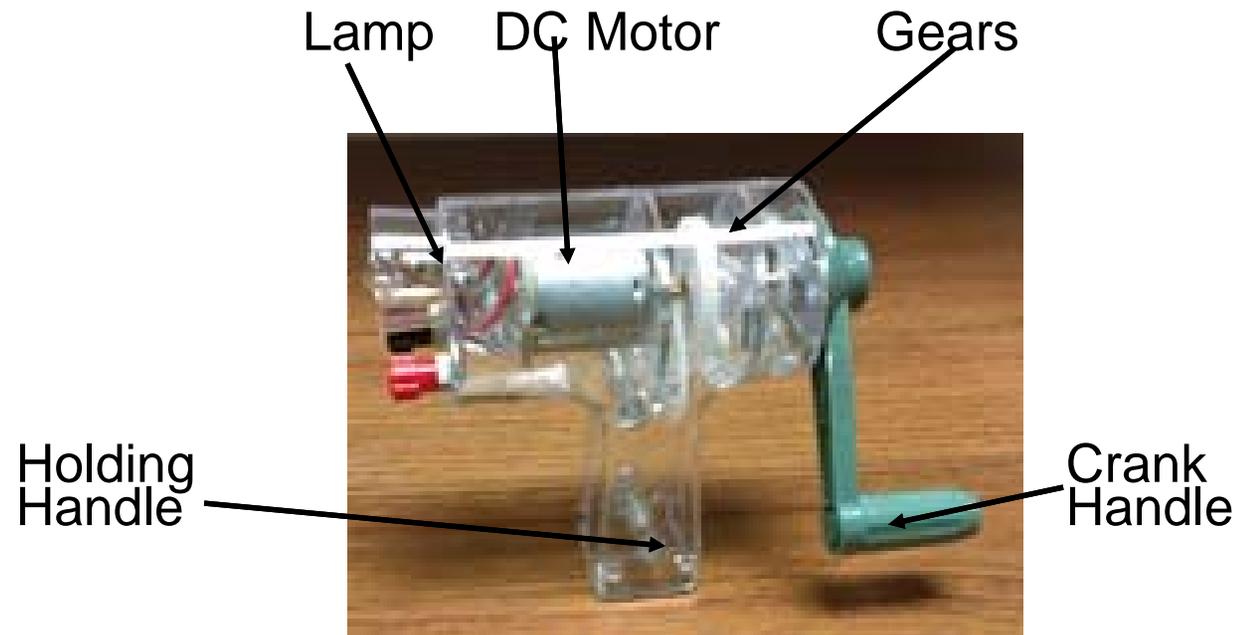
**Learning Goals: Students differentiate between static and current electricity.**

**Wait to hand out materials until you have described the background information.**

- Write the following vocabulary words on the board and their corresponding symbols as dictated in the lesson manual
  - Electricity, Current, Simple Circuit, Series Circuit, Parallel Circuit, LED
- Explain the difference between static electricity and current electricity: static is a build-up of electrical charges that do not flow (e.g. lightning), and current is a moving electrical charge through a completed circuit
- Divide the students so that there are 7-8 groups (in groups of 4).

# 1. Introduction - Hand Held Generator

- Show students the hand generator. Rotate the handle to activate it.  
Ask students what energy conversions are taking place in this device.
- Have them circle all the conversions on their observation sheet.



# Introduction - Energy Stick

**Learning Goal:** students understand that electrons can flow only if the circuit is complete.

- Show students one of the Energy sticks.
- Put a hand on each of the foil ends of the Energy Stick. The stick will flash lights and buzz.
- Tell students that the stick is activated only when an electrical circuit has been completed. Remove one hand to show the students note that the stick no longer flashes or buzzes. See lesson for explanation
- Now have 2 or more VSVS members form a connected circle (by holding hands). Have 2 VSVSers each hold the foil at the opposite ends of the stick to complete a human chain of electricity.
- Show them a “human switch” by having one



# Energy Stick contd.

- Tell students to look at their Observation sheet and ask them if they can name some energy conversions when the stick is activated. Tell them to circle the correct answers – chemical to electrical (battery to electrical) and the electrical to sound and light.
- If time permits at the end of the lesson, see how many students can form a circle and activate the Energy stick. Or do this with smaller groups and a VSVS member

# IIA. Making a Simple Circuit

**Learning Goals: Students understand how electrons flow through a circuit.**

- Hand out one bag containing circuit materials to each pair.
- Tell students to look at the grids and its components.
- Compare it with Diagram #1 on the instruction sheet.
- Tell them to remove a #3 snap connector and look at its underside. Point out the flattened wire connecting the two snaps.



Diagram #1

Continued on next page

# Ila. Making a Simple Circuit (Con't)

- Have pairs of students build simple circuits by following Diagram #2.
- Tell them not to connect one of the #3 snaps until told to do so.
- Ask them if circuit is complete (No, because the light bulb is not on)
- Have them connect the last snap as in Diagram #2 (note that the bulb now glows)

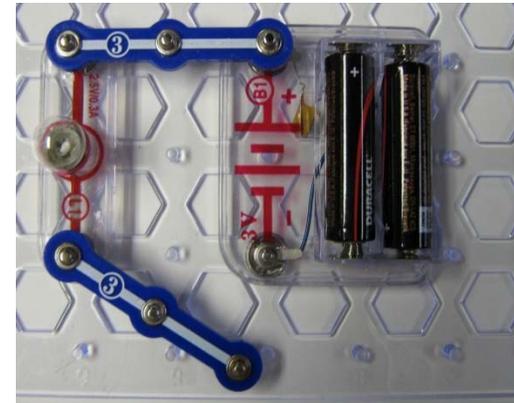
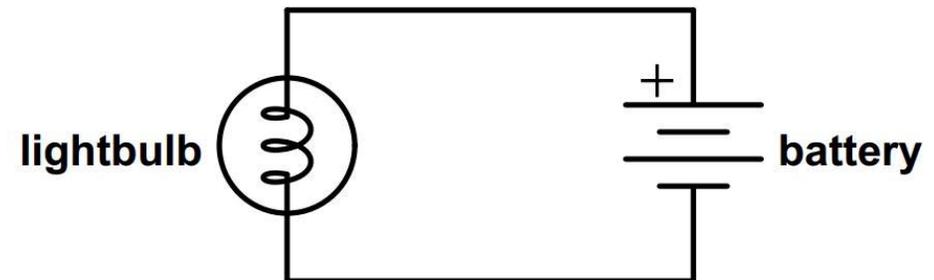


Diagram #2



# III. Activity: Using a Switch

**Learning Goals: Students understand how electrons flow through a circuit.**

- Tell students to replace one of the #3 snaps with a switch (Diagram #3).
- Have them turn the switch to the on position and see how it completes the circuit (the light bulb glows).

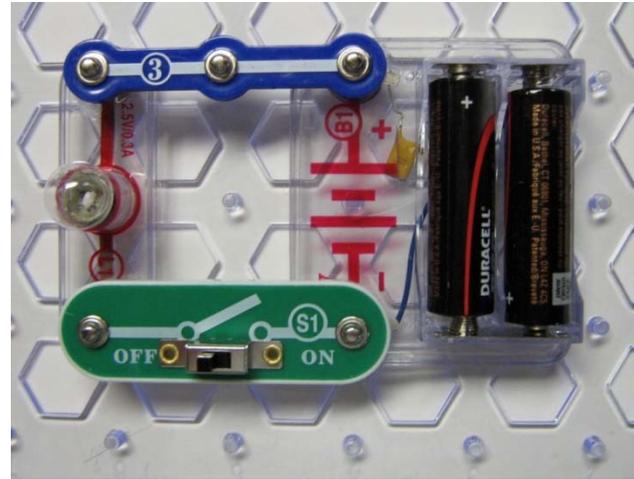
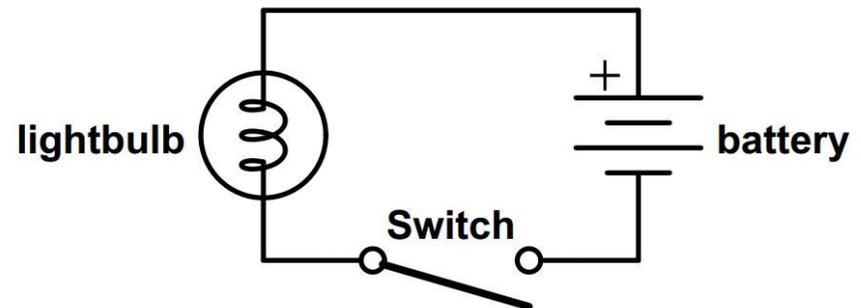


Diagram #3



# IV. Measuring Current

**Learning Goals: Students understand how electrons flow through a circuit.**

- Show the students the meter and tell them it can measure voltage and current.
- Show them the 3 positions
- Add the meter to the circuit (Diagram #4) and move the switch to the 1A setting
- Turn the switch on and measure the current.
- Record the measurement in amps (A).

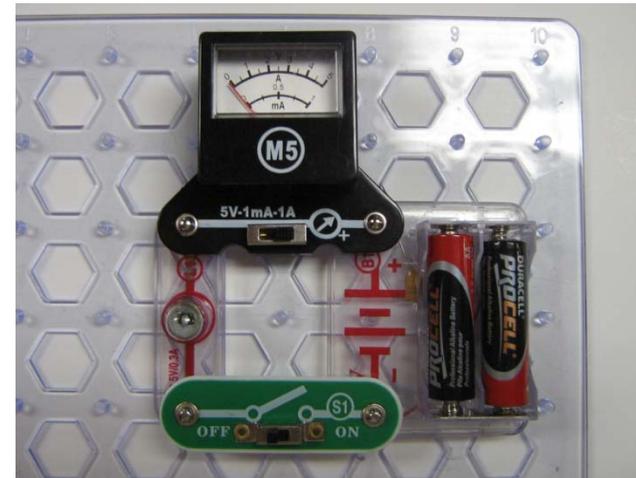
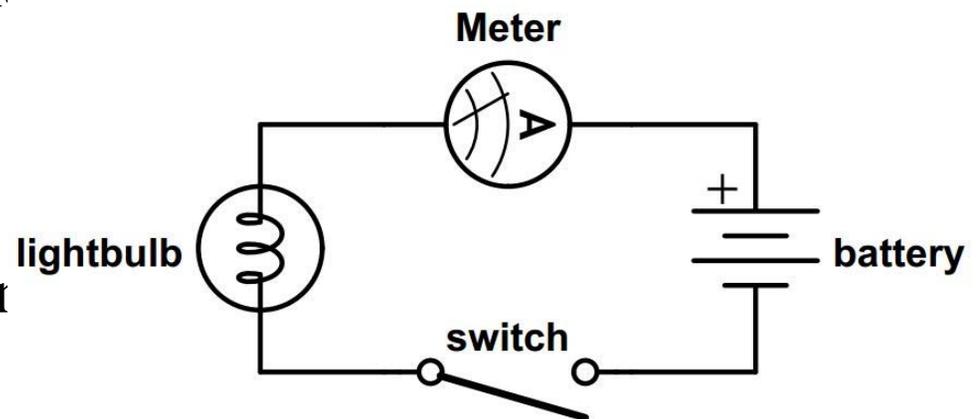


Diagram #4



# IV. Measuring Current Using an LED bulb

Remove the snap containing the light bulb and replace it with the snap containing the LED.

- Repeat steps 4-6.

Ask students:

- Which light bulb saves electrical energy? How do you know?
- Which light bulb would be more useful for keeping cooler temperatures in the house?
- What energy conversions are taking place? Answers should include:
  - Electrical to Light.
  - Electrical to thermal (feel the light bulb while the circuit is closed).

# V. Series and Parallel Circuits

**Learning Goals: Students model energy flow and energy conversions in series and parallel circuits.**

- Explain what a series and parallel circuit looks like.
- Tell the groups to split into pairs. Tell one group to build a series circuit (Diagram #5) and have the other group build a parallel circuit (Diagram #6).
- Measure the current flowing and record the data.



Diagram #5

## SERIES CIRCUIT

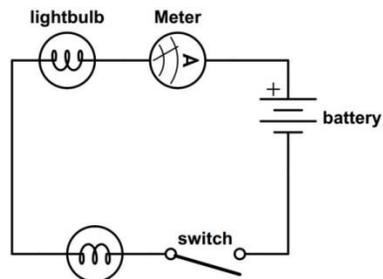
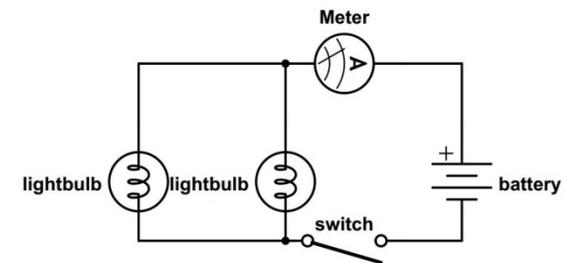


Diagram #6

## PARALLEL CIRCUIT



# V. Series and Parallel Circuits (Con't)

- While the students are assembling their circuits, have a VSVS member connect the simple circuit design and set it aside for the VSVS team
- After the students have completed their circuits, have the two pairs within each group show each other what happens to the brightness of the second bulb when one bulb is unscrewed.
- Go around the room and show them the bulb brightness in the simple circuit so they can compare brightness to that as well.
- Have the students record their observations on their observation sheets

# V. Series and Parallel Circuits (Con't)

- Have the pair with the parallel circuit rearrange the meter as in Diagram #7.
- Ask the students to measure and record the current in the new position. *It should be about double the previous measurement.*
- The first setup measures current through both bulbs, while the second measures only through the second bulb.

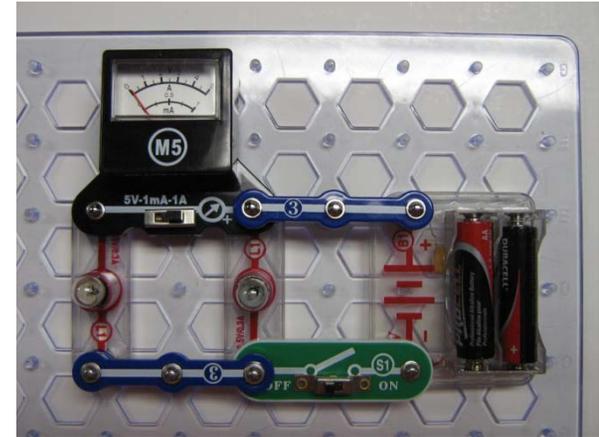
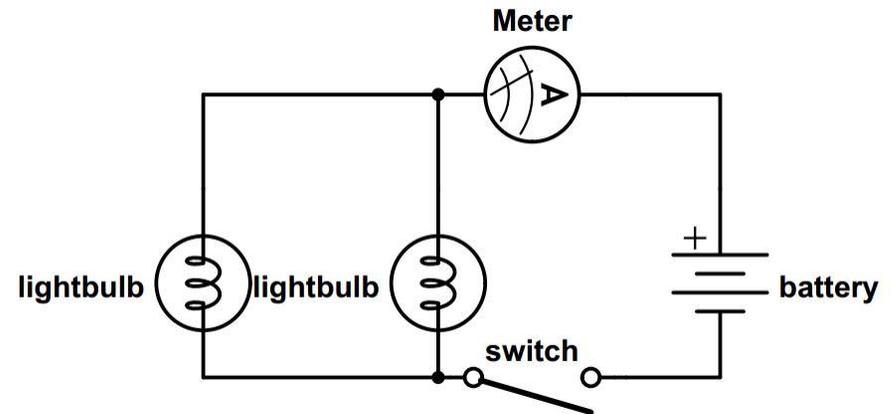


Diagram # 7



# V. Series and Parallel Circuit Discussion and Review

**Learning Goals: Students model energy flow and energy conversions in series and parallel circuits.**

- **A series circuit only has one pathway for the electric current – a break in the circuit stops the flow of electric current.**
- **A parallel circuit has multiple pathways for electric current to travel – if one pathway is broken current will still flow through the other pathway.**

# VI. Optional – Saving Electricity

- Allow the 2 pairs of students to combine their circuits and make **parallel circuits** using 4 light bulbs, with the meter in the circuit.
- Unscrew a bulb, one at a time and record current measurements.  
Explain to students that this is the equivalent to turning off a light.
- Electrical power is directly related to current used. The lower the current used, the less electrical power used.
- While new technologies (such as solar power, wind power, LED lights...) can help reduce dependence on fossil fuels to generate electrical power, it is also important to conserve electrical energy by turning off appliances such as lights, heaters etc that are not being used.

# Vb. Electrical Energy Conversions

- Ask the students what energy conversions are taking place in their circuits.

Answer should include:

- Electrical to light
- Electrical to thermal (feel the light bulb while the circuit is closed)

- Ask the students what other electrical energy conversions could be possible?

Answers should include:

- Electrical to mechanical
- Electrical to sound
- Electrical to chemical

# Clean Up

- Have the students reassemble the circuit components according to diagram # 1 and place the light bulbs in small Ziploc bags.
- Make sure all grids are packaged properly.
- Place the grids between the sheets of bubble wrap.