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Educational Innovations Inc.®

Energy Tube

OHM-350

Introduction

Aside from being fun, the Energy Tube is an ideal teaching resource for an array of scientific concepts such as open and closed circuits, conductors vs. insulators, light waves, sound waves, currents, and energy. When a conductor touches both of the electrodes on the tube, a complete circuit is formed and the tube emits a sound and flashing red/green/blue LED lights.

How Does It Work?

At each end of the Energy Tube, you'll notice a metal electrode. In between each electrode is a tangled collection of wires, LED lights, batteries, transducers, resistors, and transistors.

On its own, the Energy Tube is an open circuit, which means that it will not function until the electrical circuit is fully connected or "closed." Until then, the electricity has no way of moving from one electrode to the other.

In other words, when you place your fingers on both electrodes simultaneously, a small current of electricity* travels into one hand, through your body and out your other hand to the other electrode. Thus, the current has completed the circuit. Once the circuit is complete, the Energy Tube will emit both light and sound energy.

* *The Energy Tube's batteries provide very little current and little power, so this product is completely safe to use.*

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NGSS Correlations

Our Energy Tube and these lesson ideas will support your students' understanding of these Next Generation Science Standards (NGSS):

Elementary

4-PS3-4
Students can use the Energy Tube to apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

ETS1.A
Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria.

Middle School

ETS1.B
A solution needs to be tested, and then modified on the basis of the test results in order to improve it.

High School

HS-PS4-1
The Energy Tube can be used to develop and model how two objects interacting through electric fields, illustrates the forces between objects and the changes in energy of the objects due to the interaction.

Suggested Science Idea(s)

MS-PS3-5
Energy may take different forms.

4-PS3-4
Use the Energy Tube to test open and closed circuits or test conductors and insulators.

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Energy Tube Demonstrations

The Energy Tube allows for many different classroom demonstrations and experiments.

1. Conductors vs. Insulators

This is a simple activity you can have the students perform individually or in pairs. First show your students how the Energy Tube functions. Then allow them to try it on their own.

Next, give them a small **conductor** such as a paper clip, a key ring, or even a small metal staple. Students should place a finger on one electrode and—while holding the conductor you gave them—they should touch the other electrode with the conductor. The Energy Tube should light up and make noise.

Now, have your students do the same thing, but this time using an **insulator** such as a small piece of cardboard, a rubber eraser, a block of wood, a sponge, or a piece of cloth. They will see that the Energy Tube remains silent and unlit.

After your students recognize the difference between using two types of materials, have them experiment on their own, using other pieces of material they find around the room. They must determine whether each material is a conductor or an insulator.

The intensity of the light and sound emitted by the Energy Tube will vary based on how well the electricity is conducted. Strong conductors enable the Energy Tube to light up very brightly and buzz loudly. Poor conductors will not allow a full amount of electrical current to complete the circuit; therefore, the Energy Tube will not be very loud or bright even though the circuit is completed.

2. Human Electrical Circuit

This activity can incorporate EVERYONE in your group, and then some! Have one person hold onto one electrode of the Energy Tube. With the other hand, hold the hand (or wrist) of their neighbor. That person then holds hands with the next neighbor, and so on. The last person in the group is the one who will finally grasp onto the open electrode. As long as everyone is touching, skin-to-skin, the circuit should be complete and the tube should light up and sound.

Check out this video. It's a bit long but if you skip to the 10-minute mark, you will be amazed!

https://vimeo.com/78036886

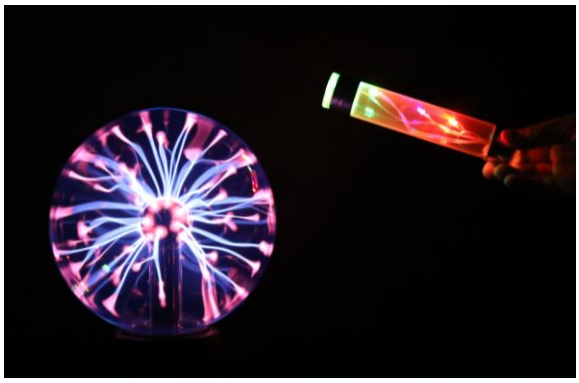
TAKE THE EI CHALLENGE: How many students can you include in your energy circle? Some teachers report being able to make a series circuit with 60 or more students! Can your class break that record? Send your photo to socialmedia@TeacherSource.com!

3. Power the Energy Tube WITHOUT touching both electrodes

For this activity, you will need a **Plasma Globe** (PLS-100).

Turn on the Plasma Globe. Then, place one hand on the Energy Tube. Bring the Energy Tube near the Plasma Globe without letting them touch. Watch the Energy Tube light up and buzz.

How did that happen? The electric field emitted by the Plasma Globe surrounds the Energy Tube (effectively "touching" both electrodes) and closes the circuit.



Now, move the Plasma Globe away from the Energy Tube. What happens to the light and buzzing sound?

Slowly move the Plasma Glove closer to the Energy Tube again.

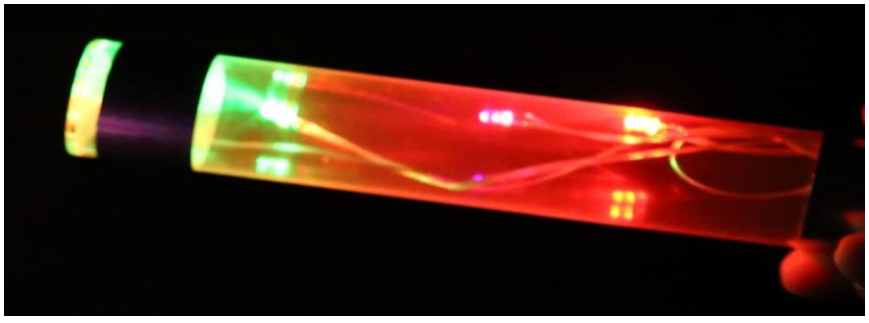
Will the red, blue, and green bulbs light up at the same time? If not, in which order will they light up? Why?

WHAT'S GOING ON?

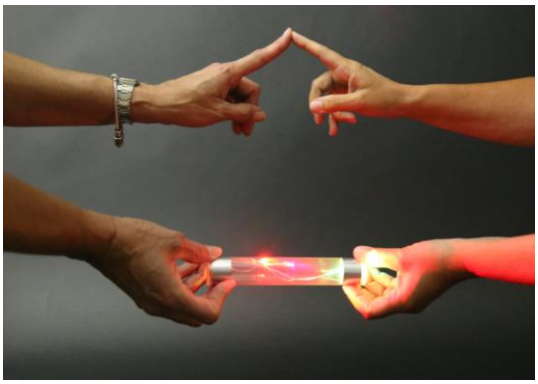
The fact is, the **red** LED light will turn on first. Then **green**, then finally **blue**. The red turns on first, because it takes less energy to light it than the green or blue LEDs.

Blue takes the most energy. This is because blue light is more energetic than red light. Blue light simply requires more voltage. This isn't because of the "brightness" of the light. Rather, the "color" of the light is important.

It's all about the light waves. Energy is expended in direct proportion to frequency. Blue light has a higher frequency than red or green light.



4. Different Paths



Start this activity in pairs. Have one person hold onto an electrode with one hand. Have the partner hold onto the other electrode. Now the two participants should touch hands or wrists with their free hands. The electrical current will enter one hand, travel through the body of the first student and into their partner and out the second student's hand to the opposite electrode. Encourage students to play around with it. Rather than touching hands, link arms, have one person touch the nose of the partner, elbow to elbow, finger to ear, etc.

*Some students aren't comfortable with holding hands with their peers. Holding wrists will suffice.

5. Open Circuit, Closed Circuit

Try playing a variation of *Duck, Duck, Goose* with the Energy Tube. First, form a circle of hands with the Energy Tube between two students. One student (who will be "it") should remain outside the circle. This student should then go around the perimeter of the circle, pointing to each person in turn and saying either "closed" or "open." Whenever a student is designated as "open," he or she should break the circuit and try to make it around the circle and complete the circuit before the person who was "it."

Useful Reference Materials

Encyclopædia Britannica (Electric Current):
www.britannica.com/EBchecked/topic/182467/electric-current

Encyclopedia.com (Conduction):
www.encyclopedia.com/topic/conduction.aspx

Physics4Kids.com (Conductors and Conductivity)
www.physics4kids.com/files/elec_conduct.html

Electricity Fun Facts

Did you know that:

… Electricity travels at the speed of light? That's more than 186,000 miles per SECOND! (Yes, per second.)

… Thomas Edison invented much more than just the lightbulb? He invented more than 2,000 products—including switches, fuses, sockets, and meters. Without these inventions, we wouldn't have electricity in our homes or schools.

… Benjamin Franklin did NOT invent or discover electricity? However, he did prove that lightning is a form of electrical energy.

… If you had a lamp on the moon connected to a switch in your bedroom, it would only take 1.28 seconds for the electricity to travel through the cable and turn on the lamp on the moon, which is on average 238,857 miles away.

… It takes about 6 billion, billion electrons to light a 100-watt light bulb for only one second. Yep, 6 billion, billion. That's 18 zeros. 6,000,000,000,000,000,000.

… You are an excellent conductor of electricity? You are made up of about 60% water. Your brain is about 75% water.

… Electric eels can produce strong electric shocks of around 500 volts for both self-defense and hunting?

… Electricity plays a role in the way your heart beats? Electricity causes the muscle cells in your heart to contract.

… A single bolt of lightning can measure up to 3,000,000 volts and it lasts less than one second?

… Google uses enough energy to continuously power 200,000 homes simultaneously?

Sources:

1. Siemens Technical Education Program: http://cmsapps.sea.siemens.com/step/pdfs/electricity.pdf
2. Purdue University: www.cla.purdue.edu/vpa/etb/resources/Electronics_01.pdf
3. U.S. Energy Information Administration: www.eia.gov/kids/energy.cfm?page=electricity_science-basics

Take Your Lesson Further

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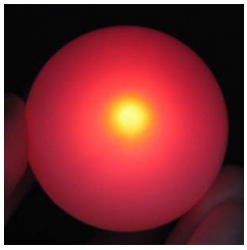
TeacherSource.com/lessons

Check our blog for classroom-tested teaching plans on dozens of topics:

http://blog.TeacherSource.com

To extend your lesson, consider these Educational Innovations products:

Energy Ball (SS-30)

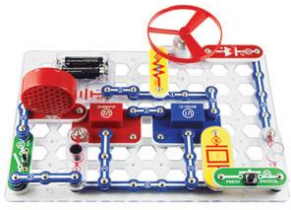


The Energy Ball is all you need to safely introduce your students to electric energy. This is a fun way to demonstrate open and closed series circuits without any danger of electric shocks! When the circuit is closed, a red light flashes and a buzzer buzzes. Closing the circuit is the fun part—just touch the metal strips with your two index fingers. Your body forms the conducting material that bridges the gap between the two metal strips and closes the circuit!

Plasma Globe (PLS-105)

The small Tesla Coil produces an alternating high voltage potential which attracts or repels free electrons. When the electrons collide with the gaseous atoms and molecules inside the globe, the gas particles are ionized creating even more electrons, as well as positive ions. A plasma is formed. When electrons return to the ionized gas, light is produced. Touching the globe with your finger provides a ground, an addition source or "sink" of electrons. You can also observe the amazing effects by moving a fluorescent tube or neon light near the Plasma Globe. They will light up in your hands!

Snap Circuits Jr. (OHM-130)



The Snap Circuits Jr. kit includes instructions for more than 100 projects ranging from a flying saucer to sound-activated switches and alarms that play music. Contains over 30 parts including a motor, photo-resistors and multiple switches, plus an illustrated manual with instructions for over 100 projects.

Hand Cranked Generator (GEN-100)

This hand-held crank generator produces up to 12 volts of DC electricity. It can be connected to an external circuit or, with a small bulb (included) used independently as a flashlight. Housed in tough transparent plastic, all of the components can be easily observed. Other devices can be easily connected to the black and red screw terminals on the front of the generator without the need for any special adapter.