Teacher Resource Guide: Doktor Kaboom!

LIVE WIRE! The Electricity Tour

The lessons and activities in this guide are driven by the **Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects (2010)** which help ensure that all students are college and career ready in literacy no later than the end of high school. The College and Career Readiness (CCR) Standards in Reading, Writing, Speaking and Listening, and Language define general, cross-disciplinary literacy expectations that must be met for students to be prepared to enter college and workforce training programs ready to succeed.

21st century skills of creativity, critical thinking and collaboration are embedded in process of bringing the page to the stage. Seeing live theater encourages students to read, develop critical and creative thinking and to be curious about the world around them.

This Teacher Resource Guide includes background information, questions, and activities that can stand alone or work as building blocks toward the creation of a complete unit of classroom work.

cuyahoga arts & culture
50 years 1965-2015 Ohio Arts Council

The Ohio Arts Council helped fund this organization with state tax dollars to encourage economic growth, educational excellence and cultural enrichment for all Ohioans.

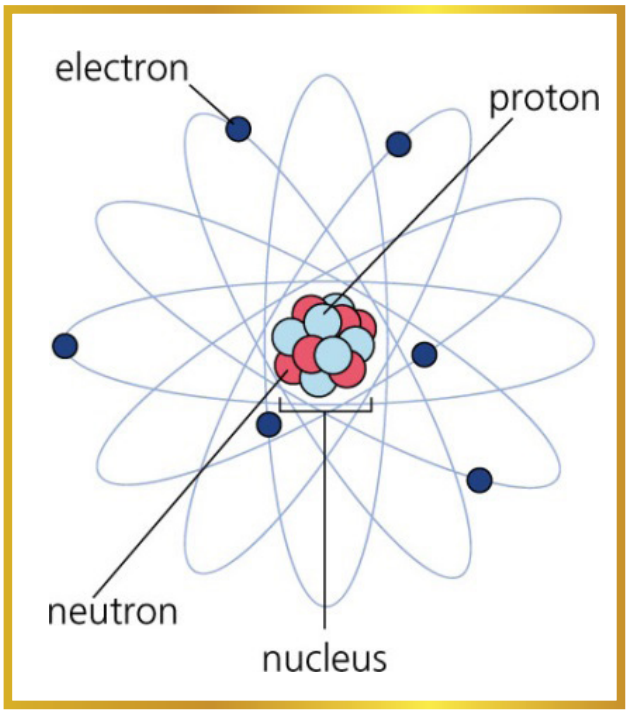
Playhouse Square is supported in part by the residents of Cuyahoga County through a public grant from Cuyahoga Arts & Culture.

ABOUT THE PERFORMANCE

Get ready to be electrified!

One Man and the Power (and Fun!) of Electricity!

Science is a blast, and nothing says scientific discovery quite like "kaboom." Get ready for a hilarious hour of electrical entertainment with Doktor Kaboom. Although this may be a "one-man show," Doktor Kaboom will ask for your help in this fun and funny exploration of electricity. Learn more here, and pay special attention to the bolded words, which you will hear on stage.



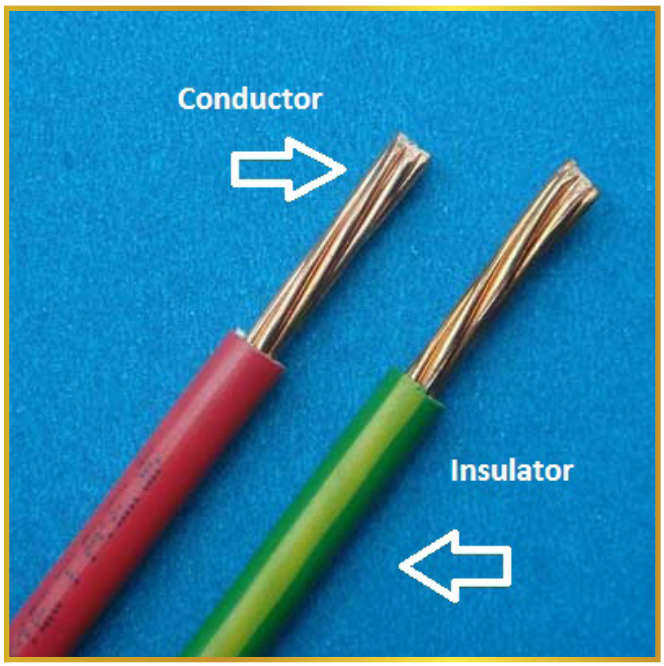
Those Crazy Electrons

Electricity begins with **atoms**. Everything is made of these molecules that are so small millions could fit on a tiny pinhead. **Protons**, **neutrons**, and **electrons** make up atoms - and how they play together is where things really get interesting. Protons have a positive **charge** and electrons have a negative one (the neutrons have no charge). Because opposite charges are drawn to each other, protons and electrons usually stay in the same atom. But sometimes electrons make a radical move to another atom… and kaboom! This is electricity. **Watch**…as Doktor Kaboom and audience volunteers test the idea that opposites attract.

On the Move

Electricity is all about movement. When you rub your shoes on the carpet on a dry winter's day and touch a doorknob, you get a little shock, right? That's because you picked up extra electrons that move when you touch something else. This is called **static electricity**. **Watch**…for Doktor Kaboom's hair-raising demonstration of static electricity.

Conductors (like metals) help electric charges move more easily. **Insulators** (like plastic) prevent charges from moving easily. **Grounding** removes a charge. The flow of electrons is called the **current**. In **direct current**, the charge moves in one direction. In **alternating current**, it moves back and forth. Machines called **generators** turn energy created by movement (such as wind turbines) into electricity. **Watch**…how Doktor Kaboom and friends turn riding a bike into a power-full experience.



It's a Gas!

Substances have four states – solid, liquid, gas (think ice, water, steam), and another gas-like state called **plasma** that conducts electricity (think lightning). **Watch**…when Doktor Kaboom tries a device that will use a flow of electric charge – called **electric discharge** – to make an **arc** (or current) of plasma in the air. As Doktor Kaboom says, what could possibly go wrong?

Electro-magnet-ificent!

Magnets (materials that can attract other items) have two opposite points – north and south **magnetic poles** – where the magnet's force is the strongest. This creates a magnetic field that can create electricity. **Neodymium** (pronounced neeoh-DIM-ee-uhm) magnets are among the strongest available. **Is it magic or**… electromagnetic? **Watch**…how Doktor Kaboom lights a lamp without touching it!

Know Your Electrical Measurements

You may hear Doktor Kaboom use these words as he performs his experiments:

- **Amps:** the number of electrons moving in a circuit (a closed loop)
- **Voltage:** the pressure pushing electrons along an electrical current
- **Watt:** a unit for measuring electric power
- **Frequency:** how fast sound or electromagnetic waves travel
- **Resistance:** how much a conductor slows the passage of current

ABOUT THE PERFORMER

Doktor Kaboom! is the creation of Actor/Comedian David Epley. David has been fortunate enough to discover two passions in his life. Science, his first, took him to studies at the North Carolina School of Science and Mathematics. His second, performing, became his career, and for more than 20 years David has made his living writing, performing and directing original interactive comedy across the US and internationally.

Since creating the character of Doktor Kaboom, science education has become David's life, taking him to theaters and schools all over the world. He has had multiple national television appearances, performances at the John F. Kennedy Center in Washington, DC, and at the World Science Festival and recently participated in a Global Online Town Hall hosted by former Vice President Al Gore.

David lives in Seattle, Washington, and is the proud papa of his daughter, Jindalee. He believes strongly in service, is a veteran of the US Army, and for five years volunteered as an EMT and firefighter with his local Fire/Rescue department.

PRACTICING SAFE SCIENCE

As Doktor Kaboom says, "Science can hurt you, especially if I'm the one doing the science." In working with electricity, he has to watch out for sparks, burns and fires. Even an expert experimenter can face unexpected dangers, so Doktor Kaboom suits up even if there's only the tiniest chance that it'll be necessary – and you should, too. And remember, you should only experiment with electricity with the help of a responsible adult.

Let's look at the gear that Doktor Kaboom wears to protect his body:

Goggles – to protect his eyes

Gloves – you guessed it – to protect his hands!

Lab coat with long sleeves covers his clothing and skin

Coming to the Theater

Playhouse Square is an exciting field trip destination! As the country's largest performing arts center outside of New York, the not-for-profit Playhouse Square attracts more than one million guests to 1,000+ performances and events each year. Playhouse Square thus acts as a catalyst for economic growth and vitality within the region. When you visit, be sure to note the GE Chandelier, the world's largest outdoor chandelier, and the retro Playhouse Square sign with its 9-foot-tall letters!

As audience members, you and your students play a vital role in the success of the performances. You are part of a community that creates the theater experience. For many students, this may be their first time viewing a live theater production. We encourage teachers to discuss some of the differences between coming to the theater and watching a television show, attending a sporting event or viewing a movie at the cinema. Here are a few points to start the discussion:

- Students are led into the theater and seated by an usher.
- Theaters are built to magnify sound. Even the slightest whisper can be heard throughout the theater. Remember that not only can those around you hear you; the performers can too.
- Appropriate responses such as laughing or applauding are appreciated. Pay attention to the artists on stage; they will let you know what is appropriate.
- There is no food, drink or gum permitted in the theater.
- Photography and videotaping of performances is not permitted.
- When the houselights dim, the performance is about to begin. Please turn your attention toward the stage.
- After the performance, you will be dismissed by bus number. Check around your seat to make sure you have all of your personal belongings.

An exciting destination for field trips and more!

Pre-Show Activities

IMPROVISATION

Improv Game: What Are You Doing?

David Epley, the creator of Doktor Kaboom, is both a scientist and an improvisational comedian. To improvise, one must be creative and able to think quickly on one's feet.

Goal: Students will practice these skills by playing the game 'What Are You Doing?' a game where you say one thing but do another.

Activity:

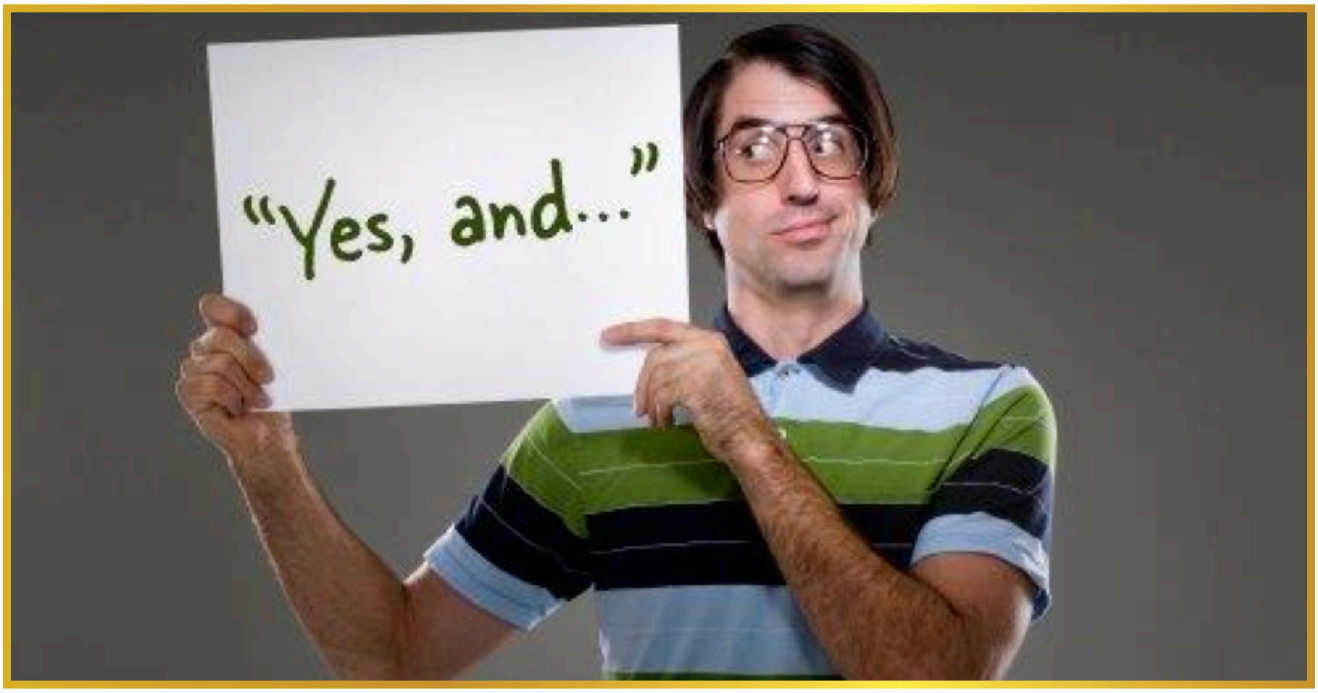
1. Have students stand in a circle.
2. To play, the first person pretends to do an action like brushing their teeth or planting a garden.
3. The person next to them then asks, "[Person's Name] What are you doing?"
4. The person who is pretending to do an action must respond by saying an action that is different than what they are showing. For example, they might say "I'm playing the trombone."
5. Then the person who asked must pretend to do the action that was just said (playing the trombone).
6. The next person then asks what that person is doing and he or she will reply with another action.
7. The game continues around the circle more than once.

Follow-up questions:

1. Did you find this challenge easy or hard? Why?
2. What was the most difficult part?
3. How could you connect the principles of this game to your daily studies?

Common Core/Ohio New Content Standards Connection

- ELA-Literacy.SL.3.1(4.1, 5.1, 6.1, 7.1, and 8.1) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.



Improv Game: Pass the Ball

Goal: Students will practice improvisational skills by playing the game 'Pass the Ball,' a game where participants pantomime throwing a ball.

Activity:

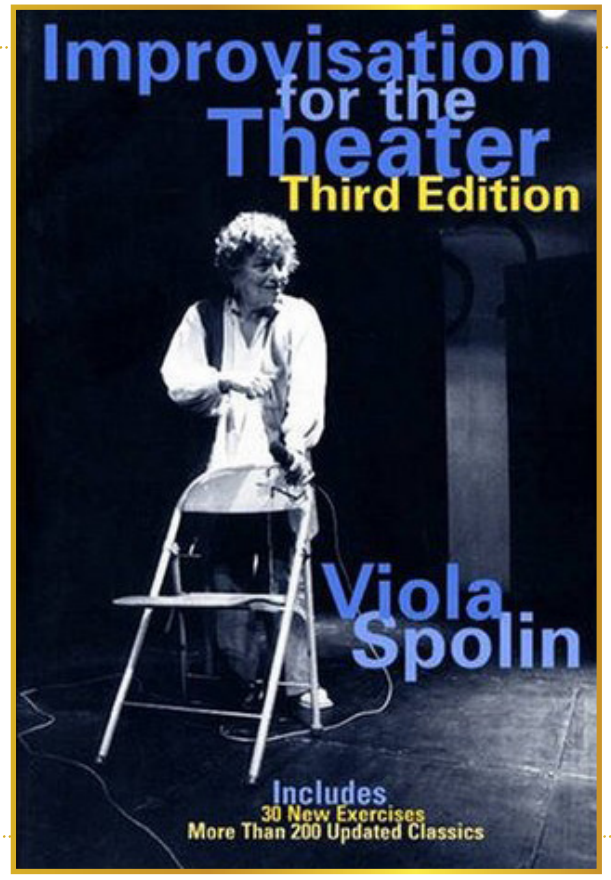
1. Have students stand in a circle.
2. Ask the players to pass a mimed ball to others (one ball at a time). To show who you are 'passing' the ball to, students should make eye contact with one another.
3. While the ball is passed between two students, the other students should be sure to watch it.
4. As students become comfortable, give suggestions about the nature of the ball. For example, it becomes heavier and heavier until it weighs a ton, or extremely light, extremely big, or extremely small.
5. The participants must convey the ball's characteristics in the way it gets passed.

Follow-up questions:

1. What sort of teamwork was needed to play this game?
2. How did you show that the ball was _____?
3. How do you think actor David Epley will use his body and voice to portray the character of Doktor Kaboom?

Common Core/Ohio New Content Standards Connection

- ELA-Literacy.SL.3.1(4.1, 5.1, 6.1, 7.1, and 8.1) Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.



Viola Spolin (November 7, 1906 – November 22, 1994) was an important innovator of the American theater in the 20th century. She created directorial techniques to help actors to be focused in the present moment and to find choices improvisationally, as if in real life.

She later called these acting exercises "Theater Games" and formed the first body of work that enabled other directors and actors to create improvisational theater. Her book, "Improvisation for the Theater," which published these techniques, includes her philosophy, as well as her teaching and coaching methods, and is considered the "bible of improvisational theater."

Spolin's contributions were seminal to the improvisational theater movement in the U.S. She is considered to be the mother of improvisational theater. Her work has influenced American theater, television, and film by providing new tools and techniques that are now used by actors, directors, and writers.

Make a Balloon Stick to the Wall Like "Magic"

GRADE BAND THEME: INTERCONNECTIONS WITHIN SYSTEMS
Physical Science (PS)
Topic: Matter and Forms of Energy
Content Statement (3): *Heat, electrical energy, light, sound and magnetic energy are forms of energy.*

Topic: Electricity, Heat and Matter
Content Statement (4): *Energy can be transformed from one form to another or can be transferred from one location to another.*

GRADE BAND THEME: ORDER AND ORGANIZATION
Physical Science (PS)
Topic: Conservation of Mass and Energy
Content Statements (7):

- *Energy can be transformed or transferred but is never lost.*
- *Energy can be transferred through a variety of ways.*

Topic: Forces and Motion
Content Statements (8):

- *Forces between objects act when the objects are in direct contact or when they are not touching.*
- *There are different types of potential energy.*

Ever see a balloon "magically" stick to the wall? Almost every adult tried the classic balloon-on-the-wall trick as a kid, but it never ceases to amaze children who see it for the first time. One of the original static electricity "magic" tricks, the classic experiment uses a balloon and a head full of static. Our updated version uses a piece of wool fabric instead so you're not left with a head full of tangled hair at the end. Try it with your kids and watch their eyes light up in wonder.

What You Need:

- 2 balloons
- Synthetic or wool fabric that can create a static charge (a wool sock is ideal)
- Scraps of material
- Dry day when there isn't too much humidity in the air

What You Do:

1. Blow up the balloons.
2. Get your child to charge one of the balloons with static electricity by gently rubbing the cloth against it.
3. Ask him to stick the charged side of the balloon against the wall. What happens?
4. Invite him to press the balloon against other surfaces, such as the refrigerator door, a cabinet or a chalkboard, to see if it will stick. He may need to charge the balloon again before doing this.
5. Now have him press it against the other balloon. Did they stick together?
6. Finally, ask him to charge the second balloon. Does he think the balloons will stick together now? Have him try it out.

What's Going On?

When your child rubbed the cloth against the balloon he gave it a negative charge known as static electricity. If there is enough of a charge, the balloon will stick to surfaces that are neutrally charged, such as a wall, by attracting the positive charge in the wall to the surface. Since the balloon is so light, this attraction is strong enough to cause the balloon to stick to the wall.

If left on the wall, eventually the balloon will fall to the ground. Why? Static charge dissipates over time, so eventually the balloon loses its negative charge and unsticks from the wall.

A charged balloon sticks to an uncharged balloon just like a charged balloon sticks to the wall. When both balloons are charged, however, they push away from each other since two negative charges repel each other.

Make Your Own Electricity

GRADE BAND THEME: ORDER AND ORGANIZATION

Physical Science (PS)
Topic: Matter and Motion
Content Statements (6):

- *All matter is made up of small particles called atoms.*
- *Changes of state are explained by a model of matter composed of atoms and/or molecules that are in motion.*
- *There are two categories of energy: kinetic and potential.*

Topic: Conservation of Mass and Energy
Content Statements (7):

- *The properties of matter are determined by the arrangement of atoms.*
- *Energy can be transformed or transferred but is never lost.*
- *Energy can be transferred through a variety of ways.*

By sixth grade, your students will have learned about atoms. They're the smallest particle of a chemical element that can take part in a chemical reaction without being permanently changed. They're also made up of protons and neutrons in a central nucleus surrounded by electrons. Sound familiar?

Sometimes, a large number of atoms in an object will gain or lose electrons (negatively charged subatomic particles that are found at varying distances from an atom's nucleus). When this happens, the entire object takes on an electric charge. The term static electricity describes situations where objects carry electric charge. And by using static electricity generated from her body, a child can cause a small fluorescent lamp bulb to light up!

What You Need:

- Plastic comb
- Small fluorescent lamp

What You Do:

Step 1
Ask your child to rub a comb through her hair. The friction between her hair and the comb will cause electrons to "jump" from her hair to the comb.

Step 2
If your child then touches the comb to the end of a fluorescent light bulb, the charged comb will discharge into the light bulb causing the bulb to emit small pulses of light. This action will generate a great deal of excitement especially if conducted in a darkened room.

What Happened?

More than likely your students will want know why this happens. Tell them that static electricity occurs, for example, when you rub a balloon on a shirt (you might wish to actually try this). The friction between the cloth and the balloon causes negatively charged particles (electrons) to transfer from the shirt to the balloon. The shirt then has an overall positive charge because it has more protons than electrons. The balloon takes on a negative charge because it has extra negative charges (electrons). The balloon will then stick to the shirt or to another surface, such as a wall.

Static electricity has many uses in homes, businesses and industries. For example, the copying machines found in most offices are electrostatic copiers. They make duplicates of pictures or written documents by attracting negatively charged particles of toner (powdered ink) to positively charged paper.

http://www.scienceinabag.com

Post-Show Activities

DOKTOR KABOOM'S BIG IDEAS

Big Idea #1: Safe Science

As Doktor Kaboom says, "Science can hurt you, especially if I'm the one doing the science." He has to watch out for splashes of chemicals, or very hot or cold liquids. Even an expert experimenter can face unexpected dangers, so Doktor Kaboom suits up even if there's only the tiniest chance it will be necessary.

Goggles: Much as they do for swimmers, goggles protect scientists' eyes.

Lab Coat: Long sleeves cover Doktor Kaboom's clothing and his skin.

Gloves: Gloves protect Doktor Kaboom's hands.

What do you think?

- Why should we always practice safe science?
- If you are going to do an experiment or demonstration, and you already know you won't need safety glasses, why should you wear them?

Common Core/Ohio New Content Standards Connection
- K-4, 5-8 Science Inquiry and Application
- Math.Practice.MP5. Use appropriate tools strategically.

Big Idea #2: Scientific Fact

One of the things that Doktor Kaboom always likes to say is that "There is no such thing as a scientific fact."

We call gravity a scientific fact, when in reality, there is no such thing. We assume gravity will work as we expect, simply because it always has. Gravity has worked so far. There is always a possibility that some time in the future, it will behave differently. We must remember to keep an open mind. Sometimes a 'scientific fact' is falsified by newer and better science. That's how science works.

What do you think?

- Do you agree with Doktor Kaboom that there is no such thing as scientific fact?
- Can you think of examples of scientific theories that people once believed were true that have been proven false with newer and better science?

Common Core/Ohio New Content Standards Connection
- K-4, 5-8 Science Inquiry and Application
- Math.Practice.MP1. Make sense of problems and persevere in solving them.
- Math.Practice. MP3. Construct viable arguments and critique the reasoning of others.

Big Idea #3: Being Right

When we have an idea in science, we call it a theory. We test our theory with experiments.

What do you think?

- Does it matter in science whether we are right or wrong?

Common Core/Ohio New Content Standards Connection

- K-4, 5-8 Science Inquiry and Application
- Math.Practice.MP3. Construct viable arguments and critique the reasoning of others.
- Math.Practice.MP7. Look for and make use of structure.

Big Idea #4: Science is for Everyone!

Doktor Kaboom believes it is important to remember that science is not just for people in lab coats or the science fair winners. He believes that science is for everyone, and encourages young people to never lose their love and interest for science.

Common Core/Ohio New Content Standards Connection

- K-4, 5-8 Science Inquiry and Application

Critical Response Questions

Students develop their comprehension when they reflect upon what they wondered about, noticed and felt. Ignite a classroom discussion with the following critical thinking questions:

When the performance began, what did you observe to determine how the Doktor Kaboom character comes to life?

- What simple acting techniques did he use?
- How did he get the audience involved?
- How did he use improv during his performance?

As the show developed, think about the actual science that was being demonstrated on stage:

- What science vocabulary does Doktor Kaboom use during each experiment?
- What precautions does he take?
- How can the experiments be applied in real life?

ELECTRIC SCIENCE: Make a Battery!

GRADE BAND THEME: INTERCONNECTIONS WITHIN SYSTEMS
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Content Statements (7):

- *Energy can be transformed or transferred but is never lost.*
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Since they were toddlers, your students have probably gotten a big kick out of anything electric. Even two-year-olds can figure out, for example, that if you push the switch on that flashlight, you can make a bright light, not to mention the delights that come from a battery in your toy truck or train. But as students learn the science behind everyday experiences (along with more complex electronic experiences), they will learn more technical and scientific concepts as they explore the "why" behind the electricity.

Here's an experiment using simple household items to replicate discoveries that were first made centuries ago by the great Italian scientist Alessandro Volta (if the last name "sparks" a memory of a certain electrical term, you're right!). This is a great way to get even the most reluctant of students excited about electricity science! Don't worry - there are no explosions in this experiment, but you can expect some delightfully "shocking" results.

What You Need:

- 1/3 cup lemon juice
- 9 pieces of paper towel, each 1"x 1" in size
- 5 shiny, clean pennies
- 5 zinc-coated washers, about 3⁄4 inches in diameter (available at hardware stores)

What You Do:

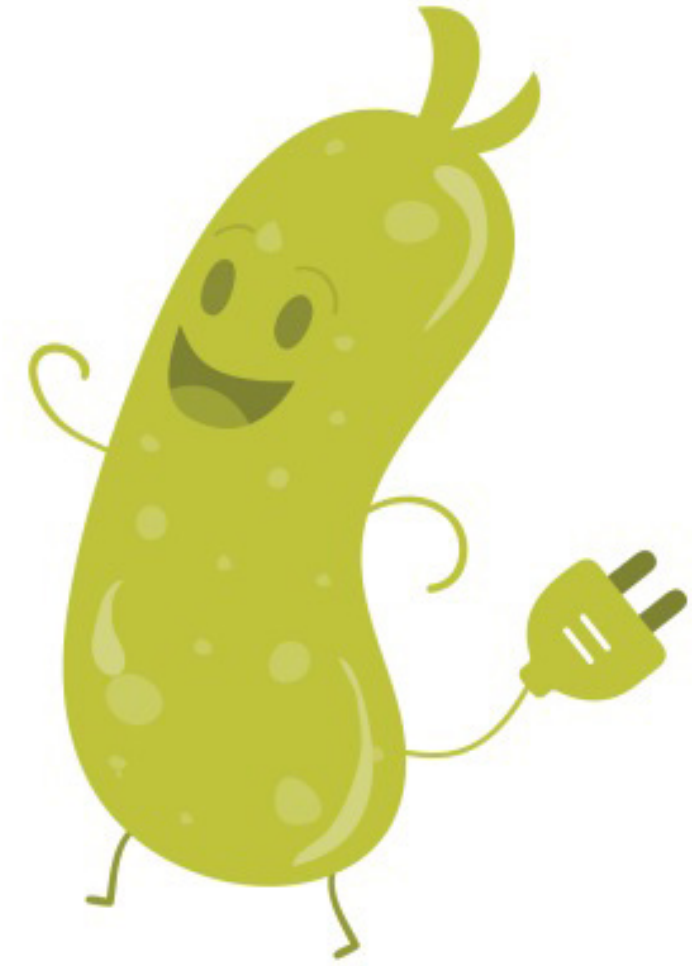
1. Explain that you will be doing an experiment to find out what happens inside a battery to make it work, and you'll do it by combining pennies, zinc washers and lemon juice. Sound weird? Students just need follow directions closely, and be ready to explore some new things while they're at it!
2. If you haven't done so already, cut the paper towels into 1" x 1" pieces, and soak your nine pieces thoroughly in the lemon juice, so that no part of the towel is dry.
3. Put one washer on a clean surface. Have students place a paper towel square over it, and then place a penny over that. Help them to alternate this way, with a paper towel piece between each coin or washer, until you have used all nine pieces.
4. Now make sure students' thumbs and middle fingers are wet, either with lemon juice or water. Have students pick up the stack using their thumb and middle finger, making sure that their fingers are touching metal, not paper towel.
5. They have just made a battery and their fingers are what completed the circuit! You can measure the mild electric charge by using a voltmeter (a battery tester), and putting each prong on one side of the stack. Or take a page from Volta's notes: according to his findings, students should feel a tingle in their fingers when they hold that stack!

What's Happening?

You've just replicated the basic workings of a battery, which actually consists of two different metals surrounded by strong acid. One of the metals has a negative charge, and one has a positive one. When your students used moistened fingers to pick up the coin stack (with a washer on one end and a penny on the other), they completed a "circuit," - a mild version of what happens when a battery powers a flashlight, radio or computer game!

ELECTRIC PICKLE

You saw the electric pickle during LIVE WIRE!... but did you ever stop to think about how cool it is?!? The conductivity of one little pickle can also illuminate a light bulb! Just connect the sensors with your favorite salty pickle and you'll see an awesome current of electricity. Plus, you'll cook the pickle at the same time... hey, sometimes science and cooking just go together.



Materials

- Pickles, the variety that are soaked in salt water
- Light bulb
- Electric circuit
- Power strip

Experiment

- Set up an electric circuit for the demonstration.
- Once you have your electric circuit set up, you will find that the light bulb will not light until the pickle completes the circuit. In other words, just plugging in the cord won't do the trick. You have to use the pickle to close the circuit.
- When the pickle is in place the light bulb will light up. Remove the current running to the light bulb and the pickle will light up! Take the pickle off the sensors and you will find a cooked pickle.

MAKE SURE THAT THE POWER STRIP WITH THE LIGHT BULB PLUGGED INTO IT IS ALWAYS TURNED OFF WHEN YOU PLACE AND REMOVE THE PICKLE FROM THE CIRCUIT.

How Does It Work?

The pickle is a great conductor of electricity in this experiment because it was soaking in salt water. Pickles are packed in salt water as part of the pickling process, and conveniently for the kitchen scientist, salt conducts electricity. The light bulb will not power until the pickle is in place because the electrical circuit is not complete. The pickle will light up on its own, without the light bulb, because the salt is such a great conductor!

See more at: http://www.stevespanglerscience.com/lab/experiments/electric-pickle#sthash.ZvjILtJJ.dpu

CAREERS IN SCIENCE

Many students do not realize the spectrum of careers that exist in the field of science. Scientists not only work in labs, but employ science in their everyday lives. From doctors to zoologists, forest rangers to chemists, scientists are everywhere!

Science is generally divided into three categories: biology, chemistry and physics. Many science careers cross over and are interdisciplinary, for example, a biochemist. Additional areas of science include computer and mathematics.

Have students research careers in the field of science.

1. Tell students they are going to be "Scientists for a Day!" The question is which type of scientist will they be?
2. Share the main areas into which science careers are generally divided: biology; chemistry; physics; mathematics and computers.
3. Have students brainstorm careers that fall within each category.
4. Help students by adding a few additional careers so each column is fairly even.
5. Next, schedule computer time for students to conduct research. The links below will help to get you started.
6. Once research is complete, have students share their findings with the class.
7. As an extension, have students vote on which career is the most appealing to them and chart the results.

Science Career Websites

Scientists at the Smithsonian
http://www.smithsonianeducation.org/scientist/index.html

Careers in Food Science for Kids
http://www.ehow.com/list_7270675_careers-food-science-kids.html

Agriculture and Food Scientist
http://www.bls.gov/k12/nature05.htm

Botanist at Yosemite National Park
http://www.nps.gov/yose/naturescience/botanist-film.htm

Landscape Architect
http://www.bls.gov/k12/nature02.htm

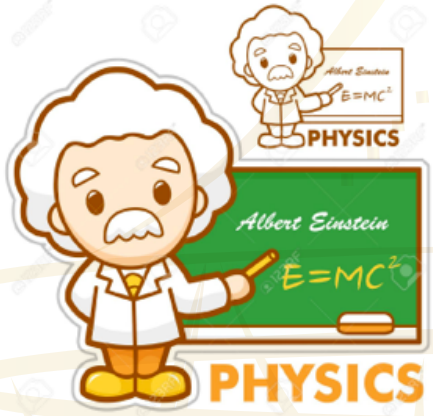
Oceanographer
http://oceanservice.noaa.gov/facts/oceanographer.html

Astronaut
http://starchild.gsfc.nasa.gov/docs/StarChild/space_level2/astronaut.html

Animal Keeper at the National Zoo
http://www.kids.gov/video/animal_keeper.shtml

Marine Biologist
http://forces.si.edu/elnino/science_2.html

Research Chef
http://www.bls.gov/opub/ooq/2002/fall/yawhat.htm



RESOURCES

Books

The Boy Who Harnessed the Wind: Young Readers by William Kamkwamba (Author), Bryan Mealer (Author), Anna Hymas (Illustrator), Dial Books Publisher, February 5, 2015.

Charged Up: The Story of Electricity (Science Works) by Jacqui Bailey (Author), Matthew Lilly (Illustrator). Picture Windows Publishing, January 1, 2004

Energy Island: How one community harnessed the wind and changed their world by Allan Drummond (Author, Illustrator) Square Fish Publishing, March 24, 2015.

Energy Makes Things Happen (Let's-Read-and-Find-Out Science 2) by Kimberly Brubaker Bradley (Author), Paul Meisel (Illustrator). HarperCollins Publisher, December 24, 2002

Ready, Set, SCIENCE!: Putting Research to Work in K-8 Science Classrooms by Sarah Michaels, Andrew Shouse and Heidi Schweingruber. National Academies Press, 2007.

Science Experiments You Can Eat: Revised Edition Paperback by Vicki Cobb (Author) and David Cain (Illustrator). HarperCollins; Rev Upd edition, 1984.

Science in Seconds for Kids: Over 100 Experiments You Can Do in Ten Minutes or Less Paperback by Jean Potter. Jossey-Bass, 1st Edition, 1995.

Secrets of Mental Math: The Mathemagician's Guide to Lightning Calculation and Amazing Math Tricks by Arthur Benjamin and Michael Shermer. Three Rivers Press, 2006.

The Everything Kids' Astronomy Book: Blast into outer space with stellar facts, intergalactic trivia, and out-of-this-world puzzles by Kathi Wagner and Sheryl Racine. Adams Media, 2008.

Theater Games for the Classroom: A Teacher's Handbook by Viola Spolin. Evanston, IL: Northwestern University Press, 1986.

TIME For Kids Big Book of Science Experiments: A step-by-step guide Hardcover by Editors of Time for Kids Magazine. Time for Kids, 2011

What Is Electricity? (Rookie Read-About Science) by Lisa Trumbauer (Author). Children's Press Publishing, September, 2004.

Web Links for Students and Teachers

Doktor Kaboom! Official Website: www.doktorkaboom.com

Below is a round-up of some wonderful educational YouTube channels for Math and Science teachers. These channels are taken from a long list that comprises more than 170 YouTube channels:

http://www.educatorstechnology.com/2013/12/top-youtube-channels-for-science-and.html

The Lawrence Hall of Science 24/7
http://www.lawrencehallofscience.org/kidsite/

Ecology Project
http://www.ecologyproject.org

Ed Heads
http://edheads.org/

The Electricity Book
http://www.bgfl.org/

The Franklin Institute
https://www.fi.edu/

Learn about Lightning

Learn all about lightning and how it relates to static electricity here.

http://www.weatherwizkids.com/lightning1.htm

Learning Science
http://www.learningscience.org/

The National Science Digital Library
https://nsdl.oercommons.org/

Science Buddies
http://www.sciencebuddies.org/

Science in a Bag
http://www.scienceinabag.com

Society for Science
https://student.societyforscience.org

Science Fair Central
http://school.discoveryeducation.com/sciencefaircentral/

Understanding Science
http://undsci.berkeley.edu/

RESOURCES

Apps for Students

Electricity for iPad

Kids will dive into the amazingly complex world of electricity, as they learn all about the flow of electrons, static vs. dynamic energy, and meet figures like Ben Franklin and Nikola Tesla.

Meet Science for iPad

'Meet Science' inspires all school-aged kids to explore fundamental concepts of Magnetism and Electricity (1st Edition) with variety of fun features such as animations, experiments, and mini-games.

Android 4.0 and above, Movin'App, free

Containing thousands of facts, Amazing Science Facts gives you the chance to learn new information about any area of science that interests you. You can receive daily facts wherever you are – the app requires no Wi-Fi, even functioning on airplane mode. You can search specific topics and share your favorite facts by email, Facebook and Twitter.

Android 2.1 and above, JD Star, free

Filled with facts and definitions, Science Bank allows you to explore the worlds of biology, chemistry, physics, space and the environment. The app contains galleries of photographs and diagrams, bringing the facts to life. You can also save your favourite facts and pictures to return to later, even adding your own.

Android 4 or later, NASA, free

Ever wanted to see what NASA is up to, right from your phone? With a growing collection of over 14,000 images and videos, you can see what's happening in space, keeping your eye on current NASA missions and news. The app also features launch and mission information, a live stream of NASA TV, and it connects to Facebook and Twitter, for easy sharing of exciting information.