Energy Stick

Presented by: Hands On! Discovery Center In partnership with: BrightRidge

You will be buzzing with excitement while using the Energy Stick to explore the difference between an insulator and a conductor and their roles in circuits.

*__Don't try to take the Energy Stick apart!__ It's glued together and you will destroy it if you open it.

One Person Circuit
Touch both ends of the energy stick to complete a circuit.
Instructions

1. Locate the silver bands located on each end of your Energy Stick. Place your hands on those bands. What happens? Did you hear a sound? Do you see a flash? That is because when you touched the rings you completed an electrical circuit.
2. Now let go of one of the rings, but keep one hand on the other ring. What happens? Do you hear a sound now? Do you see a flash? If you let go of one of the rings, nothing happens because the circuit is no longer complete.

Giant Circuit
You can create a human circuit with your friends while being completely safe.
Instructions

1. Have a small group (3-5) of friends form a circle and hold hands.
2. Open the circuit by letting go of the hand of the person next to you while everyone else hangs on.
3. Grab one of the silver bands on the end of the Energy Stick while the person next to you grabs the other one. The Energy Stick flashes and buzzes because the circuit is complete again!
4. Now let go of one of the silver bands. The circuit has been broken and the energy stick should stop buzzing and flashing.
5. Now try 10 people, then your entire class! Did you complete the circuit? What happened? Same results or different?

Take it further…

- Try adding other elements to the closed circuit to search for electrical conductors and insulators. Conductors allow electricity to flow through them while insulators resist current flow. Test some conductors and insulators by bringing them into contact with both electrodes at the same time. Try items such as metals, woods, rubber, graphite, paper, plastic, etc.
- Try using liquids! Grab one electrode with your hand and have a friend grab the other electrode. Instead of holding hands, dip your hand in a bowl of water and tell your friend to dip their hand into the same bowl. Does the connection work? Try other liquids, such as juices, sodas, etc.

What Science is at work?
When you touched the silver bands with your hands, you turned your entire body into one large electrical circuit. The tiny negative electrons flow on your skin, around your body, and from one end of the energy stick to the other. You know you have completed the circuit when the lights flash and the buzzer sounds off. Your body and skin are conductors of electricity!

All of these elements of the energy stick remain inactive because the electric current cannot flow continuously until you hold onto each end with both hands. Human bodies conduct electricity, so by holding onto both ends of the stick, your body is closing the electrical circuit needed to let the current flow continuously and activate all of the above elements.

Electricity is nothing more than free electrons moving from atom to atom through a material. This flow is called a current. Currents go in one direction at a time and can be given a very strong charge or a very weak charge. Something that allows a current to move through it freely is called a conductor. Good conductors include most metals such as copper, aluminum, iron, silver, gold, and lead, but there are others like water, mercury, and neon. If a material slows or even stops the current altogether, it offers resistance to the current and is called an insulator. Materials like glass, rubber, plastic, paper, cloth, and wood are very good insulators. However, if the charge is high enough, an insulator won't stop the current.

Since your body is mostly water and there are water and minerals on your skin, your body can be a conductor, but a poor one. The weak current travels from one silver band onto one hand and then across the surface of your skin to the other hand and onto the other silver band. This continuous loop is called a closed circuit and allows the Energy Stick to complete its detection function. Take a hand off a silver ring and you break or open the circuit and the current stops flowing to the Energy Stick. If the charge is big enough, the current can jump this gap and a bright, blue arc is the result (but it won't happen with an Energy Stick). Grab the silver band once more and you make a complete circuit. That's just what a switch on a wall does or a circuit breaker (or fuse) does in the breaker box on a house. It stops the current.

The energy stick appears to be a plastic tube with wires inside and two silver bands at each end. However, there is much more than meets the eye! All the wires on the inside are a solid-state sensing circuit, tone generator, sound transducer, battery power supply, and LED lights. The guts of the stick include a circuit board, two button batteries, an integrated circuit, three light-emitting diodes (LED), a piezoelectric transducer, a transistor, and two electrodes. Here is some more information about each of those components:

- Inside there is a circuit board with an integrated circuit, or chip. It contains tiny transistors, resistors, diodes, and other electronic parts that produce the noises and the flash pulses.
- The light-emitting diodes (LEDs) are like small red, blue, and green lights, except that they have no filament. The lights are produced by brightly glowing junctions on semiconductor chips.
- The piezoelectric transducer functions as a speaker – it's what makes the noise. It consists of a very thin slice of quartz mounted on a brass disk. When electrical pulses are applied to the quartz, it vibrates, and that vibration is what we hear as sound.
- Transistors are electronic switches. In this case, the integrated circuit provides the sound waves, but they're not powerful enough to be heard by the transducer. So, the integrated circuit tells the more powerful transistor to turn on or off, and it controls the transducer.
- Electrodes are simply electrical conductors. They are the two metallic strips that you touch to complete the circuit.
- The batteries are connected in a series to form a power supply. Each button battery supplies direct current (DC) electricity. Since the cells are so small, they provide very little current and very little power.

Key Terms

- **Circuit**-A closed path that allows for the flow of electricity.
- **Conductor**- Conductors (copper, silver, and aluminum) allow electricity to easily pass through.
- **Insulator**- Insulators (glass, air, plastic, and wood) oppose electrical currents.
- **Electrode**-A conductor that connects a non-metallic element to an electrical circuit.
- **Current**-A stream of charged particles.
- **LED**-Light emitting diode

Tennessee Science Curriculum Standards addressed:

3.PS1.3, 3.PS3.2, 3.ETS1.1, 3.ETS1.2, 3.ETS2.1; 4.PS3.3, 4.PS4.2, 4.ETS1.1, 4.ETS2.1, 4.ETS2.2, 4.ETS2.3; 5.ETS1.1, 5.ETS1.2, 5.ETS2.1, 5.ETS2.2, 5.ETS2.3