Electric Circuits

Connecting Learning and Standards

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Electric Circuits
Concepts, Curriculum and ELA

How can observations provide evidence that energy in the form of electricity can produce light, heat, and other forms of energy? In this unit, students investigate electricity by building circuits with wires, bulbs, batteries and switches and by making observations about the results. The hands-on activities are a springboard for illustrating that electric circuits require a complete loop through which an electrical current passes. From the initial investigations, students expand their understanding to include types of circuits, circuits made from different materials and in different combinations.

Electric currents transfer energy from place to place. The energy can then be used locally to produce motion, sound, heat, or light. The currents may have been produced by an initial transfer from the energy of motion into electrical energy. This unit contributes to the students' knowledge of conservation of energy and transfer of energy.

Central to the activities and learning are the skills necessary to communicate concepts in the unit. Predicting, observing, describing, recording results, and drawing conclusions are all part of the process. In addition to building circuits and troubleshooting designs, students communicate ideas through writing, drawing and discussion.

Safety rules for working with electricity are embedded in the unit along with reading to promote an interest in electricity and its multiple applications.

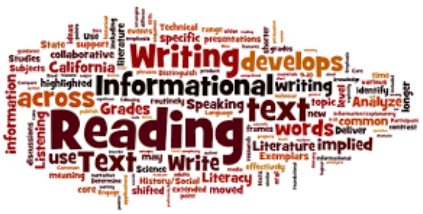
Safetymatters

Concepts

- A complete electrical circuit is required to light a bulb
- Complete circuits can be built in more than one way using the same materials
- Different types of electrical circuits show different characteristics
- A switch can be used to interrupt or complete a circuit
- Materials that conduct electricity are called conductors. Non-conductive materials are insulators
- Electricity can produce light, heat and magnetism through the transfer of energy
- A diode conducts electricity in one direction only

ELA Companion Resource

The Common Core asks students to read stories and literature, as well as more complex texts that provide facts and background knowledge in areas such as science and social studies. Students will be challenged and asked questions that push them to refer back to what they've read. This stresses critical-thinking, problem-solving, and analytical skills that are required for success in college, career, and life.[1]



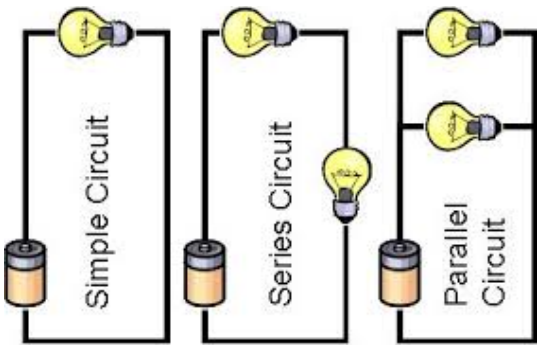
The ELA Companion Resource provides literature and activities that can be incorporated in the Electric Circuits unit. Read-Aloud books, shared reading, and guided reading books are included to provide a balanced literacy framework. Within the framework are assessment activities to inform instruction using reading, writing, listening, speaking, and a range of vocabulary reinforcement strategies. This includes:

- Anticipation Reading Guide
- Before, During, and After guided reading strategies
- Guided reading leveled books
- Word Study activities
- Discovery card extended response activities

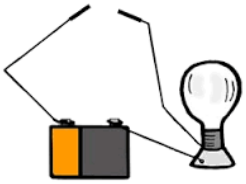
Electric Circuits - Students learn the basic properties and uses of electricity by doing a variety of activities culminating with the design, construction and wiring of a cardboard house.

Electric Circuits ELA Companion - ELA Companion kit to the Electric Circuits unit. "When building a house, would you use a series or parallel circuit?"

Suggested Grade Placement: 4-5 **Scheduling: 6-8 weeks**

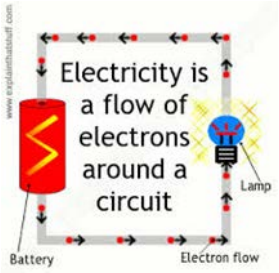


[1] http://www.corestandards.org/ELA-Literacy/ Accessed October, 2015



Common Core State Standards Connections Grade 4

ELA/Literacy – Grade 4		Electrical Circuits
RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.	Think critically and logically to make the relationships between evidence and explanation
RI.4.3	Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.	Communicate scientific procedures and explanations
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably	Guided reading, shared reading, extended response activities
W.4.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.	Develop descriptions, explanations, predictions and models using evidence
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.	Use equipment and tools to gather data and extend the senses
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.	Use data to construct a reasonable explanation Communication investigations and explanations
W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.	Work in teams to solve problems and contribute to results



New York State Standards Connections

Elementary Science Core Curriculum

Key Idea 4: Energy exists in many forms, and when these form changes, energy is conserved.

Students should understand that energy exists in a variety of forms. Students should observe the results of simple energy transformations from one form to another in their physical environment. The safe use and respect of various energy forms should be stressed in the classroom.

NYS Science Standard		Electrical Circuits
Performance Indicator 4.1 Describe a variety of forms of energy (e.g., heat, chemical, light) and the changes that occur in objects when they interact with those forms of energy.	4.1a Energy exists in various forms: heat, electrical, sound, chemical, mechanical, light 4.1b Energy can be transferred from one place to another 4.1c Some materials transfer energy better than others (heat and electricity) 4.1d Energy and matter interact: Water is evaporated by the Sun's heat; a bulb is lighted by means of an electrical current; a musical instrument is played to produce sound; dark colors may absorb light, light colors may reflect light. 4.1e Electricity travels in a closed circuit 4.1g Interactions with energy can be either helpful or harmful.	Electricity in circuits can generate energy in the form of light Electricity can produce light, heat, and magnetism Materials that conduct electricity are called conductors. Non-conductive materials are insulators Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. Electrical circuits require a complete loop through which an electrical current passes Safety rules are necessary for working with electricity

ENERGY

PS3.A: Definitions of Energy
PS3.B: Conservation of Energy and Energy Transfer
PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

Next Generation Science Standards		Electric Circuits
4-PS3-2.	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*]	Students use equipment and devices to build an electrical circuit to light a bulb Different circuit components can be added and arranged in different ways to produce different results and build a variety of electrical devices and systems Experiment with a semiconductor diode to explore the direction of electron flow
4-PS3-4.	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another. [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [*Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.*]	Students design plans for wiring a model house Apply troubleshooting strategies to complete an incomplete circuit Investigation of parallel and series circuits identifies the properties of each type. Circuit testers and problem solving techniques are used to determine hidden wiring patterns in an enclosed box

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)
- Apply scientific ideas to solve design problems. (4-PS3-4)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.

- Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)

Disciplinary Core Ideas

PS3.A: Definitions of Energy

- The faster a given object is moving, the more energy it possesses. (4-PS3-1)
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3)

PS3.B: Conservation of Energy and EnergyTransfer

- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2), (4-PS3-3)
- Light also transfers energy from place to place. (4-PS3-2)
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4)

Crosscutting Concepts

Energy and Matter

- Energy can be transferred in various ways and between objects. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4)

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)

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Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1)

Influence of Engineering, Technology, and Science on Society and the Natural World

- Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)
- Engineers improve existing technologies or develop new ones. (4-PS3-4)

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Connections to Nature of Science

Science is a Human Endeavor

- Most scientists and engineers work in teams. (4-PS3-4)
- Science affects everyday life. (4-PS3-4)

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*

Articulation of DCIs across grade-levels:
K.PS2.B (4-PS3-3); **K.ETS1.A** (4-PS3-4); **2.ETS1.B** (4-PS3-4); **3.PS2.A** (4 -PS3-3); **5.PS3.D** (4-PS3-4); **5.LS1.C** (4-PS3-4); **5.ESS3.C** (4-ESS3-1); **MS.PS2.A** (4-PS3-3); **MS.PS3.A** (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4); **MS.PS3.B** (4-PS3-2),(4-PS3-3),(4-PS3-4); **MS.PS3.C** (4-PS3-3); **MS.PS3.D** (4-ESS3-1); **MS.PS4.B** (4-PS3-2); **MS.ESS2.A** (4-ESS3-1); **MS.ESS3.A** (4-ESS3-1); **MS.ESS3.C** (4-ESS3-1); **MS.ESS3.D** (4-ESS3-1); **MS.ETS1.B** (4-PS3-4); **MS.ETS1.C** (4-PS3-4)

Scheduling and Contact Information

BoSAT Elementary Science is a resource for the classroom teacher to aid in the implementation of a "hands on" approach to teaching elementary science. BoSAT provides staff development, classroom support, science kits and materials for grades K-6. Kits are available in the areas of life, earth and physical science.

The BOCES #1 Science and Technology (BoSAT) Center provides subscribing districts with an interdisciplinary science curriculum that emphasizes the process skills of:

- Observing
- Classifying
- Measuring
- Collecting and Processing Data
- Predicting and Inferring
- Experimenting
- Creating Models
- Making Decisions
- Replicating
- Manipulating Materials

In addition, our resources include

- teacher in-service programs where teachers are provided learning theory, teaching strategies, classroom management and assessment
- flexible program for elementary science where each school district selects the science kits and programs that best fit their curriculum, including science kits, video conferencing, and mobile science lab.
- student centered programs where students are active learners and are provided opportunities to design experiments of their own choosing

Give us a call for further information or to ship a kit of hand-on experiments to you.

To view kit descriptions and order go to: http://www.bosat.org/

Please contact Debra Croce at debra_croce@boces.monroe.edu or 585-249-7063 for pricing and scheduling information.

Contact Steve Orcutt at steve_orcutt@boces.monroe.edu or (585) 249-7890 for more information about programs and curriculum.

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