The Educational Touring Theatre
and
The Adventure Science Center

Giants of Electrical Science

Study Guide

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Giants of Electrical Science Study Guide

The attached study material is designed to help prepare students to attend the Educational Touring Theatre and Adventure Science Center's program ***Giants of Electrical Science***. Also enclosed are suggestions for follow up activities. The following material is included:

- ***Giants of Electrical Science*** **Goals and Standards** (For Teachers)
- **What to Expect at *Giants of Electrical Science* (And What Will be Expected of You)** (For Students)
- **Vocabulary List**
- **Who's Who in *Giants of Electrical Science*** (A brief overview of the people who appear or are discussed in the show)
- ***Giants of Electrical Science*** **Word Find**
- **Pre-Visit Activities**
- **Watts All This About Volts and Amps?** (An introduction to the units of electrical measurement)
- **Where are the Women?** (A look at why women and minority scientists do not play a more prominent role in the show)
- **Follow Up Science Activities**
- **The History of Electricity on the Web**

The ***Giants of Electrical Science Study Guide*** was written and prepared by the Educational Touring Theatre and the Adventure Science Center, with additional material from the Middle Tennessee Electric Membership Corporation. It may only be duplicated for study purposes. If there are questions about ***Giants of Electrical Science***, or about this Study Guide, please contact the Educational Touring Theatre.

Giants of Electrical Science Goals & Standards

The curriculum based ***Giants of Electrical Science*** performance, the **Electricity Party** workshop, and the ***Giants* Study Guide** are designed as valuable instructional tools. Listed below are the Tennessee Department of Education Goals and Standards that these presentations and material will help teachers address.

SCIENCE STANDARDS

Embedded Technology & Engineering
Conceptual Strand

Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies

GLE 0507.T/E.1 Describe how tools, technology, and inventions help to answer questions and solve problems.

GLE 0507.T/E.2 Recognize that new tools, technology, and inventions are always being developed.

GLE 0507.T/E.3 Identify appropriate materials, tools, and machines that can extend or enhance the ability to solve a specified problem.

GLE 0507.T/E.4 Recognize the connection between scientific advances, new knowledge, and the availability of new tools and technologies.

GLE 0607.T/E.1 GLE 0707.T/E.1 GLE 0807.T/E.1
Explore how technology responds to social, political, and economic needs.

GLE 0607.T/E.2 GLE 0707.T/E.2 GLE 0807.T/E.2
Know that the engineering design process involves an ongoing series of events that incorporate design constraints, model building, testing, evaluating, modifying, and retesting.

Matter
Conceptual Strand 9

The composition and structure of matter is known, and it behaves according to principles that are generally understood.

GLE 0807.9.1 Understand that all matter is made up of atoms.

Forces in Nature
Conceptual Strand 12

Everything in the universe exerts a gravitational force on everything else; there is an interplay between magnetic fields and electrical currents.

GLE 0407.12.2 Observe that electrically charged objects exert a pull on other materials.

GLE 0407.12.3 Explain how electricity in a simple circuit requires a complete loop through which current can pass.
GLE 0607.12.1 Describe how simple circuits are associated with the transfer of electrical energy.

GLE 0607.12.2 Explain how simple electrical circuits can be used to determine which materials conduct electricity.

GLE 0807.12.1 Investigate the relationship between magnetism and electricity.

SOCIAL STUDIES STANDARDS

Culture

Content Standard: 1.0

Culture encompasses similarities and differences among people including their beliefs, knowledge, changes, values, and traditions. Students will explore these elements of society to develop an appreciation and respect for the variety of human cultures.

1.03 Recognize the contributions of individuals and people of various ethnic, racial, religious, socioeconomic groups to the development of civilizations.

1.04 Describe the influence of science and technology on the development of culture through time.

1.06 Understand the influence of science and technology on the development of culture through time.

Individuals, Groups, and Interactions

Content Standard: 6.0

Personal development and identity are shaped by factors including culture, groups, and institutions. Central to this development are exploration, identification, and analysis of how individuals and groups work independently and cooperatively

6.01 Recognize the impact of individual and group decisions.

History

Content Standard: 5.0

History involves people, events, and issues. Students will evaluate evidence to develop comparative and casual analyses, and to interpret primary sources. They will construct sound historical arguments and perspectives on which informed decisions in contemporary life can be based.

5.5.03 Understand the development of Industrial America.

- Identify individual leaders of business and industry.
- Explain how industry and mechanization changed ways of life in America and Tennessee.

THEATRE STANDARDS

Standard 6.0 Theatrical Presentation

Students will compare and incorporate art forms by analyzing methods of presentation and audience response for theatre, dramatic media (such as film, television, and electronic media), and other art forms.

6.1 Explore other art forms as they contrast and/or relate to theatre.

6.4 Understand the role of the audience and demonstrate appropriate audience etiquette.

Standard 7.0 Scene Comprehension

Students will analyze, evaluate and construct meanings from improvised and scripted scenes and from theatre, film, television, and electronic media productions.

7.1 Respond to selected theatrical experiences.

7.2 Examine creative drama and formal theatre, film and multimedia productions.

Updated 7/08

What to Expect at
Giants of Electrical Science
(And what will be expected of you)

You will soon have the opportunity to attend a performance of ***Giants of Electrical Science***. The Educational Touring Theatre and the Adventure Science Center of Nashville created and produced this special program. ***Giants*** may be a bit different than some of the other assembly programs you have seen at school.

Giants of Electrical Science is a live, theatre performance. A "live performance" is one in which the performers are actually right there with you, instead of being presented through some electronic media such as on TV or in a movie. In a "theatre performance," the performers are not appearing as themselves, but are instead acting as different characters.

Giants is a special kind of theatre performance known as a mono-drama, or one-man show. All nine of the characters in the show will be played by the same actor. As you watch the show, notice how the actor has to change the way his voice sounds, and how he uses his body to become the different characters. Also see how different costume pieces are used to help you tell the characters apart.

> **Acting Insight**
>
> *Actor Neil Spencer will be appearing in* ***Giants****. He has been performing at schools for over 20 years. Neil has also acted at theatres around the country, as well as for movies, TV, and radio.*

The plot of ***Giants*** is quite simple: Four famous scientists, from throughout history, will try to win the title of "Giant of Electrical Science."

Each scientist will demonstrate some of his most important electrical discoveries and inventions to convince you, the audience, that he should be awarded this honor. Students will be selected from the audience to help with some of these demonstrations. One student will even have the chance to play the part of Benjamin Franklin's son William!

> **Acting Insight**
>
> *Sometimes Spencer will use different accents. Neil had never done an Italian accent before. To help prepare for the show, he listened to "Learn Italian" tapes.*

Even if you don't get the chance to appear on stage, you still will play a vital role in the success of ***Giants of Electrical Science***. During a live performance, the actor is very aware of what is happening in the audience. If the audience is really paying attention, and focusing on the show, it gives the performer extra energy. This makes for a better performance. But, if people in the audience are talking, or being rude, this

> **Acting Insight**
>
> *Since **Giants** is a one-man show, the costume changes have to be very quick. The actor wears a base costume and then adds a few extra pieces for each character. The most elaborate change includes a wig, hat, glasses, and ruff. The simplest change is made by putting on a gold medal.*

inappropriate behavior can distract the performer. If the actor is distracted, he is no longer concentrating on the performance, and the show won't be as good. If someone in the audience is behaving very badly, the entire show might have to stop until that person has been removed!

When you attend ***Giants of Electrical Science*** please practice good audience etiquette by listening carefully and responding appropriately. Not only will you enjoy the program more, but you will also help make the performance better for everyone else, too!

Vocabulary List for *Giants of Electrical Science*

The following word are listed in the order in which they are used in ***Giants of Electrical Science***. Electrical terms are in *underlined italics*.

Insulator: A material that does not allow the flow of electricity.

Asphyxiation: Not being able to breathe.

Fathom: To understand or comprehend.

Repelled: *To be pushed away from. The opposite of attracted.*

Conductor: A material that easily allows the flow of electricity.

Leyden Jars: A special device for storing electrical charges.

Descendant: Something that follows from, or is related to, the original.

Current: A steady flow of electricity.

Brine: Salt water.

Circuit: An unbroken electrical path.

Filament: A special conductor found in light bulbs. When the filament gets hot it produces light.

Electromagnetism: The relationship between magnets and electricity.

Electromagnet: A magnet that is created by passing electricity through a coil of wire wrapped around a metal bar.

Induction Ring: A special electromagnet that induces, or causes, an electric current in an non-electrified wire.

Galvanometer: *An instrument for detecting and measuring electric current.*

Dynamo: *An electric generator.*

Menlo Park: Thomas Edison's famous laboratory.

Patent: Official recognition, or document, that protects the rights to an invention or idea.

Resistance: *The amount of difficulty an electrical current has in passing through a material.*

Who's Who? In *Giants of Electrical Science*

A lot of people either appear, or are mentioned in the play ***Giants of Electrical Science***. Here is a "cast of characters" so you will know who is who. The names are in the order in which they appear or are mentioned.

People portrayed in the play will be in a **CAPITAL** letters with a **BOLD** font.

BOB BLATANT: (1965- , United States) This game show host is a fictional character. He has appeared in many Educational Touring Theatre creative drama programs.

<u>BENJAMIN FRANKLIN</u>: (1706-1790, United States) ***GIANTS FEATURED SCIENTIST*** Scientist, inventor, printer, businessman, writer, Postmaster, Founding Father, etc., etc. The list goes on and on. Franklin was a pioneer in the study of electricity. His most famous electrical discoveries include positive and negative charges, and that lightning was electricity. This discovery led to the invention of the lightning rod. Other Franklin inventions include swim fins, bifocal glasses, the glass armonica, and the Franklin stove.

WILLIAM FRANKLIN: (1730-1813, United State/England): The last British Governor of New Jersey. Unlike his famous father, William supported the English during the American Revolutionary War.

REGGIE BROWN: (1971-, United States) An electrical repairman. The name for this fictional character comes from two great defensive linesmen of the Green Bay Packers.

<u>ALESSANDRO VOLTA</u>: (1745-1827, Italy) ***GIANTS FEATURED SCIENTIST*** Volta's most important invention was the electric battery. Before his invention of the battery, scientists were only able to use static electricity in their experiments. Volta's other important inventions were the static electricity producing electrophorus, and a device for detecting very small amounts of electricity. Although Volta's region of Italy changed rulers several times (even Napoleon ruled there for awhile), he was always able to stay in their good graces, and continue his scientific studies.

Luigi Galvani: (1737–1798, Italy) A Professor of Anatomy at the University of Bologna. His most famous experiments explored the effects of electricity on muscles and nerves.

RACHEL CARSON-STEINEM: (1963- , United States) The name for this fictitious scientist comes from combing the real environmental scientist Rachel Carson with the women's rights advocate Gloria Steinem.

Laura Bassi: (1711-1778, Italy) A Professor of Experimental Physics at the Institute of Sciences in Bologna, Italy. Bassi researched the medical applications of electricity.

Chien-Shiung Wu: (1912-1997, China/United States) An experimental physic who was an expert in electromagnetic energy and nuclear fission.

Helen Edwards: (1936- , United States) The designer of the Tevatron, a super conducting particle accelerator.

Gertrude Scharff Goldharber: (1911-1998, Germany) A nuclear scientist, with a special emphasis on fission.

Xide Xie: (1921-2000 , China) An experimental and theoretical scientist in the fields of solid state electronics and semiconductors.

Katherine Burr Blodgett: (1898-1979, United States) The first woman research scientist at the General Electric Company. Blodgett is he inventor of non-reflecting glass.

Granville Woods: (1856-1910, United States) A scientist with over 50 patents, including the dynamotor, an electric egg incubator, the multiplex railway telegraph, and improvements on the telephone and phonograph.

Lewis Latimer: (1848-1928, United States) This scientist patented improvements on light bulb filaments, and parallel circuits for street lights. Worked with Thomas Edison for 30 years.

Garret Morgan: (1877-1963, United States) The inventor of the first electric traffic signal. He is best known for his invention of the gas mask.

MICHAEL FARADAY: (1791-1867, England) ***GIANTS FEATURED SCIENTIST*** Faraday began his working life as an apprentice bookbinder. When his workday was finished, he educated himself by reading the scientific books at the bindery. Faraday has many important electrical discoveries to his credit, including inventing the electric motor and the dynamo. His theories on electromagnet fields were vital in the development of electromagnetism.

Hans Christian Orsted: (1777-1851, Denmark) This Danish physicist was an early pioneer in electromagnetism. He discovered that a wire carrying an electric current would deflect the needle of a compass.

Andre Ampere: (1775-1836, France) A mathematician, chemist, and physicist. Another early pioneer in the study of electromagnetism.

William Sturgeon: (1783-1850, England) The inventor of the electromagnet. Sturgeon was originally apprenticed as a shoe maker.

STEVE SPITZ: (1978- , United States) This fictional character is based on Mark Spitz, who won 7 gold medals for swimming in the 1972 Olympics.

THOMAS EDISON: (1847-1931, United States) ***GIANTS FEATURED SCIENTIST*** Edison liked to call himself an "inventor" instead of a scientist. He held over 1,000 patents, mostly for practical inventions and innovations. Edison's 'Big Three" inventions are: the practical incandescent light bulb, the phonograph, and the motion picture camera. His laboratory, Menlo Park, was known as "The Invention Factory."

Simon Cowell: (1959- , England) This record producer is best known as the nasty judge on the *American Idol* television show.

Giants of Electrical Science *Word Find*

N	U	O	B	W	N	Z	G	W	M	G	N	W	Y	N	O	Z	U	T	A
O	D	J	G	E	Q	L	L	R	I	U	F	Y	A	P	S	T	L	R	N
E	C	H	O	T	N	T	U	C	B	O	Y	G	Z	A	U	I	L	B	I
G	M	H	E	S	T	J	H	I	R	A	R	H	G	Z	Q	P	E	W	L
R	I	L	I	L	D	N	A	O	G	O	T	S	X	K	R	S	W	R	K
U	C	A	A	E	E	O	A	M	M	I	O	E	I	T	F	E	O	E	N
T	H	U	H	N	N	N	O	T	I	A	G	J	J	E	D	V	C	G	A
S	A	R	A	H	D	S	E	W	A	N	S	A	P	Q	P	E	N	G	R
M	E	A	L	K	K	R	H	D	E	L	F	E	L	D	H	T	O	I	F
A	L	B	H	J	R	U	E	I	W	L	B	R	D	V	Z	S	M	E	M
I	F	A	R	A	P	Z	U	A	U	A	L	B	A	I	A	N	I	B	A
L	A	S	G	F	J	B	W	C	M	N	R	I	O	N	S	N	S	R	I
L	R	S	D	O	E	N	B	A	P	P	G	D	V	B	K	O	I	O	L
I	A	I	C	M	R	Z	I	U	J	G	E	W	S	N	V	L	N	W	L
W	D	X	I	D	E	X	I	E	Z	H	Q	R	U	Y	A	E	I	N	I
Y	Y	P	H	C	W	M	B	M	R	N	H	I	E	R	V	R	Y	N	W
W	N	A	L	E	S	S	A	N	D	R	O	V	O	L	T	A	G	F	V
C	M	E	N	I	E	T	S	N	O	S	R	A	C	L	E	H	C	A	R
H	A	N	S	C	H	R	I	S	T	I	A	N	O	R	S	T	E	D	Y
T	J	R	E	M	I	T	A	L	S	I	W	E	L	B	K	F	J	Z	F

Find the following people who appear or are mentioned in *Giants of Electrical Science*. For extra credit, circle the fictional characters in the list below.

ALESSANDRO VOLTA
ANDRE AMPERE
BENJAMIN FRANKLIN
BOB BLATANT
CHIEN-SHIUNG WU
GARRET MORGAN
GRANVILLE WOODS
HANS CHRISTIAN ORSTED
HELEN EDWARDS
LAURA BASSI
LEWIS LATIMER
LUIGI GALVANI
MICHAEL FARADAY
RACHEL CARSON-STEINEM
REGGIE BROWN
SIMON COWELL
STEVE SPITZ
THOMAS EDISON
WILLIAM FRANKLIN
WILLIAM STURGEON
XIDE XIE

The following scientists are also mentioned in *Giants of Electrical Science*, but didn't fit in the puzzle.

Gertrude Scharff Goldhaber   Katherine Burr Blodgett

Pre-Visit Activities for *Giants of Electrical Science*

Provided by The Adventure Science Center of Nashville

Here are a few fun activities that you may use to help prepare your students for attending the ***Giants of Electrical Science***.

1. Write the word energy on the board. Ask "What do you think of when you read this word?" Possible suggestions might be: electricity, light, motion, burning fossil fuels, magnetism, etc. Brainstorm and list words. Have students make a list of objects in the classroom that use energy.

2. Discuss how energy is defined as "the ability to do work." Ask students for examples of work using electricity. Examples might be: lighting a light bulb, turning on a fan, moving a turbine, etc. Ask students for examples of how their bodies use energy.

3. A few days before the program, ask students to keep an electricity diary. Students should record their use of any form of electricity from the minute they arise in the morning to the end of their day. Have teams or individuals find out when each of these electrical objects was first used. How many have been around over 100 years?

Watts All This About Volts and Amps?

People love to measure things. If you think about it, it only makes sense. If you are making a cake, you need to measure the ingredients so you don't end up with too little flour or too much milk. When you are building a tree house, you measure the distance between limbs to be sure you cut the right length board. In math class, you measure how much time there is until lunchtime.

We need measurements when using electricity too. If we use too little electricity, our lights may not come on. If we use too much electricity, we might blow a fuse, or, worse yet, burn down the house. That is where watts, volts, and amps come in. Watts, volts, and amps are all units of electrical measurement.

Watts are the total amount of electrical energy being used. To figure out the total amount of electrical energy being used -- the watts -- we have to know how strong the electricity is (volts) and how fast the electricity is flowing (amps). The equation for this would be: Watts = Volts x Amps.

Try out this analogy: Think of a boxer, we'll call him "Joe", getting ready to hit a punching bag. The total amount of energy Joe uses to hit that bag is similar to watts. The strength of Joe's muscle is like volts. How fast Joe punches is like amps.

There are two ways Joe can hit the bag with a lot of total energy (watts). One way is to use a lot of muscle power, a lot of force (volts). The other way is to hit the bag with a lot of speed (amps).

Let's say Joe wants to scare his next opponent by knocking the punching bag off of its stand. It will take 500 "watts" of energy to do this. One way Joe could knock the bag off is by using 500 "volts" of muscle power at 1 "amp" of speed. 500 "watts" = 500 "volts" x 1 "amp."

Or, Joe could knock the bag off by using only 1 "volt" of muscle power, but hit the bag at a really fast 500 "amps" of speed. 500 "watts" = 1 "volt" x 500 "amps."

There are lots of ways Joe could combine his power and his speed to knock the bag off: 100 "volts" of power at 5 “amps” of speed, 50 “volts” of power at 10 “amps” of speed, and so on. The important thing is that he uses enough total energy to get the job done. If Joe uses too little energy, he won’t even dent the bag, and his opponent will laugh at him. If Joe uses too much energy, the bag will go flying off the stand, crash through the wall of the gym, and smash Joe’s car two stories below.

While Joe’s fighting skills may electrify us, we wouldn’t really use watts, and volts, and amps to measure his punches. We are only using them here to help visualize the ways that we measure electricity.

There is one more important electrical measurement - - ohms. Ohms measure the resistance of the flow of electricity. Resistance is how difficult it is for the electricity to flow through a material.

Let’s return to our friend Joe. How hard it is for Joe to throw a punch is like the ohms. If Joe is just working out in the gym, like usual, his fist is just traveling through the air, so there is very little resistance to his punch. The “ohms” would be low. But, if we place Joe in a swimming pool to work out, his fist has to fight through all of that water, and there would be a lot of resistance, so the “ohms” would be very high.

When we are getting ready to send electricity through a wire, we need to know how many ohms of resistance there are, so we are sure to send enough current through to get the job done.

So what is the big deal about watts, volts, amps, and ohms? Nothing really. Like feet and inches, they are simply units of measurement to be sure we use just the right amount of electricity.

Where Are The Women?

By ***Giants of Electrical Science*** Playwright Neil Spencer

At our very first meeting to discuss the *Giants of Electrical Science* play, the Director of Education at the Adventure Science Center asked me if I could include the contributions of women electrical scientists in the show. “How about the electrical contributions of minority scientists, too?” she asked.

“Sure, I can do that,” I said, “No problem!” Little did I know at the time just how difficult it was going to be to fulfill that promise.

I knew why the educators at the Science Center thought it was important to present women and minority scientists. I agreed with them. Even now, in the early Twenty-first Century, although we can find both men and women in science, although we can find people from all different nationalities and backgrounds in science, when we hear the word “scientist,” we almost all imagine a white man in a lab coat.

The problem with this pervasive image of scientists all being white men, besides the fact that the picture is now completely inaccurate, is that this vision of who a scientist is can be a very discouraging and disheartening one if you don’t fit that picture. If we only view scientists as white men, then we are less likely to encourage girls, or students with different ethnic backgrounds, to pursue their dreams of becoming scientists.

The Adventure Science Center is about making science exciting for all people, not just white guys. Like I said, I agree with them. Science is for everyone.

As I got into my research for *Giants*, I discovered that I was in trouble. *Giants of Electrical Science* isn’t just about the science of electricity; it is also about the history of electricity. The concept for the show called for presenting the four scientists who had the greatest impact on the development of electrical science. The developmental phase of electricity as a science was basically from 1740 – 1900. During that time, all of the major electrical breakthroughs and inventions came from the work of white men. “Where are the women?” I cried. “Where are the scientists of color?”

The sad fact is, that during the development of electrical science, women and ethnic minorities were almost completely shut out of the world of science. Not only were they denied scientific opportunities, but educational opportunities of any kind were very limited. For more than half of the target time period, slavery was still practiced in the United States.

What a tragedy! Who knows what fantastic scientific inventions and discoveries could have been made if over two thirds of the potential scientist in the world hadn’t been denied the chance to be scientists? Thank goodness that more and more scientific opportunities are now opening up for both genders, and for people of all backgrounds.

I dug a little deeper into the history of electricity. I was delighted to find that there were some women and scientists of color who fought through prejudice and stereotypes and made significant electrical contributions. However, while their contributions were important, they were not as essential to the development of electrical science as those of some of the white guys. This was going to be a big problem for the show.

What was I going to do? Obviously, to be true to the history of electricity and to the concept of the show, I was going to have to focus on the white scientists who made the greatest contributions. But, there was still that promise I had made to the Adventure Science Center.

It wasn’t easy, but I am happy to report that I did find a way to fulfill my promise of including some of the contributions of women and minority scientists. I’m not going to tell you how I fit it into the show – I don’t want to spoil the surprise. Although it was a difficult challenge, including these contributions made the play better, because it starts to erase that picture of scientists just being white men. Besides, the solution made the play a lot more fun, too!

Follow Up Activities to *Giants of Electrical Science*
Provided by the Adventure Science Center of Nashville

Here are some activities you may wish to use after your class has
Attended the ***Giants of Electrical Science*** presentation.

Scientists and Their Inventions

List a group of everyday objects that use electricity. Ask students to choose one object and determine when it was originally invented, by whom, and under what circumstances was it necessary to invent this object, how it worked, and how the invention of this object changed everyday life. For example, what impact did streetlights have on cities? How did the early washing machine work? For a timeline of technology that reveals the inventor and the time, go to:

http://www.pbs.org/wgbh/amex/telephone/timeline/timeline_text.html.

EXPERIMENT: Making a Home Made Battery

Purpose: This activity shows you how to build and test a simple homemade battery to better understand electricity.

Materials:

lemon
lamp (bulb holder)
knife
hammer
copper strip
zinc strip (zinc coated bolts will also work)
2 copper wire leads
penny nail
galvanometer or 0.2 volt bulb
science journal

Procedure:

1. Roll the lemon a few times on a counter to get the juices flowing.
2. With adult supervision: Use the knife to make two parallel (side by side) slits 2 cm apart in the lemon.
3. Make a small nail hole in the end of the metal copper and zinc strips.
4. Insert the copper strip into one slit and the zinc strip into the other slit so that they stay 2 cm apart.
5. Connect the wire leads to the copper strip and the zinc strip by looping the wires through the holes made by the nail.
6. Connect one of the ends of the wire to the terminals on a lamp (bulb holder) or on one end of the galvanometer.

7. Predict what will happen when the loose wire touches the lamp terminal or the galvanometer.
8. Take the other loose wire end and touch it to the open terminal of the lamp or galvanometer to complete the circuit in short intervals.

The current is too weak to electrocute anyone!

If the galvanometer is used as the load, record the reading.

If the lamp with a bulb in it is used, note the brightness of the bulb.

Conclusion:

1. What is the power source?
2. Would two strips of the same metal produce electricity?
3. What other fruit can be used to make an electroscope instead of the lemon?

EXPERIMENT: Creating Static Electricity

Purpose: To demonstrate that "static" is a true form of electricity and to show that electricity flows when there is a large enough charge imbalance

Materials:

- balloon
- fluorescent light
- dark room or area
- science journal

Procedure:

1. Hold up the fluorescent bulb and ask students how you can get it to glow without putting it into a lamp or socket.
2. Have students discuss what they know about static electricity.
3. Make the room as dark as possible.
4. Invite a student to rub the balloon against his/her head. While you are holding the bulb, have the student touch the balloon to the metal contact at one end of the bulb.
5. Observe and record what happens in your science journal.

6. Discuss what happened and why.

Conclusion:

1. Why did the bulb glow?
2. How could you make the bulb glow longer? Brighter?

3. In your science journal, write a brief explanation of what happened in this experiment. Share your ideas with a classmate.

What's Happening?

Fluorescent tubes are filled with a gas that gets "excited" when even a small amount of electricity is applied to it. When you touch the end of the tube with the balloon, electrons jump from the balloon to the metal conducting tip of the bulb. These electrons hit low pressure mercury gas in the bulb. When the gas molecules become excited, they give off ultraviolet rays. These rays excite the phosphorus coating on the inner surface of the glass tube, which, in turn, gives off white light.

EXPERIMENT: Make a Static Detector

Purpose: This activity helps you learn about static charge or static electricity and shows you how to construct a device that will check whether an object has a static charge.

Materials:

- insulated piece of electrical wire
- Christmas tree icicle (2) or gum wrapper
- glass jar with a narrow neck (12-oz. glass soda bottle)
- modeling clay
- wire strippers
- plastic comb
- balloon
- wooden spool
- pencil
- scissors
- science journal

Procedure:

1. Strip 3 cm off the ends of a piece of insulated wire.
2. Make a J-like hook out of the uninsulated electrical wire.
3. Place a Christmas tree icicle aluminized (shiny) side down over the hook. Make sure there is an even amount of material hanging on each side of the hook.
4. Lower the hook with the icicle into the jar. There should be about 5 cm of wire sticking out of the jar.
5. Seal the jar top with a rubber stopper or carefully pack modeling clay around the wire to cover the top of the jar.
6. Do not open the bottle to reposition the icicle once it is inside the jar.
7. Create a charge on a comb by combing through your hair three times or by rubbing it with a piece of wool once.
8. Slowly bring the comb near the uninsulated wire at the top of the electroscope. Do not touch the wire with the comb!

9. Record what happens in your science journal.
10. Remove the comb and again record what happens in your science journal.
11. Repeat steps 8-11 using a balloon. Rub the balloon against your head five times and record your observations in your science journal.
12. Repeat steps 8-10, rubbing the balloon against your head ten times. Record your observations in your science journal.
13. Repeat steps 8-10, rubbing the balloon only once against your head. Record your observations in your science journal.

Conclusion:

1. If both icicles had a negative charge, what would happen?
2. Is there a difference in the distance the icicles moved apart from one another when the balloon or the comb was rubbed on the head a greater number of times?
3. What scientific generalizations can you make about how positive and negative charges relate to one another after conducting this investigation?

Extension
1. Investigate the following questions by first recording a prediction in your science journal:
    What happens when the comb actually touches the wire?
    What happens when you touch the exposed wire with your finger?
2. Try to charge other objects by rubbing them together. Bring the charged item next to the wire tip so that the icicles move apart.
3. Touch the wire with different objects (ex. Scissors, wooden spool, pencil) to see which objects conduct (transfer) the static electric charge and which items have no effect (insulate). Record your observations.

These experiments are from The NASA "Why?" Files. To download units and order video to use in the classroom, go to:

http://scifiles.larc.nasa.gov/.sed.

History of Electricity on the Web

Would you like to learn more about the scientists that are featured in ***Giants of Electrical Science***? The Internet is a great place to start. Here are some of the sites we visited while working on the show.

Overview of Electrical History:

www.ideafinder.com/features/smallstep/electricity.htm

Benjamin Franklin:

www.ushistory.org/franklin/ (An excellent site!)

http://sln.fi.edu/frankloin/rotten.html

www.school-for-champions.com/biographies/franklin2.htm

Alessandro Volta:

www.energyquest.ca.gov/scientists/volta.html

www.italian-american.com/volta.htm

www.ideafinder.com/history/inventors/volta.htm

http://scienceworld.wolfram.com/biography/Volta.html

Michael Faraday:

www.bbc.co.uk/history/historic_figures/faraday_michael.shtml

http://scienceworld.wolfram.com/biography/Faraday.html

www.rigb.org/rimain/heritage/faradypage.jsp

Thomas Edison:

www.americaslibrary.gov/cgi-bin/page.cgi/aa/edison

http://inventors.about.com/library/inventors/bledison.htm

www.thomasedison.com

http://sln.fi.edu/franklin/inventor/edison.html

Always Practice Internet Safety!

Please get permission before surfing the web. All of the sites listed were up and running at the time this list was made. They all presented material in a way that was appropriate for students. But, we do not have control over these sites or over their content. If you discover that any of these sites are inappropriate in any way, please protect yourself and other students by exiting the site immediately and then reporting the site to a teacher or another adult.

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