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| **4th Grade: Energy** | | |
| **Content Area:** Science | | |
| **Unit Title:** Energy | | |
| **Target Course/Grade Level:** 4 | | |
| **Unit Summary:** The Energy Module provides first-hand experiences in physical science dealing with energy and change.  **Primary Interdisciplinary Connections**  **ELA/Literacy**  RI 1: Refer to details and examples in a text when explaining.  RI 2: Determine the main idea of a text.  RI 4: Determine the meaning of academic words or phrases.  RI 5: Describe overall structure of information in a text.  RI 6: Compare and contrast two accounts of the same topic.  RI 7: Interpret information presented visually.  RI 8: Explain how an author uses evidence to support points.  RI 9: Integrate information from two texts on the same topic.  RI 10: Read and comprehend science texts.  ---  RF 3: Know and apply grade-level phonics and word analysis skills in decoding words.  RF 4: Read with sufficient accuracy and fluency.  ---  SL 1: Engage in collaborative discussions.  SL 2: Paraphrase portions of a text read aloud or information presented orally.  SL 4: Report on a text in an organized manner, using appropriate facts and relevant details.  SL 5: Add visual displays to presentations.  ---  L 3: Use knowledge of language and its conventions when writing, speaking, reading, or listening.  L 4: Determine or clarify the meaning of unknown words.  L 4c: Consult reference materials.  L 6: Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases.  ---  W 2: Write informative/explanatory text.  W 5: Strengthen writing by revising.  W 7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.  W 8: Gather relevant information from experiences and print.  W 9: Draw evidence from informational texts to support reflection.  **Math**  4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be  interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation  and estimation strategies including rounding.  ---  MP.4 Model with mathematics.  ---  4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. | | |
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| **21st Century Themes:**  Digital media will be used incorporated in project presentations. This module will develop students’ abilities to do and understand scientific inquiry. Students will identify questions, design and conduct scientific investigations to answer those questions, employ tools to gather, analyze, and interpret data. They will use data to construct reasonable explanations, develop and communicate investigations and evidence and understand that scientists use different kinds of investigations and tools to develop explanations using evidence and knowledge. This module will develop and extend students’ understandings about science and technology. Students will work collaboratively in teams and use tools and scientific techniques to make better observations. | | |
| **Unit Rationale**  Students investigate electricity and magnetism as related effects and engage in engineering design while learning useful applications of electromagnetism in everyday life. They explore energy transfer through waves, repeating patterns of motion, that result in sound and motion.  The five investigations focus on the concepts that energy is present whenever there is motion, electric current, sound, light, or heat, and that energy can transfer from one place to other. Students conduct controlled experiments by incrementally changing variables to determine how to make an electromagnet stronger and how the amount of energy transfer changes when balls of different masses hit a stationary object. | | |
| **Learning Targets** | | |
| **Disciplinary Core Ideas**  *PS2.B: Types of Interactions*   * Electric and magnetic forces between a pair of objects do not require that the objects be in contact The sizes of the forces in each situation depend on the properties of the objects and their distances apart, and forces between two magnets on their orientation relative to to each other.   *PS3.A: Definitions of Energy*   * The faster a given object is moving, the more energy it possesses. * Energy can be moved from place to place by moving objects or through sound, light, or electric currents.   *PS3.B: Conservation of Energy and Energy Transfer*   * 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. * Light also transfers energy from place to place. * 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.   *PS3.C: Relationship Between Energy and Forces*   * When objects collide, the contact forces transfer energy so as to change the object's’ motions.   *PS3.D: Energy in Chemical Processes and Everyday Life*   * The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.   *PS4.A: Wave Properties*   * Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. * Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).   *PS4.B: Electromagnetic Radiation*   * An object can be seen when light reflected from its surface enters the eyes.   *PS4.C: Information Technologies and Instrumentation*   * Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.   *ETS1.A: Defining and Delimiting Engineering Problems*  *ETS1.B: Developing Possible Solutions*  *ETS1.C: Optimizing The Design Solution*   * Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. | | |
| **PE #** | **Performance Expectations** | |
| 3-PS2-3 | Ask questions to determine cause-and-effect relationships of electric or magnetic interactions between two objects not in contact with each other. | |
| 3-PS2-4. | Define a simple design problem that can be solved by applying scientific ideas about magnets. | |
| 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. | |
| 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. | |
| **ETS #** | **Engineering, Technology, and Applications of Science** | |
| 3-5-ETS1-1 | Defining and delimiting engineering problems. | |
| 3-5-ETS1-2 | Developing possible solutions. | |
| 3-5-ETS1-3 | Optimizing the design solution. | |
| **Unit Essential Questions**  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?  What materials stick 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?  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?  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?  How are waves involved in energy transfer?  How does light travel?  How can you make a motor run faster using solar cells? | | **Unit Enduring Understandings**  Magnets interact with each other and with materials that contain iron.  Like poles of magnets repel each other; opposite poles attract. The magnetic force declines as the distance between the magnets increases.  Conductors are materials through which electric current can flow; all metals are conductors.  Any change of motion requires a force.  Gravity is a pulling force that acts between all masses.  Energy is present whenever there is motion, electric current, sound, light, or heat.  Electricity (electric current) transfers energy that can produce heat, light, sound, and motion. Electricity can be produced from a variety of sources.  A circuit is a system that includes a complete pathway through which electric current flows from a source of energy to its components.  Energy can be generated by burning fossil fuels or harnessing renewable energy sources such as solar, wind, hydroelectric, and geothermal.  The faster an object is moving, the more energy it has.  Motion of one object can transfer to motion of other objects in a collision; a larger force causes a larger change.  Kinetic energy is energy of motion; potential energy is energy of position.  Waves are a repeating pattern of motion that transfer energy.  An object is seen when light from an object enters and is detected by the eye. |
| **Unit Learning Targets**  Students interpret data from graphs to build explanations from evidence and make predictions of future events. They develop models to represent how energy moves from place to place in electric circuits and in waves. Students gain experiences that will contribute to the understanding of crosscutting concepts of patterns; cause and effect; systems and system models; and energy and matter. | | |
| **Evidence of Learning** | | |
| **Embedded Assessments:**   * Response Sheets * Performance Assessments * Science Notebook Entries   **Benchmark Assessments:**   * Investigation I-Checks * Surveys | | |
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