Electricity & Circuits

Teacher Lesson Plan

Background Information

Electricity is moving electrons.

- Atoms are the building blocks of the universe. Electrons are tiny particles found in atoms.
- The center of an atom is called the nucleus, made of particles called protons and neutrons.
- Electrons are constantly spinning and moving in levels around the nucleus.
- In the past 200 years, many people have contributed knowledge about the properties of electricity.
- This has led to the many inventions using the power of electricity to do work and make life more comfortable.
- Electricity is a secondary form of electricity. It can be transformed from other forms such as coal, petroleum, natural gas, biomass and nuclear energy. Moving wind and water as well as the heat from geothermal energy, can power a generator to produce electricity. Photovoltaic cells transform light energy from the sun to electricity.

Circuits

- Electrons flowing through a wire make a complete path, called a circuit.
- Our electric grid produces alternating current (AC).
- A battery produces electricity, but only when it is part of a circuit.
- A battery produces direct current (DC).
- When a switch is open no electricity flows or makes a complete path. When a circuit is closed, electrons can flow freely.
- Different materials are conductors of electricity. Silver is the best electricity conductor, but it isn't widely used due to its cost. Copper is the metal used in most homes' electrical systems.
- Some materials do not conduct electricity or resist the flow of electricity. These are called insulators.

Student Activities

LESSON 1: Open & Closed Circuits

- Materials-Energy Batons
- Form a circle and hold the wrist or touch fingers of the students beside you. Students need to be touching skin, not clothes. Two people will hold the metal electrodes on the ends of the Energy Baton.
- The baton will light up and make a sound when everyone is touching. This represents a **closed circuit** - everyone is touching which allows a pathway for the electrons to flow.

- Now, two students release their hands. This represents a **switch**. The Baton will not light up or make sounds. This is an **open circuit.**

LESSON 2: Electricity Conductors and Insulators

- Materials: Energy Batons, Samples of Insulations & Conductors
- Student Worksheet: Electricity Insulators & Conductors
- Repeat the exercise above, but now add in samples of insulators and conductors. Have two students opposite of the Baton each hold one end of a insulator/conductor sample.
- If the material is a conductor of electricity, it will complete the circuit and the bulb will light.
- If the material is an insulator, it will not close the circuit and the Baton will not light up.
- Students will discover metals are the best conductors of electricity. Water also conducts electricity.
- Conductors and insulators are topics in both electricity and thermal energy. Conductors always allow energy to transfer easily. Insulators always resist the transfer of energy. However, the materials for electric and thermal energy conductors and insulators may vary.

Answers to Student Worksheet:

Electricity Conductors: **metal spoon, aluminum foil, paper clip, water**
Electricity Insulators: **straw, plastic spoon, paper, chopstick, glass, fabric, rubber tire**

LESSON 3: Series & Parallel Circuits

- Materials: Snap Circuit Sets
- See separate series and parallel circuit instruction page.

LESSON 4: Snap Circuits

- Materials: Snap Circuit Sets *Teacher note: you may want to take a picture of the pieces before taking anything out of the box so students can return pieces to the proper space.*
- Use the Snap Circuit sets to discuss open/closed circuits and that electricity can be transformed into light, sound, motion and heat. Series and Parallel circuits can also be discussed.
- The Project Guide in each kit provides the directions for each circuit.

LESSON 5: Electricity and Literature

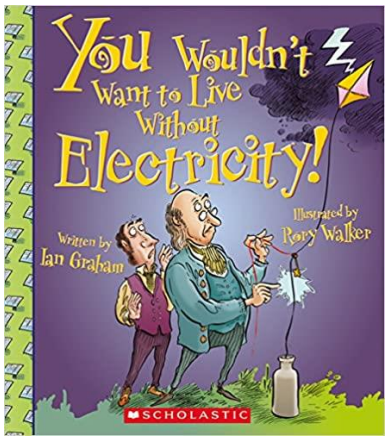
Teacher Note: Electricity activities may be used in any order. The literature and timeline activities could be done first, last or interspersed between the energy baton or snap circuits lessons.

Objectives:

1. Many of the items that we use in our daily lives and in our homes are powered by electricity.
2. Many people have contributed to discoveries concerning electricity.

3. There are two types of electricity: static and current.
4. Electricity is a secondary energy source that can be transformed from other sources, typically with a generator.

Book: *You Wouldn't Want to Live without Electricity!*
by Ian Graham



Key Vocabulary:

- Electric Circuit – A path around which an electric current flows.
- Electric Current – A flow of electrically charged particles.
- Electron – A negatively charged particle. A flow of electrons forms an electric current.
- Turbine – A disk or drum with blades, like a multi-blade propeller, that spins when a liquid or gas flows through it.

Book Talk:
Many of you have heard of the story of Benjamin Franklin flying a kite during a lightning storm. That's not a great idea. It's surprising he wasn't electrocuted! So how did people find out about electricity? What's the difference between static electricity and current electricity? Our knowledge of electricity changed over time with many discoveries allowing us to design inventions to help make our lives easier. Let's read the book, *You Wouldn't Want to Live without Electricity!* to learn about this amazing energy source.

Read *You Wouldn't Want to Live without Electricity!*

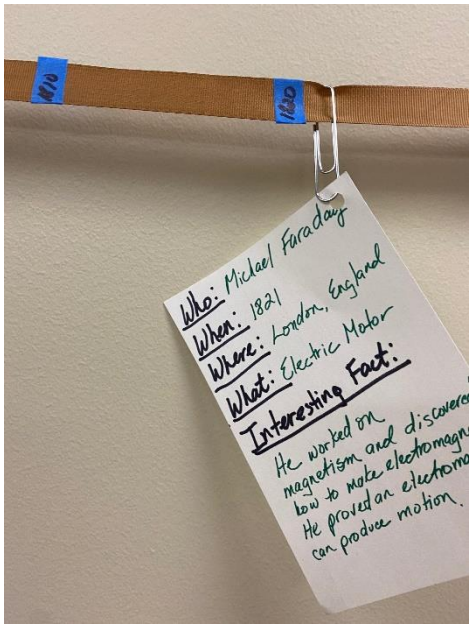
- Before reading the book, pass out student discussion guide to students. Have students pre-read the questions to get an idea of what they should be listening for while you read.
- While reading book, students answer discussion questions.
- Give time to complete questions after reading.
- Discuss answers to questions.
- Additional Ideas for Discussion Questions:
    - If the entire page of questions is too much for your students, consider breaking up the questions, assigning each student 1-2 questions to answer while you read.
    - When you are done reading have students find someone with the SAME question and meet to discuss their answers, looking for similarities and differences in their thinking
    - Likewise, you may choose to have students find someone with a DIFFERENT question and meet to share their answers.

LESSON 6: History of Electricity Timeline

Background:
A timeline is a tool that allows students to visualize a sequence of events. In this activity, it allows them to see that scientific ideas and discoveries are based on the work of previous scientists. Each scientist takes an idea or a tool/product and expands or refines it.

Classroom Timeline Procedure:

1. Explain to students that a timeline is a picture of a series of events. It is a history of how something changed overtime.
2. As a preview, students could do a timeline of their life. On a piece of paper, have them draw a line. The length should be one inch for each year of their life. Mark the inches. Have them write something that happened in their life each year.
3. Using the student worksheet, assign person/event/discovery to each student or student pair.
4. Students will research and complete the information card. The book is the primary source for the information. However, students may use additional resources if time allows.
5. Prepare a class timeline. It can be done with masking/painting tape, twine, rope, or ribbon etc.
    - *Teacher Note: Using twine, rope or ribbon with the decades marked in tape will be reusable year after year*.
    - You should have a minimum of 3.5 meters if spacing each decade 10 centimeters apart.
    - If using feet, you need 25 feet if spacing 10 inches apart.
    - Leave about 20 centimeters blank in the beginning. (Ancient Greeks can be placed there).
    - Mark off decades beginning with 1740. Continue until you run out of room.
    - Leaving space at the end will allow students to add some of their favorite inventions such as the first video game (Willem Higinbotham -1958) or first LED (Nick Nolonvak Jr.-1962.) If you Google *electricity timeline*, you can find many other suggestions.
    - Students can incorporate social studies into the activity by including current world/US events on their timeline card and/or include the President of the United States when their inventor lived or other important Ohio, US or World current events.
6. Have students line up according to year. Each student/pair will then read their card to the class and place it on the class timeline in the appropriate place. Use tape, paperclips or clothes pins.
7. When all students have placed their cards on the line, discuss what they observe.
8. Have them hypothesize what discoveries they might envision to put on the timeline in the future.



Person/Discovery/ Event	Date	Additional Resources
Static Electricity	Ancient Greece – about 500 BC	https://www.coolkidfacts.com/static-electricity-for-kids/
James Watt	1776	https://kidskonnect.com/people/james-watt/
Benjamin Franklin	1762	Website: Franklin flies kite in thunderstorm https://www.history.com/this-day-in-history/franklin-flies-kite-during-thunderstorm https://www.fi.edu/benjamin-franklin/kite-key-experiment
Michael Faraday	1821	https://www.dkfindout.com/uk/science/famous-scientists/michael-faraday/
Hippolyte Pixii	1832	http://ffden-2.phys.uaf.edu/webproj/212_spring_2017/Jacalyn_Morgan/1775941155590410311e3ae/who-invented-alternating-current.html
Thomas Edison	1877	https://www.dkfindout.com/uk/science/famous-scientists/thomas-edison/
First Earth Day	1970	https://www.parents.com/fun/parties/special-occasions/fun-facts-about-earth-day/
First public power station was built	1882	https://easyscienceforkids.com/best-hydropower-facts-video-for-kids/
Alessandro Volta	1800	https://www.dkfindout.com/uk/science/electricity/batteries/
Leyden Jar	1745	YouTube: Science with a Leyden Jar https://www.youtube.com/watch?v=spuXN0ccRQ8
Hans Christian Oersted	1820	https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/section/22.2/primary/lesson/discovery-of-electromagnetism-ms-ps
Andre-Marie Ampere	1827	https://kidskonnect.com/people/andre-marie-ampere/
J.J. Thomson	1897	https://wiki.kidzsearch.com/wiki/J._J._Thomson
James Clerk Maxwell	1865	https://kids.kiddle.co/James_Clerk_Maxwell
Industrial Revolution (connection to electricity)	1760 to 1840	https://www.ducksters.com/history/us_1800s/inventions_technology_industrial_revolution.php https://owlcation.com/humanities/12-Facts-on-the-Industrial-Revolution
First photovoltaic cell (solar panel)	1954	https://www.ducksters.com/science/environment/solar_power.php