Introductory Electricity Program for Grades 1-3 for 90 minutes

Static Tubes, Energy sticks and Squishy Circuits!

Objective: Students will have a basic understanding of how electricity is made through the movement of electrons, can exist in short bursts (static) or in a continuous current. They will experiment with open and closed circuits and understand the difference between materials that are insulators and conductors.

Vocabulary words: predictions, static electricity, current, open and closed circuits, insulators and conductors (we did not use terms such as series or parallel circuits).

Introduction:

- (10 min.)Began with a discussion on what they already know about electricity. Introduced static electricity by asking about walking across carpet and then toughing a door knob and getting shocked. If you touch another person, the other person gets shocked worse than you! Why do you get shocked more in the winter time than the summer? Discuss that air holds water and the amount it holds is called humidity. The more humid it is the more water is in the air. The less humid (typically in winter or also in an air conditioned room) the less water is in the air. Static electricity occurs when there is very little moisture in the air and it is considered "dry".

- Everything in our Universe is made up of atoms too small for us to see. They are made up of smaller parts and one part is called electrons. When you rub two surfaces together, these electrons "jump" to the other object and at that brief moment, they produce electricity in the form of a shock that you can feel and even sometimes see! The only difference between this form of electricity and the kind that turns on the lights in this room is that the static is very brief and the current in the lights is continuous until you turn off the lights and "break" the electrical current.

Engage:

- **Let's experiment with Static Electricity! (This is best to do on a dry, winter day)**
- Materials needed: static tubes (1/child)- premade Steve Spangler Baby Soda Bottle plastic test tubes half filled with Styrofoam beads, piece of wool or a winter glove, rubber balloons

- (15 min.) Give kids blown up balloons and experiment with "building up a charge" by rubbing it on carpet or their hair. Can you make your hair stand up? Can you get the balloon to stick to your hair or the walls? Sometimes rubbing the balloons on plastic chairs in their classroom may work too.

- Next, get out the static tubes (Steve Spangler test tubes half filled with Styrofoam beads). Can they build up a charge by rubbing the tubes on their clothing, a piece of wool or a winter glove?

Observe the beads and the patterns they make in the tube. They "defy gravity" by hanging from the top of the tube! They may make stripe patterns too! Pretty cool!

- **Now let's experiment with Energy Sticks!**
- Materials needed: Energy stick (1 per 2 kids, purchased from Steve Spangler Science or Amazon's website), paper plates for trays, baggies of items to test (1 per 2 kids) that are listed on the Data Sheet (a toothpick, coins, plastic coated paper clip, banana, cut apple, various fruits, and a shallow bowl of water (students to put fingers in, not the energy sticks!), Plasma Balls (purchased on Amazon) and an extension cord if needed, individual Student Data Sheets (See attached pg. 5), pencils.

- (30 min.)Collect the static tubes and have the students in groups of 2 or 3 depending on the size of the class. Hold up an Energy Stick and tell students they are going to try to light up the stick. Hand one child in the group an Energy Sticks and see what happens. Wait for them to explore and discover that it can light and make sound but not always. What are they doing to make it work? Do they have to maintain a certain amount of pressure? What do they have to be touching? Can the two students get it to work by each holding it at the same time? If so, what do they have to do it get it to continually light and make sound? Discuss and demo as a class what each group has discovered.

- Let's see if we, as a class all together, light up just one stick. Does anyone have an idea on how we can accomplish that? Form a circle and clasp hands. Choose two kids to each hold one end of the stick to get a continuous *closed circuit*. What can we say about the human body? It is a *conductor*. It lets electricity pass through it. How can we break the current? (someone let's go of their hands) What would happen if just one person were to put a winter glove on and then clasp hands? Does it still light? The gloves are what we call an *insulator*. The glove material does not carry the current well so it is called an insulator.

- Testing Water: Let's now make predictions on what would happen if two people were each to place their fingertips in a shallow bowl of water. Do you think water is an insulator or a conductor of electricity? How do we know? Ever heard of the danger of having electrical appliances near the bathtub? You can get a powerful shock (electrocuted) because the current going through the wires in your outlets is very strong. Much stronger than that in the Energy Stick. Have two students, standing next to one another, each put the fingertips of one hand in the water and with the other hand, continue to complete the circuit with all others in the circle. Does it light? What can we say about water? Is it an insulator or a conductor?

- Testing Objects: Have students go back to tables and pass out a small tray and a baggie (1/per 2 kids) with the items to test to see if the electrical current will go through these objects as well as it does humans and water. Pass out the Data Sheets and pencils then make predictions first before testing each object. If they struggle on how to accomplish it, demonstrate with a partner by showing them how to hold the object and then touch it to the silver band on the energy stick. Does it light up and make sound? Is it weak or strong? Divide the objects on the tray into piles of objects that were *conductors* and *insulators*. Discuss why some lit up the energy stick and why some did not. Record the results on the Data Sheets. Can they think of any other objects to test? Look around the room and then try it! Add your results to your Data Sheet.

- Plug in a Plasma Ball and demonstrate how it can light up an Energy Stick that is near it without you even holding it on both ends! Is it magic or science? Magic can always be explained by science and math. There are electrons being emitted from the ball and they are lighting up the stick. It's science!

- **Squishy Circuits.**
- (30 min.) **WARNING! Go over safety procedures with kids so they know not to cross the leads once they have turned the battery box "ON". Demonstrate for them what not to do and then make them take a PLEDGE that they will not touch the leads together!**

- Materials: Squishy Circuit kits (Squishy Circuit Store Website), Four AA batteries per kit, Play-Doh OR Sargent Art dough (Amazon), modeling clay (Crayola works well), paper plates to use as trays, paper towels, zip-lock bags for used LED bulbs or dough/modeling clay.

- Distribute two tubs of different colored Play-Doh/Sargent Art dough per every 12 kids. Pair the students so each pair will use two different colors of dough. Each student will mold one ball of dough (of their chosen color) about the size of your fist and form it on their paper plates.

- While working in pairs, hand out one Squishy Circuit battery box (four AA batteries should already be inserted by teacher) and tell them to put both metal leads into opposite sides of one ball of dough **without having the leads touch one another!**

- Hand them one Red LED bulb and tell them to insert it into the dough **without touching the leads.** Turn on the battery box. Did the LED bulb light? (No.) Why not? (The current wants to go through the path of least resistance and will not go through the bulb. It is going from the box, through the (+) wire, into the dough, through the (–) wire and into the box again to complete the closed circuit. It doesn't need to travel through the LED bulb to complete the circuit.

- Instruct them to take out one lead and put it into the second ball of dough (different color than the first). Keep a space between them (they should not be touching) and then see what happens. (Nothing.) How can we make the bulb light up? Let them experiment.

- Take the LED bulb out and separate the wire terminals a little bit (be careful not to pull off or pull too far open). Put one terminal into each of the balls of dough to close the loop. Does it light? Some might glow because they put the LED in correctly just by chance. Others will not. Have them take out their LED bulbs and look at it. Notice that one terminal wire is longer than the other. The longer one is the (+) terminal. The shorter one is the (–) terminal. They need to be placed next to the correct colored wire. The black wire coming from the battery box is (-) and red wire is (+), so this is what we call *polarity*.
  Would you say this dough is *conducting or insulating* the electricity?

- Next, with your LED bulb "on", take the two pieces of conductive dough and push them together. What happens? Why? The electricity choose to go around the LED and flow only through the dough. It doesn't need the bulb to complete the circuit.

- Separate the two pieces of dough and the LED should once again light up because the electricity must go through the LED to complete the circuit.

- Create a sandwich with the *insulating* modeling clay between the two pieces of *conducting* dough. Does the LED continue to light even though we have one continuous piece of dough/clay? How can this be? Remember the first time we experimented with using only one ball of clay, we had to separate it placing air between them.

- The modeling clay must be insulating and therefore making the current run through the LED bulb to light up and close the loop to get the current back to the battery box.

- Next, take the balls of dough and roll into two hotdog shapes. Lay them parallel to one another on the paper plates. Insert the leads into each of the hot dog ends. Add LED bulbs to bridge the gap starting closer to the leads and working your way down the hotdogs with more colored LED bulbs. **Be sure not to let the LED bulbs touch the leads!**

- If you use all the same colored bulb, you will really notice a diminished light the farther you go away from the leads due to how much farther the current has to travel through the dough.

- If you choose to use different colored bulbs, beware that they light at different wavelengths and therefore take more or less current so they may look dimmer or brighter depending on how far or near they are to the leads also.

- ***Extend- If Time Permits:***
- ***Materials:*** motors and buzzers from Squishy Circuits kits, white cardstock 4"paper disks, colored pencils

- Hand out a motor from the Squishy Circuits kits, 2 white paper 4"disks and colored pencils to each pair of students. Have the kids' color a design on the disks to reflect sections of one color similar to a color wheel and the other 2nd disk can be other designs such as various shapes or swirl patterns. Use the motor to poke a hole in the center of the disk. The disk needs to fit snug so don't stretch out the hole and make it too big!

- Attach the motor instead of the LED bulbs to be sure it is getting all the current and therefore will run faster or let the students come up with this idea by experimenting with all the components. Add one paper disk at a time and watch it spin! Does it make a new pattern or new colors blend together?

- Students can go home with their colored disks and their Energy Stick Data Sheets.

- ***CLEAN UP:***

- Paper plates can be thrown away and all dough and clay put back in original air tight contains or in zip lock bags.

- Battery Packs- Use paper towels to wipe off the leads so the salt in the dough will not corrode them. Take out all batteries, replace covers and repack in Squishy Circuit kits. You can leave one battery pack out so it can be used to determine the color of the LED bulbs so they can be put away in their proper location in each kit. Take apart battery pack and place in kit when done with LED color determination.

- Students can do this clean-up if vigilant in wiping off each LED bulbs wire terminals with clean paper towel so they do not corrode from the salt in the dough. To determine the LED bulb color at the end of the lesson, set up a battery pack and two balls of dough to test each one. Return the bulbs to the kit's proper color coded location.

Does it Make the Energy Stick Light?

	Prediction		Results	
Object:	**Yes**	**No**	**Yes**	**No**
Clay				
Play-Doh				
Dime				
Penny				
Nickel				
Quarter				
Apple				
Apple (cut)				
Banana				
Banana (cut)				
Lemon				
Lemon (cut)				
Lime				
Lime (cut)				
Orange				
Orange (cut)				
Potato				
Potato (cut)				
Construction Paper				
Notebook Paper				
Pencil (Eraser Holder)				
Pencil (Eraser)				
Pencil (Lead)				
Pipe Cleaner (End)				
Pipe Cleaner (Side)				
Coated Paper Clip				
Paperclip				
Drinking Straw				
Toothpick				
Aluminum Foil				
Wax Paper				
CD				
Bowl of Water				