It's Electrifying

Grade Levels: 3-6
Subject: Science
Time Slot: 30 minutes
Topic: Electrical Circuits

Rationale:
The purpose of these lessons is to help students learn new science content and new science strategies that will help them gain confidence and expertise in their science abilities. Through observation and exploration students can learn the flow of electrons.

Goals:
The Students will learn about open and closed circuits by trying to light a bulb using various systems of bulbs, wires and cells (batteries and lemons).

Virginia Standards of Learning:

3.11 The student will investigate and understand different sources of energy. Key concepts include
- a) the sun's ability to produce light and heat energy;
- b) sources of energy (sunlight, water, wind);

4.3 The student will investigate and understand the characteristics of electricity. Key concepts include
- a) conductors and insulators;
- b) basic circuits (open/closed, parallel/series);
- c) the ability of electrical energy to be transformed into heat, light, and mechanical energy;
- d) historical contributions in understanding electricity.

6.2 The student will investigate and understand basic sources of energy, their origins, transformations, and uses. Key concepts include
- a) the role of the sun in the formation of most energy sources on Earth;
- b) nonrenewable energy sources (fossil fuels including petroleum, natural gas, and coal);
- c) renewable energy sources (wood, wind, hydro, geothermal, tidal, and solar); and

Objectives:
Cognitive:
The students will be able to differentiate between an open and closed electric circuit.
The student will be able to create and diagram a functioning parallel circuit using dry cells, wires, buzzers, bulbs, and bulb holders two out of three times.

Affective:
The students self confidence will increase while working with fractions. By gaining understanding of electrical circuits students can feel more comfortable with science and the flow of electrons.

Psychomotor:
The students will be able to draw a pictorial representation of the circuits. Along with the pictures the students will be able to explain aspects of circuits.

Inquiry Questions:
How can you make a closed circuit that will light a bulb or buzz a buzzer?
Do lemons conduct electricity? How can we Test if a lemon conducts electricity?

Content:
When you flip a light switch on and off, you are closing and opening a circuit. A circuit is the path that electricity follows. For electrons to travel (creating an electric current), the circuit must be closed. When you flip the light switch off, you are opening the circuit and the lights turn off. When you flip the switch on, the circuit it closed and the lights come on. When the circuit is closed, the switch controls the amount of current that flows into the buzzer. When the switch is on, this allows current to flow through the switch to the buzzer (the circuit is closed), hence the buzzer sounds. But when the switch is off, this prevents current flow throughout the circuit (the circuit is open), and the buzzer does not sound.
From 2005 AIMS Education Foundation
A complete circuit is a series of wires and/or electrical devices that form a closed path through which electricity can flow. You need a source of energy. Any system that causes the bulb to light is a complete circuit.

Materials:
Worksheets (50)
Display board
Flash Light
Pennies (10)
Nails (6)
LED lights (6)
Lemons (6)
Pencils (6)
Electricity kits (6)

Advanced Organizer: (4 min)
*Point out safety rules
Demonstrating the concept of circuit flow

Have students form a circle giving each a penny (electron). Have one person in the circle hold a flashlight. Begin the electron movement along the conducting circle, each student passes and receives and electron in turn. As the "current flows" the person holding the flashlight should turn the light on. When the electrons stop flowing, or the circle becomes broken, the flashlight should be turned off. Students will learn that work can be done when there is a continuous flow (current) of electrons.

Make sure to use vocabulary such as open and closed circuits. Discuss what makes the two different from each other.

Free exploration: (10 min)
Show the student a cell, two wires, and a bulb. Discuss the key question: How can you make a complete electric circuit that will light a bulb? Arrange students in groups of 2 or 3 per group. If students work in larger groups, some will not get hands on experience. Give each group a cell, wired and a bulb; challenge them to get their bulb to light. Allow time for exploration so that the students may test various circuits. Help any groups that have trouble. Have each successful group show and explain what they did. As the students explore have them draw their circuits on the worksheet. The students should also be recording notes about the circuits they are producing.

Compare groups' electrical circuits. Ask: What do successful setups have in common? (They make a circular pathway with the foil between battery and bulb.) Let kids draw and label circuits on the activity sheet.

Experiment: (14 min)
Can lemons conduct electricity?

Discuss if students think that a lemon can conduct electricity. Keep a tally of those who think it can and those who think it can not.
Creating a battery from a lemon is a common project in many science text books. Successfully creating one of these devices is not easy.
Batteries consist of two different metals suspended in an acidic solution. Copper and Zinc work well as the metals and the citric acid content of a lemon will provide the acidic solution.
Batteries like this will not be able to run a motor or energize most light bulbs. It is possible to produce a dim glow from an LED.

Spilt the students up into groups of two or three while they make their batteries.

Creating the battery: Insert a penny into a cut on one side of the lemon. Push a galvanized nail into the other side of the lemon. The nail and penny must **not** touch. This is a single cell of a battery. The zinc nail and the copper penny are called **electrodes**. The lemon juice is called **electrolyte**.

All batteries have a "+" and "-" terminal. Electric current is a flow of atomic particles called **electrons.** Certain materials , called **conductors**, allow electrons to flow through them. Most metals (copper, iron) are good conductors of electricity. Electrons will flow from the "-" electrode of a battery, through a conductor, towards the "+" electrode of a battery. **Volts** (voltage) is a measure of the force moving the electrons. (High voltage is dangerous!)

Have the students test the voltage of the lemon using a digital multi meter. Discuss what type of results each group received.

Have the students explore and try to light a bulb with one lemon. Discuss why the light bulb will not light up. Brainstorm ways that we can try and make the light a bulb.
Try connecting more then one lemon together. By connecting lemons we create a higher voltage.

Important information about LEDs: LEDs are designed to work at very low voltages (~ 2V) and low currents. They will be damaged if connected to batteries rated at over 2 volts. LEDs require resistors to control current when used with batteries rated at over 2 volts. Lemon batteries produce low current. It is OK to connect an LED to a lemon battery.

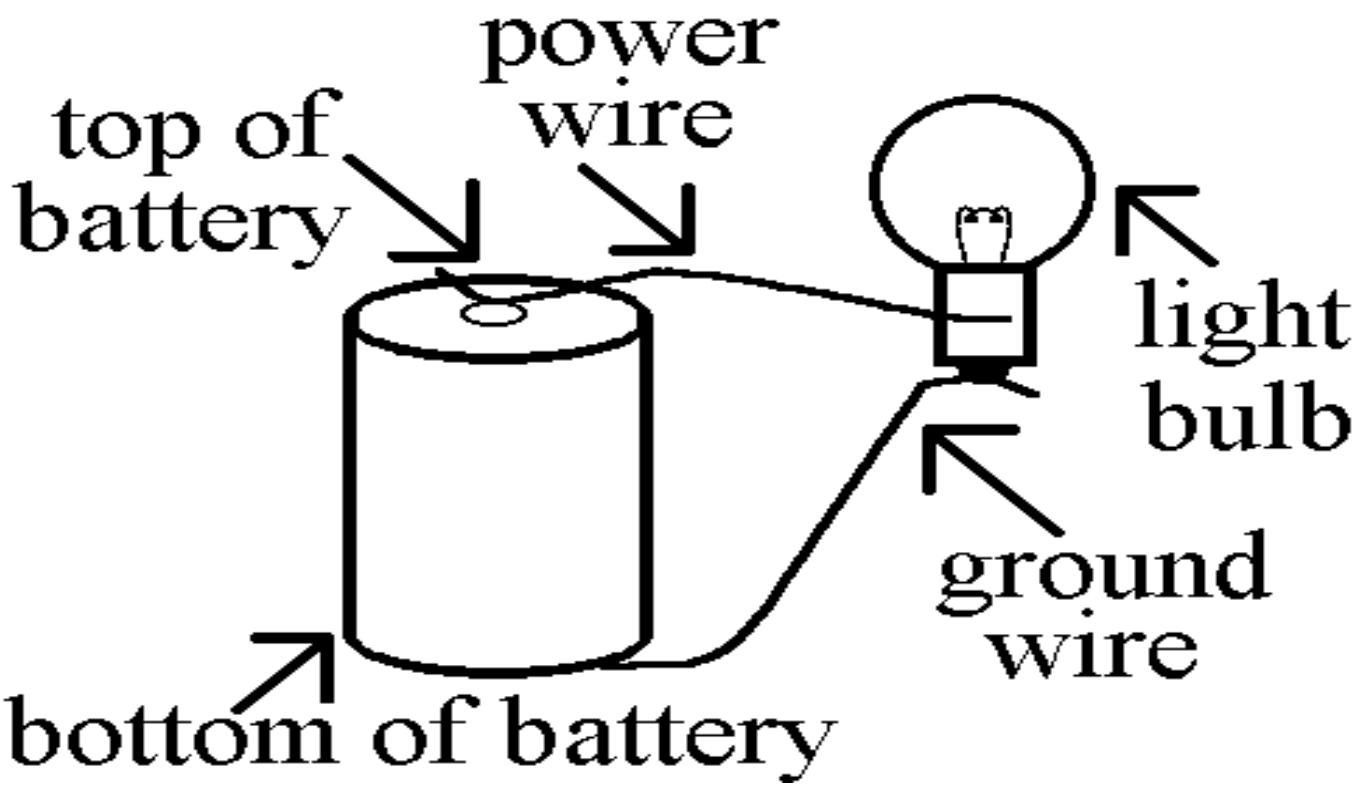
Closure: (2 min)

Collect materials and make sure to remind the students of the safety rules regarding electricity.

Assessment:

Complete the worksheet. Ask students questions about open and closed circuits. How is an open circuit different from a closed circuit? Why? What happens to electrons in each of those circuits?

Reflection:



Safety Check

- Do not play with electricity.
- Do not place objects on top of electrical cords or wires because the wires may become damaged.
- When using electrical devices, follow all instructions.
- When you remove a plug from a wall outlet, use the plug; do not pull on the cord
- Do not stick any object into an electrical outlet