



Inquiry Lab

TEACHER ENRICHMENT RESOURCE PACKET



Electricity

Electricity, in one form or another, is all around us! Learn about flowing and static electricity

Learning Objectives:

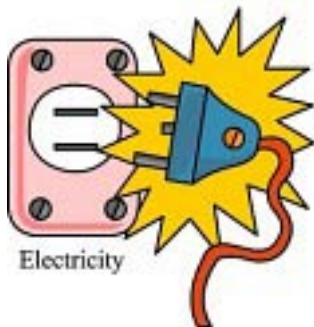
- Learn about a variety of electrical phenomena.
- Discover how to power a lightbulb using household objects.
- Practice teamwork skills in collaborating on some electrifying challenges.

Think it.
Try it.
Explorit.

contents

Learning Objectives	1
Background Information & Classroom Activities	2-4
Science Standards	5
Explorit Programs	5

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Background Information "Electricity"



Thank you for choosing Explorit Science Center's *Inquiry Lab* program to supplement your on-going science curriculum. Whether you use the program to kick off a new unit, wrap up a nearly completed unit, or purely to excite and interest your students in the wonderful world of science, advance preparation and follow-up with your students are critical to achieving the greatest educational benefit from this unique science experience.

Explorit provides two resources to help prepare you and your students for the *Inquiry Lab*. First, simple logistics of the program are detailed in the confirmation letter. Second, this Teacher Enrichment Resource Packet (TERP) outlines appropriate science content and processes to help you:

- successfully prepare your students prior to visiting Explorit;
- participate fully in the *Inquiry Lab* yourself
- follow-up with your students back in the classroom.

What exactly is electricity? Well, it is not easy to explain, but in a nutshell it can be roughly described as a general term that encompasses many types of phenomena resulting from the presence and flow of electric charge. Two commonly-encountered examples of such phenomena are lightning and static electricity, but also electromagnetic fields and electromagnetic induction. The concept of electricity has been observed and studied since the first recordings of history and was often considered to be magic. However, until the 17th and 18th centuries, no real advances in understanding or harnessing electricity were made. Following these discoveries, a number of practical applications in the late 19th century transformed the world and helped spark the Second Industrial Revolution.

The word "electricity" comes from the New Latin word "electricus", which means "of amber" or "like amber", and can be credited to an English physician by the name of William Gilbert who, in 1600, set out to determine once and for all if amber was indeed magnetic since it was able to attract light objects, like feathers, when rubbed with the fur of a cat. Prior to Gilbert's experimentation it was thought for millenia that amber must be related to the naturally-occurring magnetic mineral known as magnetite since both exhibited similar attracting properties. However, Gilbert successfully established that amber's attractant abilities were due to the electrical phenomena known as static electricity. In the 18th century, Benjamin Franklin performed his now-famous "kite and key" stunt in which he sent a metal key into a lightning storm in an effort to prove his theory that lightning was a form of electricity. After sparks jumped from the key down to the back of his hand and shocked him a bit, his theory was proven to be fact.

Although Gilbert and Franklin made some of the most progressive advances in the study of electricity, it was not until near the end of the 19th century that the field of electrical engineering really took off and a plethora of pioneers paved the way for our current society's utilization of electricity. These pioneers included Nikola Tesla (worked on numerous inventions, especially in the field of electromagnetism),

Thomas Edison (invented phonograph, motion picture camera, and a practical light bulb that lasted longer than others'), George Westinghouse (father of modern electrical industry and instituted the use of alternating current (A.C.) as opposed to Edison's preference of direct current (D.C.)), Alexander Graham Bell (invented first practical telephone and the metal detector), and Lord Kelvin (developed the Kelvin scale of absolute temperature measurement).

Take a moment and look around you. The experiments and knowledge performed and gained by so many over the last few centuries have been decidedly in our favor in terms of scientific advancement when it comes to all things electrical. In fact, as a source of energy there are almost infinite applications for electricity, such as transport (vehicles), heating (heaters) and cooling (air conditioners), communications (telephone), computation (computers), and many more. Most assuredly, there are many more applications for electrical phenomena that have yet to be discovered and perhaps you or your students will be the people who find them!

Classroom Activity #1

ACTIVITY #1: Electrical Brainstorms

Think It: Electricity is all around you being used in a number of ways to power a number of everyday devices .

Try It: You'll need thinking caps and a classroom (or somewhere with a number of electrically-powered devices within viewing distance). Now, students will either be called on to name a device in the vicinity that uses electricity or they could generate a written list. They could also be challenged to think of other devices that they interact with on a daily basis that also use electricity.

Exlorit: Where does the electricity come from that powers all these devices (ie. battery, wall socket, etc.). Tracing the electrical path might also be fun to try (power lines, power station, fossil fuels, etc.).



Classroom Activity #2

ACTIVITY #2: Lemon Battery

Think It: Challenge students to construct a battery made from a lemon and test it out.

Try It: You'll need lemons (1/pair), 20 gauge bare copper wire (2 inches/student), paper clips (1/pair), and markers (1/pair). Now, clip the copper wire into 2 inch segments and bend the paper clips in half and cut them at the halfway point. Pair off the students and hand each a piece of both metal segments, a lemon, and a marker. As them to take turns gently softening up the lemon by rolling it around and squeezing it, but take care not to break the skin. Now, instruct all to push both of their wires into opposite sides of the lemon as close together as possible without any of the wires touching (side-to-side or through the lemon). Have each student



Classroom Activity #3

use the marker to somehow notate which side is his/her's. Then, have them take turns touching their tongue to the two wires simultaneously. They should feel a slight tingle on their tongue where it meets the wires and a metallic taste in their mouth. Congratulations, they have built a voltaic battery!

Explanation: A voltaic battery transforms chemical energy into electrical energy. The chemical energy in the lemon is known as citric acid and when electrodes (the two wires) of differing materials are placed in a liquid containing an electrolyte (a solution, like citric acid, that can conduct electricity) an abundance of electrons (small charged particles) gather on the end of one electrode and the other electrode loses electrons. Then, when a moist tongue touches the wires, a circuit is closed and a small electric current flows.

Explorit: A single lemon can produce about 7/10th of a volt of electricity (very small). If more than one lemon was used, would it be possible to power an electrical device, such as a miniature light bulb or a watch (answer: in theory, yes)?

ACTIVITY #3 Magnetic North

Think It: You may know that a compass needle always points north, but do you know why?

Try It: You'll need a bar magnet marked with "N" (for North) and "S" (for South) at opposite ends, string, and a compass. Now, Bring out the compass and allow it to come to a stop. Usually, the red end of the needle in the compass is the one that points North and the "N" section on the compass face should then be aligned with the red needle. Then, tie the string around the bar compass and hang it from somewhere in the room, so it can turn freely. Ask the class which end of the magnet, "N" or "S", will point the same way as the red end of the compass needle? The answer should be "N", but it may take a while for the magnet to come to a stop.



Explanation: All magnets point towards magnetic North, which is also towards the North Pole end of the planet, but is actually several hundred miles away from what we consider to be the North Pole. The magnet does this because it aligns itself with the electromagnetic field that surrounds the Earth. The red pointer in the compass does the same thing because it is a magnetized piece of metal (either steel or iron).

Explorit: One fun idea might be to play a game with the compass in order to further understand how it works by placing some paper clues labeled with a cardinal direction either around the room or outdoors. Combine the paper clue with a verbal one as well and have the class attempt to find the clues by starting them off with a written clue, such as "North" and a verbal clue, given after they locate the direction with the compass, such as "bookshelf".

Science Standards

CA STANDARDS

Physical Science (K-1a, 2-1f, 3-bcd, 4-1abcdg, 5-1c)

Investigation and Experimentation (K-4abce, 1-4d, 2-4ag, 3-5abde, 4-6acd, 5-6bh, 6-7abe)

NATIONAL STANDARDS

K-4: A, B, E, F, G; 5-8: A, B, E, F, G

Explorit Programs for Schools and Groups

At Explorit's Sites

Discovery Lessons & Inquiry Labs Visit one or more of our Changing Exhibitions throughout the year.
Nature Safaris & Labs Fall and Spring visits to Explorit's indoor and outdoor spaces at Mace Ranch Park

Explorit in Your Classroom

Classroom Adventures Science Investigations for Grades K-6 that come to you.
Young Scientist Series Science investigations through multiple visits at your location.

For the Whole School

Health in Your World With your local community's participation, learn about keeping your body and the world healthy and safe.
Science in Your World The ultimate family science night that's just right for everyone!
Science Assembly A multi-media presentation for the whole school.

Reservations required.
For information please call
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