Electricity

FRAMEWORK

I. Scientific and Engineering Practices: 4

II. Cross-Cutting Concepts 2, 4, 5

III. Disciplinary Core Ideas PS 1, ETS 2

SKILLS/OBJECTIVES

- To understand the charges of electrons and protons
- To understand the role of flowing electrons in conducting electricity
- To understand how static electricity is created

MATERIALS

- Lemons
- Copper and Zinc electrodes
- Wires
- Voltmeter
- Light bulbs
- Batteries
- Balloons
- Containers (for water/ balloon experiment)
- Salt (for balloon experiment)

NOTES

- Activity 4 (completing a circuit) is intended for older kids (10-11 years old); however, younger students are capable of completing the circuit with help from older students and mentors.

BACKGROUND

- All things are made up of atoms, each of which has at least one electron.
- Does anybody know what an electron is?
- Electrons are tiny negatively charged particles. Their presence or absence helps dictate the reactivity of different substances.
- In a non-charged object, there are equal amounts of negatively charged particles (electrons) and positively charged particles (protons).
- Some of the electrons can be transferred from one object to another, creating a charge in both objects. This can happen when you rub two objects together (like balloon on your head, feet on the ground.
- Oppositely charged objects are attracted to each other, and similarly charged objects are repelled by each other. (Just like magnets!)

Activity # 1	**Electron Tag**
Materials	-students and mentors
Worksheet	no

- **Explain that each student is an electron, a tiny negatively charged particle present in nearly all matter.**
- **Electrons are attracted to tiny positively charged particles called protons. Two particles with the same charge (electron-electron or proton-proton) are repelled by each other, as seen when using magnets.**
- **Have a mentor stand in the middle of the room, yelling out "negative!" or "positive!"**
- **When the person calls "positive," all the negatively charged electrons will rush to the positively charged person. When the person calls "negative," they must rush away.**

Activity # 2	**Electric current**
Materials	o balloons
Worksheet	no

- **Explain that in order to create an electric current, electrons need to be continuously flowing from one area to another area. If there are**

any holes, electricity won't flow, and we can't turn on any lights or plug in our microwaves or play video games!

- Have two mentors stand in the middle of the room. One holds several balloons, the other holds nothing.
- **Each mentor represents an electrode, a piece of metal which is used when creating electricity. The mentor holding the balloons is called the "anode" and needs to pass its electrons (the balloons) to the other mentor, the "cathode."**
- **Have the kids stand in a line to help pass the balloons from the anode to the cathode.**
- **When the first electrons reach the cathode, raise your hand/ yell that they have turned on the lights; if they stop, put your hand down/ yell that the lights are off.**

Activity # 3	**Static Electricity**
Materials	-inflated balloons -1 plastic container filled with water -1 empty plastic container -salt
Worksheet	yes

- **Blow up balloon and tie the end (if not already inflated)**
- **Rub balloons on your head to create static charge. Show that your hair is sticking up due to electrical build-up**
- **Pour some water from the full container of water into the empty one, creating a thin stream. Hold the charged balloon near the stream of water. The electrically charged balloon should bend the stream of water.** The extra electrons on the balloon attract the positive parts of the water molecules (the positive end of the dipole) causing the stream to bend toward the balloon. (The water molecules are reoriented so the positive end of the dipole faces the stream and the negative end faces away).
- **Put some salt on the table.**
- **Use the charged balloon (re-charging on your hair if necessary) to pick up the balloon.** The negatively charged balloon is attracted to half of the positively charged ions in the salt crystals.
- **Have the kids draw an example of static electricity on the worksheet**.

Activity # 4	**Completing the circuit**

Materials	o Batteries (C,D, or AA) o Small lightbulb o Piece of aluminum foil (4 x 12") o 12 paper clips or short wires
Worksheet	yes

- **Begin the activity by setting up a scenario for the students. First, split the students up into group of 3-6, depending on the age group. Then, tell the students to pretend that he/she and his/her group members are exploring Lechuguilla Cave, the sixth longest cave (130.24 miles (210 km)) known to exist in the world, and the deepest in the continental United States (1,604 feet (489 m)), in New Mexico. (Show a picture of this cave.) All of a sudden, the person leading the group walks into an overhanging rock and the light on their helmet breaks. All they have left is their "backpack", which includes a few different sized light bulbs, a few C/D/AA batteries, some paper clips, a few index cards and the aluminum foil left over from their turkey sandwich lunch.**
- **Pass out the materials to each group. Explain to the students that their task is to light the light bulb using the materials in their backpack (aluminum foil, battery, and light bulb are the key elements to completing the circuit).**
- **Hand out the worksheet at the beginning of the activity and tell the students to draw and label their circuits.**

How to complete the circuit:

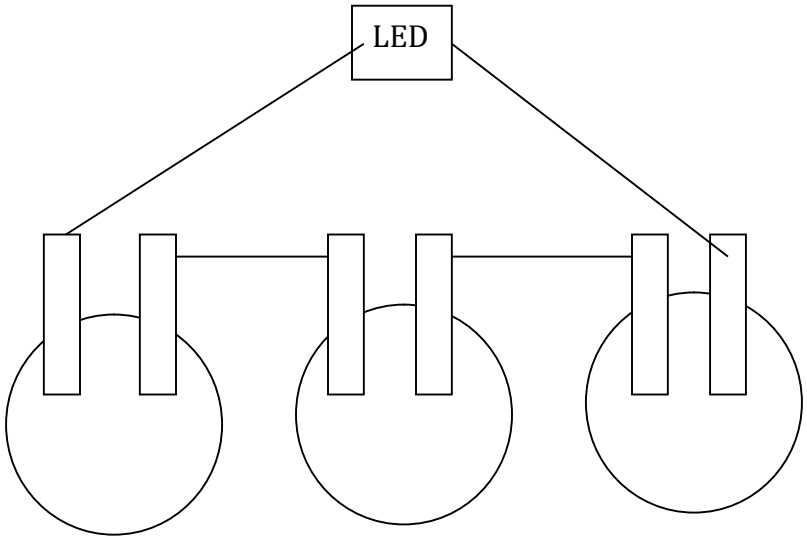
- **Fold the aluminum foil several times to make a strip 12 inches long and about ½ inch wide**
- **Set the battery on one end of the strip**
- **Hold the metal base of the light bulb to the other end of the battery**
- **Touch the metal base of the light bulb with the aluminum foil strip**
- **This can also be done by splitting the strip of aluminum foil into two separate strips and touching one strip from the light bulb to one end of the battery and the other strip from the light bulb to the other end of the battery**
- **If there is extra time, ask the students to try different battery sizes to see how that affects the brightness of the light bulb**
- **Try using different sized light bulbs and adding wires to make more complex circuits**

- Electrons flow from one end of the battery through the wires to the light bulb and then to the other end of the battery. The electrons need to be constantly

flowing as in the previous game. They need to move through a good electrical conductor, like metal.

Activity # 5	**Lemon light demo**
Materials	-3 copper electrodes -3 zinc electrodes -3 lemons -4 wires with alligator clips -LED light
Worksheet	no

- This is a demonstration done by one mentor
- **Roll lemons in hands to stimulate juices**
- **Place one copper and one zinc electrode into each lemon**
- **Connect zinc and copper electrodes in adjacent lemons by alligator clip wires, leaving one copper electrode and one zinc electrode free**
- **Attach empty electrodes to LED ligh via alligator clips**



- The light bulb will light very dimly

Electricity!!!

Conclusions

- Electrons are at the core of electricity
- The movement of electrons creates electricity
- Their presence charges an object, so it can act as an electromagnet
- It is easiest to create static electricity in cold dry weather, so have fun with balloons and nylon combs in the winter!

Today we're going to be discussing electricity. To do this, we will be doing a couple of experiments.

Can you draw an example of static electricity?

Now we're going to make light! Draw how to light a bulb with a battery: