BOE Approved 8/18

# Cliffside Park Public Schools

**Science**

**Unit Name:** Energy (Physical Science)

**Resource:** FOSS Next Generation, Delta Education

**Duration:** Ten Weeks

**Enduring Understandings**

**Energy and Circuits**

- Energy is evident whenever there is motion, electric current, sound, light, or heat. Energy can transfer from place to place.
- An electric circuit is a system that includes a complete pathway through which electric current flows from an energy source to its components.
- Conductors are materials through which electric current can flow; all metals are conductors.
- In a series circuit, there is a single pathway from the energy source to the components; in a parallel circuit, each component has its own direct pathway to the energy source.
- The energy of two energy sources (D-cells or solar cells) adds when they are wired in series, delivering more energy than a single source. Two cells in parallel deliver the same energy as a single cell.

**The Force of Magnetism**

- Magnets interact with each other and with some materials.
- Magnets stick to (attract) objects that contain iron.
- All magnets have two poles, a north pole at one end (side) and a south prole at the other end (side).
- Magnets are surrounded by an invisible magnetic field which acts through space and through most materials.
- When an iron object enters a magnetic field, the field induces magnetism in the iron object, and the object becomes a temporary magnet.
- The magnetic force acting between magnets declines as the distance between them increases.
- Earth has a magnetic field.

**Electromagnets**

- A magnetic field surrounds a wire through which electric current is flowing.
- The magnetic field produced by a current-carrying wire can induce magnetism in a piece of iron or steel.
- An electromagnet is made by sending electric current through an insulated wire wrapped around an iron core.
- The number of winds of wire in an electromagnet coil affects the strength of the magnetism induced in the core.
- The amount of electric current flowing in an electromagnetic circuit affects the strength of the magnetism in the core.
- A telegraph system is an electromagnet-based technology used for long-distance communication.

**Energy Transfer**

- Energy is evident whenever there is motion, electric current, sound, light, or heat. Energy can be transferred from place to place.
- Objects in motion have energy.
- When objects collide, energy can transfer between objects, thereby changing their motion.
- Kinetic energy is energy of motion; potential energy is energy of position or condition.

**Waves**

- Waves are a repeating pattern of motion that transfer energy from place to place.
- Sound energy can be represented as waves.
- Light travels in straight lines and can reflect (bounce) off surfaces.
- Matter can absorb light.
- An object is only seen when light from the object enters and is detected by an eye.
- Solar cells are designed technologies to transfer visible light into electricity.

**Essential Questions**

**Energy and Circuits**

- What is needed to light a bulb?
- What is needed to make a complete pathway for current to flow in a circuit?
- How can you light two bulbs brightly with one D-cell?
- Which design is better for manufacturing long strings of lights—series or parallel?

**The Force of Magnetism**

- What materials sticks to magnets?
- What happens when two or more magnets interact?
- What happens when a piece of iron comes close to or touches a permanent magnet?

- What happens to the force of attraction between two magnets as the distance between them changes?

**Electromagnets**

- How can you turn a steel rivet into a magnet that turns on and off?
- How does the number of winds of wire around a core affect the strength of the magnetism?
- How can you reinvent the telegraph using your knowledge of energy and electromagnetism?

**Energy Transfer**

- What do we observe that provides evidence that energy is present?
- How does the starting position affect the speed of a ball rolling down a ramp?
- What happens when objects collide?

**Waves**

- How are waves involved in energy transfer?
- How does light travel?
- How can you make a motor run faster using solar cells?

**Focus of Standards**

| **Student Outcomes**<br>**Energy and Circuits** | **Skills** | **Assessments** |
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| • I can investigate electric current and circuits, the pathways through which electricity flows.<br>• I can work with a variety of components—D-cells, light bulbs, motors, switches, and wires—and explore conductors and insulators.<br>• I can explore series and parallel circuits and compare the functioning of the components in each circuit<br>• I can formulate and justify their predictions, based on their observations of electricity transferring energy to produce light and motion. | • Asking Questions and Defining Problems<br>• Developing and Using Models<br>• Classifying Information<br>• Observing Investigations<br>• Exploring New Ideas<br>• Planning and Carrying Out Investigations<br>• Analyzing and Interpreting Data<br>• Using Mathematics and Computational Thinking<br>• Constructing Explanations and Designing Solutions | ***Assessments:***<br>• **Formative**: Notebook Entries:<br>○ Notebook Entries<br>○ Teacher Observation<br>○ Anecdotal Records/Notes<br>○ Science notebook<br>○ Embedded Assessment Notes<br>• **Summative Performance**<br>○ Foss Post-test on Energy<br>○ Vocabulary check<br>• **Benchmark Assessments**:<br>○ Investigation Checks<br>○ Constructing models- energy and circuits<br>○ Constructing models- magnetic fields<br>○ Constructing models- energy transfer |

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| **The Force of Magnetism**<br><br>● I can investigate the properties of magnets and their interactions with materials and each other.<br>● I can go outdoors to find objects in the environment that are attracted to magnets<br>● I can conduct an investigation to determine if like or opposite poles of a magnet attract<br>● I can construct a simple compass and use it to I can detect magnetic effects<br>● I can discover that magnetism can be induced in a piece of iron<br>● I can investigate the strength of the force of attraction between two magnets by graphing data to look for patterns of interaction<br><br>**Electromagnets**<br><br>● I can explore how to use electricity to make an electromagnet<br>● I can explore the variables that influence the strength of the magnetism produced by their electromagnets<br>● I can use all the concepts they have learned to engineer a simple telegraph system and communicate using a click code<br><br>**Energy Transfer**<br><br>● I can observe energy transfer that results in heat, light, sound, and motion and they are introduced to sources of energy and components that store energy<br>● I can conduct structured investigations with steel balls and ramps to discover | ● Engaging in Argument from Evidence<br>● Obtaining, Evaluating and Communicating Information | ○ Constructing models- wave energy<br>● **Alternative:**<br>○ Conferences<br>○ Diagrams<br>○ Word Bank for vocabulary<br>○ Modeling<br>○ Illustrations of energy processes and sequences<br>○ Storybook assembly |

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| how the variable of starting position on the ramp affects the speed of the rolling ball<br>● I can test the variables of mass and release position to find out how these variables affect energy transfer<br><br>**Waves**<br><br>● I can experience waves through firsthand experiences using ropes, demonstrations with waves in water, spring toys, and a sound generator<br>● I can analyze compression waves (sound waves) to learn the general properties of waves—amplitude, wavelength, and frequency<br>● I can use mirrors to experience reflecting light<br>● I can build a conceptual model about how light travels<br>● I can design series and parallel solar cell circuits and observe the effect on the speed of a motor<br>● I can observe that cells in series make the motor run faster, but cells in parallel do not deliver additional power to the motor | | |

**NJ Student Learning Standards: Science**
**Energy**
4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.
4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.
4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*
**Waves and their Applications in Technologies for Information Transfer**
4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.*

**Earth and Human Activity**

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

**Engineering Design**

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

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**ELA: RI.4.1, RI.4.3, RI.4.4, RI.4.5, RI.4.7, RI.4.9**
**Math: 4.OA.1, 4.OA.2, 4.OA.3**

**Career Awareness, Exploration, And Preparation**

**Strand A: Career Awareness**

9.2.4.A.1 Identify reasons why people work, different types of work, and how work can help a person achieve personal and professional goals.

9.2.4.A.2 Identify various life roles and civic and work-related activities in the school, home, and community..

9.2.4.A.4 Explain why knowledge and skills acquired in the elementary grades lay the foundation for future academic and career success.

**8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.**

**A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.**

8.1.2.A.1 Identify the basic features of a digital device and explain its purpose.

8.1.2.A.4 Demonstrate developmentally appropriate navigation skills in virtual environments (i.e. games, museums).

**E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.**

8.1.2.E.1 Use digital tools and online resources to explore a problem or issue.

**8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming**

**All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.**

**A. The Nature of Technology: Creativity and Innovation Technology systems impact every aspect of the world in which we live**.
8.2.2.A.1 Define products produced as a result of technology or of nature.
8.2.2.A.2 Describe how designed products and systems are useful at school, home and work.
8.2.2.A.5 Collaborate to design a solution to a problem affecting the community.
**B. Technology and Society: Knowledge and understanding of human, cultural and societal values are fundamental when designing technology systems and products in the global society.**
8.2.2.B.1 Identify how technology impacts or improves life.
8.2.2.B.2 Demonstrate how reusing a product affects the local and global environment.
8.2.2.B.3 Identify products or systems that are designed to meet human needs.
8.2.2.B.4 Identify how the ways people live and work has changed because of technology.
**C. Design:The design process is a systematic approach to solving problems.**
8.2.2.C.1 Brainstorm ideas on how to solve a problem or build a product.
8.2.2.C.2 Create a drawing of a product or device that communicates its function to peers and discuss..
8.2.2.C.5 Describe how the parts of a common toy or tool interact and work as part of a system.
8.2.2.C.6 Investigate a product that has stopped working and brainstorm ideas to correct the problem.
**D. Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.**
8.2.2.D.5 Identify how using a tool (such as a bucket or wagon) aids in reducing work.
Distinguish between opinions and evidence in one's own explanations.
Construct an argument with evidence to support a claim.

**Career Ready Practices**
CRP1. Act as a responsible and contributing citizen and employee.
CRP2. Apply appropriate academic and technical skills.
CRP3. Attend to personal health and financial well-being.
CRP4. Communicate clearly and effectively and with reason.
CRP5. Consider the environmental, social and economic impacts of decisions.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP11. Use technology to enhance productivity.

**NJSLS-S: Science and Engineering Practices**
**Practice 1. Asking questions (for science) and defining problems (for engineering)**

- Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.
- Ask questions about what would happen if a variable is changed.
- Identify scientific (testable) and non-scientific (non-testable) questions.
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
- Use prior knowledge to describe problems that can be solved.
- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

**Practice 2. Developing and using models**

- Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
- Identify limitations of models.
- Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.
- Develop and/or use models to describe and/or predict phenomena.
- Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.
- Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.

**Practice 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.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
- Evaluate appropriate methods and/or tools for collecting data.
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- Make predictions about what would happen if a variable changes.
- Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.

**Practice 4. Analyzing and interpreting data**

- Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
- Represent data in tables and/or various graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.
- Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation.
- Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
- Analyze data to refine a problem statement or the design of a proposed object, tool, or process.
- Use data to evaluate and refine design solutions.

**Practice 5. Using mathematics and computational thinking**

- Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.
- Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success.
- Organize simple data sets to reveal patterns that suggest relationships.
- Describe, measure, estimate, and/or graph quantities (e.g., area, volume, weight, time) to address scientific and engineering questions and problems.
- Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.

**Practice 6. Constructing explanations (for science) and designing solutions (for engineering)**

- 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.
- Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard).
- Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.
- Identify the evidence that supports particular points in an explanation.
- Apply scientific ideas to solve design problems.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.

**Practice 7. Engaging in argument from evidence**

- Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).
- Compare and refine arguments based on an evaluation of the evidence presented.
- Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation.
- Respectfully provide and receive criticism from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions.
- Construct and/or support an argument with evidence, data, and/or a model.
- Use data to evaluate claims about cause and effect.
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

**Practice 8. Obtaining, evaluating, and communicating information**

- Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.
- Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.
- Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices.
- Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices.
- Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.
- Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.

**Core Instructional Materials:**

- FOSS Next Generation: Energy (2016)

**Supplemental Materials: (videos, leveled readers, Readworks, recommended books etc.)**

**Videos: https://www.fossweb.com/moduledetail?dDocName=G3842595&classId=**
**Recommended books: https://www.fossweb.com/additional-resources-books-xslt?dDocName=G4292315#non-fiction-books**

**21st Century Themes**
**Global Awareness** Global Awareness/Environmental Literacy:
**Environmental** Literacy Knowing sound, light and energy around you to make you a safe/productive citizen
**21st Century Skills**
Creativity and innovation

- Critical thinking and problem solving
- Communication and collaboration

**Interdisciplinary Connections**
Fourth grade investigations follow a clear and coherent conceptual flow and a consistent instructional design. Students develop science knowledge by building a framework of concepts and supporting ideas.
NJSLS State Standards for ELA are introduced, developed, and practiced in the context of learning science content and engaging in the science and engineering practices. Students read and comprehend complex science texts related to their prior experience and knowledge. They write informational/explanatory texts, arguments to support claims, and narratives about experience in science. They engage in collaborative discussions about science and learn new vocabulary and language structures in context. The decision to use additional science texts, writing tasks, oral discourse opportunities, and vocabulary development activities is based on how well they address the science as well as the ELA standards.

**ELA: Interdisciplinary Connections: NJSLS for ELA are introduced, developed, and practiced in the context of learning science content and engaging in the science and engineering practices.**

- Read and comprehend complex science texts related to their prior experience and knowledge.
- Write informational/explanatory texts, arguments to support claims, and narratives about experience in science.
- Engage in collaborative discussions about science.
- Learn new vocabulary and language structures in context.

**Math**
The fourth grade program integrates mathematics with science in two ways throughout the grade 3 modules. In active investigations, students apply mathematics during data gathering and analysis. In addition, the Interdisciplinary Extensions at the end of each investigation usually include a math problem of the week. These problems enhance the science learning by providing hypothetical data for students to analyze or in some way relate to the context of the investigation. The notes explain for the teacher the problem and describe how students might approach its solution. The problems are prepared for distribution to students on duplication masters in the Teacher Masters chapter of Teacher Resources.

**Mathematical Practices**
**The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.**

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.

- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

| **Differentiation/Accommodations/Modifications**<br>***(Alternate Modes of Instruction and Support)*** | | |
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| **Modifications to Support Gifted and Talented Students** | **Modifications to Support English Language Learners** | **Modifications to Support Our Learners (Students with IEPs/504s and At-Risk Learners)** |
| Newsela article:<br>*Kids turn on the lights for people in need*<br>Lexile: 930<br><br>Recommended non fiction books<br>https://www.fossweb.com/additional-resources-books-xslt?dDocName=G4292315#non-fiction-books<br><br>Independent research- pros and cons of various sources of energy<br><br>Debate / Compare and contrast- energy costs- environmentally vs. monetary<br><br>Participate in inquiry and project-based learning units of study<br><br>Assigning roles within partnerships | Newsela article:<br>*Kids turn on the lights for people in need*<br>(Spanish version)<br><br>Equipment photo cards (spanish and english)<br><br>Modeling energy movement<br><br>Visual cues- image gallery<br>https://www.fossweb.com/additional-resources-image-galleries-xslt?dDocName=G4292315#image-galleries<br><br>Researching energy sources per native country<br><br>Vocabulary log-<br><br>Pronunciation/translation assistance<br>https://dictionary.cambridge.org/us/ | Newsela article:<br>*Kids turn on the lights for people in need*<br>Lexile: 630<br><br>Storyboard- Sense of sight investigation- how light is interpreted by living organisms<br><br>Equipment photo cards<br><br>Visual cues- image gallery<br>https://www.fossweb.com/additional-resources-image-galleries-xslt?dDocName=G4292315#image-galleries<br><br>Word walls<br><br>Review student individual educational plan and/or 504 plan.<br><br>Establish procedures for accommodations and modifications for assessments as per IEP/504. |

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| Differentiated supports: content, process, product, environment | Vocabulary builder Thesaurus- https://www.thesaurus.com/<br><br>Native Language Translation (peer, online assistive technology, translation device, bilingual dictionary)<br>Pair visual prompts with verbal presentations<br><br>Front Load and immerse students in literacy and language experiences related to content<br><br>Provide students with visual models, sentence stems, concrete objects, and hands-on materials.<br><br>Model procedures for life skills.<br><br>Collaboration between ELL and general education teacher to maximize learning | Establish procedures for modification of classwork and homework as per IEP/504.<br><br>Modify classroom environment to support academic and physical needs of the students as per IEP/504.<br><br>Provide appropriate accommodations, instructional adaptations, and/or modifications as determined by the IEP or 504 team.<br><br>Differentiation through content, process, product, environment<br>Provide Title I services to students not meeting academic standards in ELA and/or Math.<br><br>Provide instructional adaptations and interventions in the general education classroom.<br><br>Modify classroom environment to support student needs.<br><br>Differentiated instruction<br><br>Basic Skills<br><br>Intensive individual intervention |

**Sources:**
NJSLS Science Standards (2016): http://www.nj.gov/education/cccs/2016/science/
NJ: 2014 SLS: Technology: http://www.state.nj.us/education/cccs/2014/tech/8.pdf
NJSLS-S: Science and Engineering Practices: http://www.nj.gov/education/cccs/2016/science/3-5-ETS1.pdf
21st Century Life and Careers: http://www.state.nj.us/education/cccs/2014/career/9.pdf
Career Ready Practices: http://www.state.nj.us/education/cccs/2014/career/9.pdf
2015 FOSS Next Generation: www.FOSSweb.com