Solar vs. Wind

Lesson 2: Introduction to Circuits

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GRADE LEVEL: 7-8

LESSON DURATION: 1 day (can be extended)

SUBJECT AREAS: science, energy, energy transformation, series circuit, parallel circuit, load, anode, cathode, electrons, electrical energy

LESSON OVERVIEW: This lesson begins with students having hands-on experiences creating electrical circuits using a battery, wires, and a light bulb. Students will learn that electricity is the flow of electrons, and how electricity moves within a circuit.

OBJECTIVES:

By the end of these two lessons students should be able to:

1. Create a simple circuit on their own when given the appropriate materials.
2. Diagram the flow of electrons within a circuit.
3. Differentiate between series and parallel circuits.

STUDENT BACKGROUND: This lesson assumes a basic knowledge of different kinds of energy, but little to no experience with electrical circuits. If students are comfortable creating series and parallel circuit as well as diagraming the flow of electrons, this lesson could possibly be skipped.

EDUCATOR BACKGROUND: It will be helpful if you feel comfortable with basic circuitry.

NEXT GENERATION SCIENCE STANDARDS:

MS-PS3-5 (Crosscutting Concepts)

- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion)

COMMON CORE STANDARDS:

CCSS.ELA-Literacy.RST.6-8.4

- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6-8 texts and topics*.

KEY VOCABULARY:

- Circuit
- Series Circuit
- Parallel Circuit
- Load
- Electricity/Electrical Energy
- Electrons
- Cathode
- Anode

MATERIALS NEEDED:

- "Activity Sheet #2: Introduction to Circuits" (one per student)
- One Large Ziploc bags (or plastic bins) per 4 students – students will work in their groups in pairs of two, see "teacher note" below. Each bag should contain:
  - AA battery pack for 2 batteries (metal or plastic battery holder for easy connection)
  - 2 insulated wires (alligator clips can make things easier)
  - 2 small LED bulbs
- Computer access for each student or pair of students. This lesson can be done from the front of the room using a projector if you only have one computer. ***Note: if you don't have computer access, you can simply have students create parallel and series circuits using supplies provided including alligator clips, light bulbs, and 1.5 V batteries. This will probably take much longer, but it will be more hands-on.***
- **Optional:** Energy Stick from Steve Spangler for intro activity

Teacher Note*:*
Snap circuits are a much easier option and may be substituted for the all of the materials listed above. Students seem to learn and understand circuits more quickly because they don't get "hung up" on issues such as being unable to make a good connection etc. If you wanted to do this lesson with snap circuits, get the biggest set (you will need at least two sets for a class). The "Snap Circuits Extreme SC-750 Electronics Discovery Kit" is excellent because it includes a solar cell as well as many more "snap" wires than the other kits. It costs just under $90 but it is worth it. There are other much cheaper sets with fewer parts that are still good. They simply have fewer options.

PREP:

1. Prepare contents of Ziploc bag (1 bag per 4 students)
2. Make copies of "Activity Sheet #2: Introduction to Circuits"
3. Have "PhET" website called "Circuit Construction Kit" ready to show the class. http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc

4. If you are able to get computer access for all students this is optimal but you could simply demonstrate the topics from your projector if you have to***. Important note: At this time, the PhET simulation for circuits is available as a download only. It will only operate on machines with Java installed. This means that it is likely to not work on a Chromebook or iPad.***
    - **Alternative Option #1**: If laptops don't work for this – consider reserving computer lab and use desktop computers.
    - **Alternative Option #2:** If you don't have computer access or would rather students physically construct series/parallel circuits, you can use alligator clips, light bulbs, and batteries with holders etc. This option will probably take quite a bit longer but will be more hands-on. *This option might work even better with the "snap circuits" materials if they are available.*

LESSON 2:

Opening – "Circuit Brainstorm" (6 -10 minutes)

- **Think/Pair:** Ask students to write down whatever they think of when they hear the word circuit on Part 1 of their "Activity Sheet #2: Introduction to Circuits" sheet.
- **Share:** Have students share with their "elbow partner" the description they came up with
- **Class Share:** Call on one person from each group to share at least one thing they talked about in their group
- **Optional:** Have students stand in a circle or multiple circles using Steve Spangler Energy Sticks. Students work together to hold hands and get the sticks to light up and make noise. They make observations about what makes the stick work and what doesn't. Ask them probing questions to describe necessary components and requirements for a working circuit.

"Circuit Diagram" Activity (10 minutes)

- Hand out Ziploc bags with materials above including the battery, "snap wires," and small light bulb. Next, ask students to make the light bulb light up.
- When students are successful, have them draw a diagram of their set up (circuit) for "Part 2: Circuit Diagram." Students may also set up their circuit on top of butcher paper and trace a circuit and this information around it.

Lecture (10 minutes)

- **Notes/Lecture**: Draw a diagram of the circuit on the board for students. You can either have students add/fix their diagram on Part 2 of their "Activity Sheet #2: Introduction to Circuits" or you can have students draw a brand new diagram on notebook paper (or in their science notebooks if you use them). Make sure to label the flow of electrons to show the electrons ("e's") traveling from the negative side to the positive side of the battery (unfortunately society draws the electrons going the opposite direction but this is false).

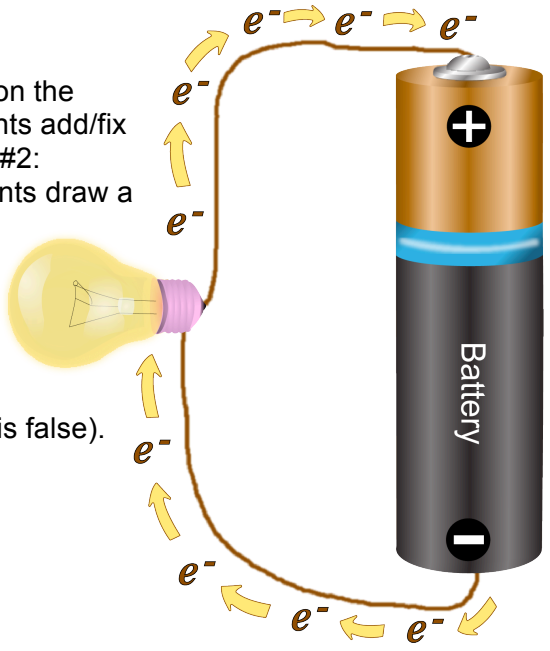

Figure 1. Simple Battery Circuit.

Next, label the negative terminal of the battery (cathode -) and the positive side of the battery (anode +) on the battery. If you decide to do Cornell notes, students can write questions for their Cornell Notes and/or write a summary paragraph (5 sentences describing what they learned about circuits) as homework.

PhET Simulation – "Circuits" (20 minutes)

- Visit or log onto PhET (a free website for science and math simulations) using the URL: http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc or use keyword "PhET, circuits" in your preferred search engine to pull up the link.

  Teacher Note:
  This site allows students to virtually "get" materials (wire, battery, switches, resistors, light, voltmeter, etc.) and create a circuit step by step. The lightbulb will light up if student create the circuit correctly. The length of the light rays will be proportional to the voltage. Thus, students will see a drop in the amount of light produced when they add resistors or change from a parallel to a series circuit. Their experimental set up can also be tested using the voltmeter shown if they connect the leads correctly. Have student pairs share with the class what they learned from activity when they are done.

- Here is a list of tasks for students to complete on Part 3 of "Activity Sheet #2: Introduction to ***Circuits"*** (You can do this as a class or students can work in pairs or individually if you have enough computers.)
  1. Have students build a simple circuit using a battery, light, wire, and light bulb.
  2. Have students build a **series** circuit with one battery and two light bulbs (see Fig. 2).
  3. Have students build a **parallel** circuit again with one battery and two light bulbs (Fig. 2).
  4. Have students experiment by adding resistors, more light bulbs, increasing the number of batteries, etc.
  5. If time allows, have students discuss the differences between series and parallel circuits using their observations in the simulation.

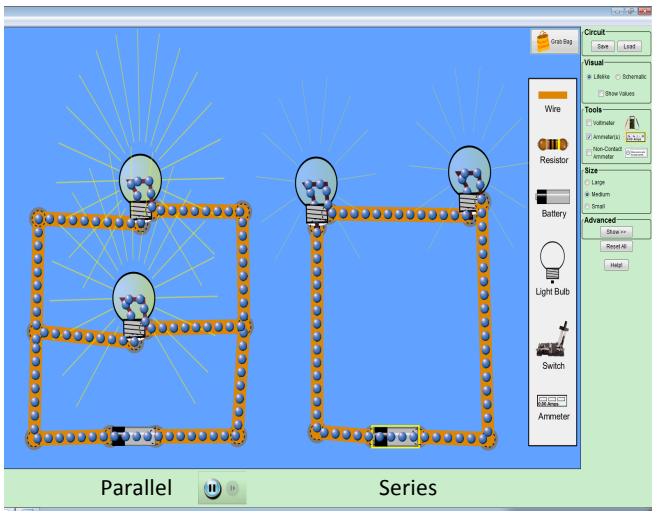

Figure 2. PhET Circuit Simulation Screenshot.

Teacher Note:
You will probably need to show students how to measure the voltage across the light bulbs by placing a lead from the voltmeter on the positive terminal and the negative terminal of the battery and comparing them in the PhET simulation. Simply click on the "voltmeter" under the "tools" section of the task panel and attach the leads to either side terminal of the light bulb. Compare the voltage between the parallel and series circuits.