Electricity Game Plan

eCamp Electric Lab

Objective You're going to take a deeper look at the atom by stripping off part of it called the electron and messing around with it to make things move, stick, jump, and have bad hairdos. This is an excellent time to hone their observation skills and get them into the habit of changing and testing only one thing at a time.

Main Ideas While the kids are playing with the experiments see if you can get them to notice these important ideas. When they can explain these concepts back to you (in their own words or with demonstrations), you'll know that they've mastered the lesson.

1. Opposite charges attract, like charges repel.
2. Electrons cannot be seen, but they are very small particles that are easy to move around.

About the Experiments The experiments in this section are mostly the same ones found in Unit 10, for two reasons. First, these are the activities we do when we teach Science Camp Workshops during the summer, and we've added live video from these workshops so you can see us in action. Second, have you seen how massive Unit 10 is? We took the feedback we received to heart and now we've made Unit 10 a lot more doable by chunking the experiments down into three main categories and minimized the academics so you can focus on getting your kids excited just by doing the coolest experiments from the section.

Electricity experiments can be frustrating because unlike other activities, you can't tell where you're going wrong if the circuit doesn't work. Here are the things we test for when troubleshooting a circuit with the students:

1. Are the batteries in right? (Flat side goes to the spring.)
2. Is the connection between the alligator clip and the wire a metal-to-metal connection? (Often kids will clip the alligator clip onto the plastic insulation.)
3. If it's an LED that you're trying to light up, remember that those are picky about which way you hook up the plus and minus (red and black). Switch the wires if you're having trouble.
4. Change out the wires. Sometimes the wire can break inside – it can get disconnected from the alligator clip inside the plastic insulation, but you can't see it. When it doubt, swap out your wires.

The *How* and *Why* Explanation Blow up a balloon. If you rub a balloon on your head, the balloon is now filled up with extra electrons, and now has a negative charge. Your head now has a positive charge because your head was electrically balanced (same number of positive and negative charges) until the balloon stole your negative electrons, leaving you with an

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unbalanced *positive* charge. When you put the balloon close to your head, notice how your hair reaches out for the balloon. Your hair is positive, the balloon is negative, and you can see how they are attracted to each other!

Your hair stands up when you rub it with a balloon because your head is now positively charged, and all those plus charges don't like each other (repel). They are trying to get as far away from each other as possible, so they spread far apart.

The *triboelectric series* is a list that ranks different materials according to how they lose or gain electrons. Near the top of the list are materials that take on a positive charge, such as air, human skin, glass, rabbit fur, human hair, wool, silk, and aluminum. Near the bottom of the list are materials that take on a negative charge, such as amber, rubber balloons, copper, brass, gold, cellophane tape, Teflon, and silicone rubber.

When you rub a glass rod with silk, the glass takes on a positive charge and the silk holds the negative charge. When you rub your head with a balloon, the hair takes on a positive charge and the balloon takes on a negative charge.

When you scuff along the carpet in socks, you gather up an electric charge in your body. That charge was static until you zapped someone else. The movement of electric charge is called electric *current*. When electric current passes through a material, it does it by electrical conduction. There are different kinds of conduction, such as metallic conduction, where electrons flow through a conductor (like metal) and electrolysis, where charged atoms (called ions) flow through liquids.

An electrical circuit is like a NASCAR raceway. The electrons (racecars) zip around the race loop (wire circuit) superfast to make stuff happen. Although you can't see the electrons zipping around the circuit, you can see the effects: lighting up LEDs, sounding buzzers, clicking relays, etc.

There are many different electrical components that make the electrons react in different ways, such as resistors (limit current), capacitors (collect a charge), transistors (gate for electrons), relays (electricity itself activates a switch), diodes (one-way street for electrons), solenoids (electrical magnet), switches (stoplight for electrons), and more. We're going to use a combination diode-light-bulb (LED), buzzers, and motors in our circuits right now.

A CIRCUIT looks like a CIRCLE. When you connect the batteries to the LED with wire and make a circle, the LED lights up. If you break open the circle, electricity (current) doesn't flow and the LED turns dark. LED stands for "Light Emitting Diode". Diodes are one-way streets for electricity – they allow electrons to flow one way but not the other.

Let's get started building circuits!

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Questions to Ask When you've worked through most of the experiments ask your kids these questions and see how they do:

1. Why does the hair stick to the balloon? Does the shape of the balloon matter? Does hair color matter? Hair texture? How much goop you have in your hair?
2. What other things does the balloon stick to?
3. What happens when you bring the balloon close to a pile of confetti?
4. Why do you think the ping pong ball moved? Are there other objects you can try instead of the ping pong ball?
5. Why does the water wiggle and move when you bring the balloon close to it? What if you bring the balloon close to a pan full of water?
6. Are you able to make the yardstick rotate all the way around in a full circle?
7. Can we see electrons? What charge does the electron have?
8. Why does the balloon stick to the wall?
9. How do you get rid of extra electrons?

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