

Study Guide for Teachers

Box of Light *ZAP! Electricity*

Young Audiences New Jersey &
Eastern Pennsylvania
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ABOUT THE PROGRAM

ZAP! Electricity is a hair-raising look at electrons, static electricity, currents, conductors and insulators, electromagnetism, and the all-important question, “Are we good conductors of electricity?” Every demonstration uses children from the audience and every concept in the show also has a physical mnemonic device that helps the audience remember the concept and vocabulary word. ZAP! is fun, fast, and absolutely shocking!

LEARNING GOALS

Students will

- receive a basic introduction to electricity.
- explore static electricity, current electricity, and electromagnetism.
- participate in demonstrations that illustrate how electricity moves and works.
- experience the excitement and fun of science.

ARTIST INFORMATION

ZAP! Electricity's performer, Rand Whipple, is Box of Light's founding director. Whipple has over 30 years of experience performing for school audiences. He has performed in 13 countries on four continents and has been presented numerous times by the Smithsonian's Discover Theater.

BACKGROUND INFORMATION FOR STUDENTS

Molecules: Where Electricity Starts

Molecules are the smallest piece of something that is still that thing. Molecules are made up of smaller parts called atoms and electrons. It is the electrons that create electricity. Some electrons are stuck to their molecule, some are free to move to other molecules. These are called free electrons, and it is their moving (or bumping, as we put it in the show) that creates a flow of electricity.

Free Electrons Don't Like Each Other

Electrons repel one another, and it is that repelling of electrons that creates a flow of electricity. For this to happen, a molecule must have free electrons. No free electron, no bump. No bump, no electricity.

Two Types of Electricity

Although all electricity is created from the repelling of electrons, we encounter it in two forms: static and current electricity. Static electricity can't hurt you, although it can surely get your attention. A current of electricity can hurt, burn, or even kill you. It's nice to know the difference.

BEFORE THE PROGRAM

1. Have a discussion about what the students are about to see. It's good to discuss theater etiquette and participation etiquette. Make sure to talk about the difference between seeing a live performance and watching a performance by an actor on television or in the movies. Students need to know that they are an important part of the show they are about to see. The performer wants everyone in the audience to be able to hear and enjoy the program, so they need to make sure to give their full attention during the performance and not distract others.

2. Introduce electrons and electricity. Electricity is a type of energy that can build up in one place or flow from one place to another. When electricity gathers in one place it is known as static electricity (the word static means something that does not move); electricity that moves from one place to another is called current electricity.

VOCABULARY WORDS

Atom: The basic unit or building block of a molecule.

Battery: A container that allows a chemical reaction to create a flow of electrons

Circuit: The path along which electrons flow to create an electrical charge. The circuit must be made of a conducting material.

Conductor: A material that allows a current of electricity. The conductor must be made of a material that has free electrons to bump or repel one another.

Current: A flow of electrical charge (a continuous "bumping" of electrons).

Electricity: A form of energy created by the bumping (or repelling) of free electrons.

Electromagnetism: Magnetism created by a flow of electrons through a conductor.

Free electrons: Negatively charged particles that make up a current of electricity.

Insulator: A material that does not allow a flow of electricity. The material of an insulator does not contain the free electrons needed for a current of electricity.

Molecule: The smallest part of something that is still that thing. Molecules contain free electrons, which create a flow of electricity.

Static: A stationary electrical charge, usually created by friction or rubbing. Static has a weak current. It can move very light objects but not much else.

AFTER THE PROGRAM

1. Hold a follow-up discussion. This is a good method for the students to process their learning experience. Here are some good questions to start with: What was your favorite part of the performance? Why? Was anything surprising to you? Why? How did the experiments make you feel? Did any of the experiments remind you of anything you've experienced before?

2. Make a small electromagnet. You can do this using a battery, some insulated (plastic-covered) copper wire, and a nail. There are a few websites that tell you what to do step-by-step:

- [How do I make an electromagnet?](#)
- [Science projects: Make an electromagnet.](#)

REMEMBER TO TELL YOUR STUDENTS:

Electricity is amazingly useful—but **it can be very dangerous.** Household electric power can kill you, so be sure to treat it with respect. Don't play with household power sockets or push things into them. Don't take apart electrical appliances, because dangerous voltages can linger inside for a long time after they are switched off. If you want to know what something electrical looks like inside, search on the web—you'll find a safe answer that way.

It's generally okay to use small (1.5 volt) flashlight batteries for experiments if you want to learn about electricity; they make small and safe voltages and electric currents that will do you no harm. **Ask an adult for advice if you're not sure what's safe.**

RESOURCES

Activities at the Exploratorium
<https://www.exploratorium.edu/explore/electricity-magnetism>

Explain That Stuff!
<https://www.explainthatstuff.com/electricity.html>

The Franklin Institute Online
<https://www.fi.edu/exhibit/electricity>

Steve Parker, *DK Eyewitness Books: Electricity.*

Rosalyn Schanzer, *How Ben Franklin Stole the Lightning.*