Classroom Activity – *Creative Circuits*

Activity type: Post-visit activity

Level: Grades 3 - 9

Time Duration: One lesson period

Description: In this activity students will review and build upon the material covered during the Circuit Cities and Electric Avenues workshop and the Shocking workshop.

Science Curriculum Outcomes

Outcomes	**Student Learning**
Science 6 Physical Science – Understanding Electricity	
Explain and model the properties of simple series and parallel circuits	**I can;** - Construct a simple circuit to make a light turn on. - Understand the difference between a parallel and series circuit
Science 9 Physical Science – Characteristics of Electricity	
Analyze the relationships that exist among voltage, current and resistance in series and parallel circuits	**I can;** - Build a model of a series and parallel circuit with a physical representation - Differentiate between series and parallel circuits and where they are used.

Overview:

In this lesson students will review their knowledge of current electricity by constructing a physical representation of a circuit. By using a conductive material, students will build a circuit with the goal of turning a light on.

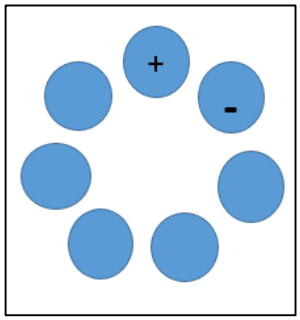
Introduction:

As an introduction, review the properties of electricity. Review the differences of between parallel and series circuits. A series circuit is a closed circuit where the electrical current travels through each part of the circuit and returns to the starting point. It only has one loop or path for the current to follow. A parallel circuit is a circuit which usually has more than one path for the electrical current to flow.

Activity:
Be a Circuit Relay

This activity will have students acting as if they were an electrical circuit and will review the concepts of a closed circuit, an open circuit, and a short circuit.

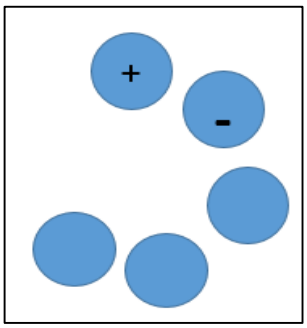
1. Have students stand in a large circle and provide each student with a cup. The first student will be the negative (-) end of the battery and need to pick up a pom-pom ball and put it in the neighboring student's cup. The pom-pom ball represents the electrons in a circuit. The student will need to "pour" or pass the pom-pom ball from cup to the cup of the person beside them without dropping it on the floor. They should only have one pom-pom ball in their cup at any given time. They must do this a quickly as possible.



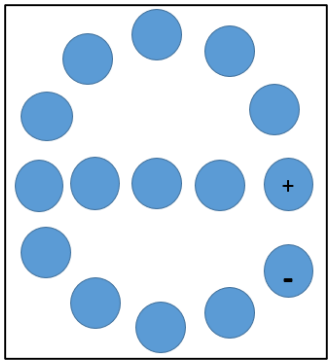
2. The last student in the circle will need to place the pom-pom ball in the bucket at the end of the circle. The students represent the circuit and the last student is attached to the positive (+) end while the first student is attached to the negative end (-).

3. After they have done this for a minute or so, stop the game. Explain that they are a closed circuit since the pom-pom balls were able to travel all the way along the circuit.

4. Try this again, but make some changes to the circle to create an example of an open circuit. Spread some of students out creating a gap so that they cannot touch each other or place the pom-pom ball in the next student's cup. Have the students start passing the pom-pom balls and remind them they cannot throw the pom-pom balls to each other. The gap between students will create a buildup of pom-pom balls and the balls will not pass through the circuit. When this occurs with electricity it is because the circuit is not completed – there is a gap somewhere and this causes the electricity to not travel to the end location. An open circuit is also seen when there is a switch. When the switch is off the circuit is open and when the switch on, the circuit is complete.



5. Change the circle one last time to create a short circuit. Create a line of student between the first (-) and last (+) student in the circle, splitting the circle in the middle. This will create an intersection where some students will not pass the pom-pom ball.



6. After a few moments of observing that some students are not passing the pom-pom balls stop the game. Ask the students why some of them are not passing the pom-pom ball around? Explain, this is called short circuiting. Electricity looks for the path of least resistance or the shortest path. When a short circuit occurs electrons can move too fast and heat up which can cause an electrical fire. However if there is still some form of resistance in the short circuit, it will not start a fire.

Materials:
Plastic or paper cups, pom-pom balls (ping pong balls can also be used), an area with space for students to stand in a circle

Activity:
Circuit Art

This activity will have the students create circuit art using aluminum foil, batteries and LED lights. This activity must be done with caution, the battery in the circuit art should not be kept on the art work for long periods of time.

1. Review the topic of conductive properties by brainstorming a list of conductive materials and non-conductive materials. This can either be done in small groups using written examples or using available materials. For example, students can make a table and list materials that are conductive and materials that non-conductive.
   In addition students could do this activity with hands on materials and divide the materials into two groups.

For example:

Conductors - Materials in which electricity can travel through. Some examples are: Carbon, ionized water, aluminum foil, and copper pennies.

Insulators - materials in which electricity has a more difficult time moving through. Insulators are materials such as rubber and plastics. However, there is no such thing as a perfect insulator; some electricity will still pass through the material. Some examples are: wooden skewers, rocks, rubber erasers, and cotton fabric.

2. Have students create a design, using markers to show where they would like the aluminum foil to go. Remember the foil needs to connect the battery to the LED. For an example template, see appendix A. If the students have a good understanding of how a circuit works this step can be omitted.
3. Once the plan for the art is created the students will glue the aluminum foil on the marked path.

4. Attach the LED light using tape placed over the LED leads. Ensure that the LEDs are placed directly on the aluminum foil.
5. Next, test out your circuit. Place a battery at the opposite end from the LED on the aluminum foil path. Make sure the light will go on. Decorate the remaining art work. Do not glue the battery on to the picture.

Helpful tips:

- Aluminum foil paths cannot cross, touch or intersect. This would create a short circuit.
- Copper is more conductive then aluminum. However copper foil tape can be difficult to find and is more expensive. Aluminum foil is delicate and can rip easily. This activity works best if the foil is approximant 1 cm wide.
- The aluminum foil must connects the battery to the LED light, however aluminum foil can be used in other places for decoration.
- Students can use the battery to test their art work before it is done; however batteries should be the last item given out.
- Ensure the battery isn't left on the art work or glued to the paper. This could cause it to overheat.
- Be very cautious not to create a short circuit. Short circuits can start electrical fires!
- If the light doesn't work on the first attempt, flip the battery around and try it again. The LED lights only work in 1 direction.

Materials:
LED light bulb (small), coin cell battery, sheet of construction paper, aluminum foil, markers or other drawing tools, decorations (googley eyes, sequins), glue, clear tape

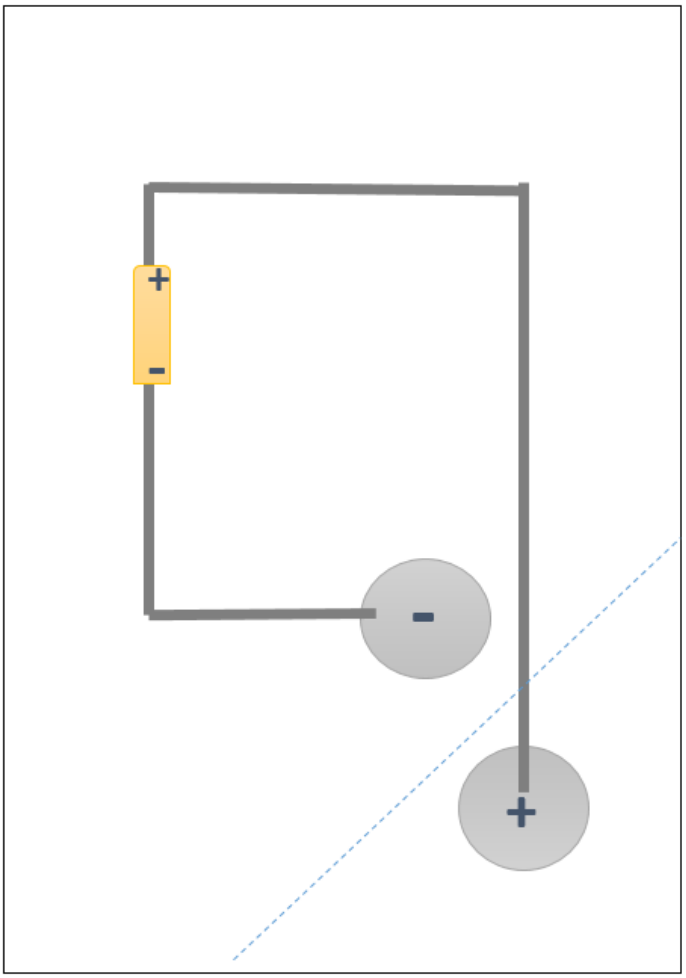
Links to additional circuit activities and lessons –

Paper circuits
http://makezine.com/projects/simple-paper-circuit/
http://tinkering.exploratorium.edu/2014/08/01/modified-version-paper-circuits-activity-classroom
http://highlowtech.org/wp-content/uploads/2012/08/PaperCopperTapeHandout.pdf

More advanced activities using paper circuits
http://www.nexmap.org/insideout-notebooking/#paper-circuitry

Try making circuits out of different materials –
Play dough circuits
http://courseweb.stthomas.edu/apthomas/SquishyCircuits/
http://www.ted.com/talks/annmarie_thomas_squishy_circuits?language=en

Appendix A



1. Place the aluminum foil over the gray lines.

2. Place the LED light on the yellow rectangle.

3. Place the battery, negative terminal down, on the (-) circle. Fold the corner over so that the (+) circle makes contact with the + terminal on the battery. The LED should light up.