4th Grade Unit 3 - How Energy Powers Our World

Content Area: **Science**
Course(s): **Science Grade 4**
Time Period: **MP3**
Length: **36 days**
Status: **Published**

NJSLS - Science

3-5-ETS1	Engineering Design
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.
4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
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.
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-PS4-3	Generate and compare multiple solutions that use patterns to transfer information.
4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

Science and Engineering Practices

Planning and Carrying Out Investigations

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)

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. (3-5-ETS1-3)

Constructing Explanations and Designing Solutions

Apply scientific ideas to solve design problems. (4-PS3-4)

Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3, 3-5-ETS1-2)

Developing and Using Models

Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)

Obtaining, Evaluating, and Communicating Information

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

Asking Questions and Defining Problems

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. (3-5-ETS1-1)

Disciplinary Core Ideas

PS3.A: Definitions of Energy

Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2)

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)

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)

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. (4-PS3-4)

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. (4-PS4-1)

Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)

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. (4-PS4-3)

ESS3.A: Natural Resources

Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)

ETS1.A: Defining and Delimiting Engineering Problems

Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions

Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)

At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)

Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

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. (3-5-ETS1-3)

Crosscutting Concepts

Energy and Matter

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

Patterns

Similarities and differences in patterns can be used to sort, classify, and analyze simple rates of change for natural phenomena. (4-PS4-1)

Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)

Cause and Effect

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

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

People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)

Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (4-PS3-4, 3-5-ETS1-2)

Rationale and Transfer Goals

In this unit, students investigate how energy is transferred, transformed, and utilized in their everyday lives. The unit begins with an exploration of energy transfer, where students observe how energy moves from place to place through sound, light, heat, and electric currents. Putting this knowledge into practice, students take on

the role of engineers to design, test, and refine a device that converts energy from one form to another, such as mechanical energy into electrical energy.

Next, students shift their focus to waves as a mechanism for transferring energy and information. Through hands-on modeling, students analyze the repeatable patterns of waves (amplitude and wavelength) and observe how waves can cause objects to move. They then explore how technology uses these wave patterns to transmit information over distances, designing and testing solutions that use codes to transfer data.

Finally, students connect these physical science concepts to the real world by evaluating Earth's energy resources. They research how fuel sources (like fossil fuels) and renewable options (like wind, solar, and water) impact the environment, learning how society balances its energy needs with ecological responsibility. By the end of the unit, students will have a holistic understanding of how energy shapes our technological world and our planet.

Enduring Understandings

Energy cannot be created or destroyed; instead, it moves from place to place and changes from one form to another.

Waves are regular, repeating patterns of motion that can move energy through matter or space without moving the matter itself. Humans can harness these patterns to transmit information over long distances.

Engineers solve real-world problems by designing, testing, and refining devices that convert energy or transmit information, balancing available materials, time, and safety.

The energy we use to power our daily lives comes from natural resources, and choosing between renewable (wind, solar) and non-renewable (fossil fuels) resources involves weighing the impacts on Earth's environment.

Essential Questions

How does energy move and change from one form to another?

How do waves transfer both energy and information?

How does our choice of energy resources impact Earth's systems?

Content - What will students know?

- Energy can manifest as motion, sound, light, heat, and electric currents.
- Energy can be transferred from place to place by moving objects, sound waves, light beams, or electric currents.
- When objects collide or when devices operate, energy is transformed from one form to another.
- An electric current requires a complete, closed loop (circuit) to transfer energy to a device.
- A wave is a regular, repeating pattern of motion.
- Waves have measurable features, specifically amplitude (the height of the wave) and wavelength (the distance between two peaks).
- Waves transfer energy through a medium (like water or air) and can cause objects in that medium to move up and down or back and forth, but the matter itself does not travel with the wave.
- Humans use patterns and codes (like Morse code, binary code, or digitized signals) to transmit information across distances using waves and technology.
- The energy we use comes from natural Earth resources, which are categorized as either renewable (e.g., solar, wind, water) or non-renewable/fossil fuels (e.g., coal, oil, natural gas).
- Extracting, refining, and burning fossil fuels impacts Earth's air, water, and land differently than capturing energy from renewable sources.
- Every energy source has advantages (like cost or reliability) and disadvantages (like pollution or reliance on weather conditions).

Skills - What will students be able to do?

- Conduct controlled observations to provide evidence of how energy moves via sound, light, heat, and electric currents.
- Apply engineering design steps to build, test, and refine a physical device that converts energy from one form to another.
- Evaluate and troubleshoot an energy-conversion design by identifying where energy is lost or how the device's efficiency can be improved based on given constraints.
- Develop and use physical or digital models of waves to demonstrate how changes in amplitude (height) and wavelength (spacing) alter a wave's appearance and energy.
- Demonstrate through modeling that waves move energy across a distance and cause objects to move

up-and-down or back-and-forth, while the medium (matter) itself stays in place.

- Design, test, and compare multiple communication systems that use patterns or codes (such as Morse code, secret grids, or flashlights) to transfer information over a distance.
- Obtain, evaluate, and combine information from multiple reliable sources (text, video, graphs) to explain how specific energy resources are derived from the Earth.
- Graph or chart data comparing the environmental impacts of renewable resources (wind, solar, hydro) versus non-renewable resources (coal, oil, gas).
- Construct an evidence-based argument or presentation explaining the pros and cons of a community's choice of energy source.

Activities - How will we teach the content and skills?

- Mystery Science Electricity, Light, & Heat Anchor Phenomenon
- Mystery Science Electricity, Light, & Heat Lesson 1
- Mystery Science Electricity, Light, & Heat Lesson 2
- Mystery Science Electricity, Light, & Heat Lesson 3
- Mystery Science Sound, Waves, & Communication Anchor Phenomenon
- Mystery Science Sound, Waves, & Communication Lesson 1
- Mystery Science Sound, Waves, & Communication Lesson 2
- Mystery Science Sound, Waves, & Communication Lesson 3
- Mystery Science Sound, Waves, & Communication Lesson 4

Formative Assessments

- Mystery Science Electricity, Light, & Heat Lesson 1 Assessment
- Mystery Science Electricity, Light, & Heat Lesson 2 Assessment
- Mystery Science Electricity, Light, & Heat Lesson 3 Assessment
- Mystery Science Sound, Waves, & Communication Lesson 1 Assessment
- Mystery Science Sound, Waves, & Communication Lesson 2 Assessment

- Mystery Science Sound, Waves, & Communication Lesson 3 Assessment
- Mystery Science Sound, Waves, & Communication Lesson 4 Assessment
- Daily Exit Ticket
- Daily Formative Assessment

Summative Assessments

- Mystery Science Sound, Waves, & Communication Performance Assessment
- Mystery Science Sound, Waves, & Communication Unit Assessment
- Grade 4 Science Unit 3 Benchmark

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• Definition of a wave • Definition of a force • How forces affect an object's motion	Grade 1: People also use a variety of devices to communicate (send and receive information) over long distances. Grade 2: A situation that people want to change or create can be approached as a problem to be solved through engineering. Grade 2: Asking questions, making observations, and gathering information are helpful in thinking about problems Grade 2: Before beginning to design a solution it is important to clearly understand the problem.	1-PS4-4 Activities K-2-ETS1-1 Activities K-2-ETS1-2 Activities K-2-ETS1-3 Activities 3-PS2-1 Activities 3-PS2-2 Activities

	Grade 2: Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. Grade 2: Because there is always more than one possible solution to a problem, it is useful to compare and test designs. Grade 3: Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative, addition of forces is used at this level). Grade 3: The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)	

Key Resources

Mystery Science

Video Links

Developing and Using Models: http://www.bozemanscience.com/ngss-analyzing-interpreting-data

Wave Properties: http://www.bozemanscience.com/ngs-ps4a-wave-properties

Patterns: http://www.bozemanscience.com/ngs-patterns

Classroom Resources –

NSTA Curators Project – http://ngss.nsta.org/DisplayStandard.aspx?view=topic&id=16

Career Readiness, Life Literacies, & Key Skills

9.2.5.CAP.1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
9.4.5.CI.1	Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).
9.1.5.CR.1	Compare various ways to give back and relate them to your strengths, interests, and other personal factors.
9.4.5.CI.2	Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue (e.g., 6.3.5.CivicsPD.3, W.5.7).
9.2.5.CAP.3	Identify qualifications needed to pursue traditional and non-traditional careers and occupations.
9.2.5.CAP.4	Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.
9.4.5.DC.4	Model safe, legal, and ethical behavior when using online or offline technology (e.g., 8.1.5.NI.2).
9.4.5.DC.8	Propose ways local and global communities can engage digitally to participate in and promote climate action (e.g., 6.3.5.GeoHE.1).
9.4.5.IML.2	Create a visual representation to organize information about a problem or issue (e.g.,

	4.MD.B.4, 8.1.5.DA.3).
9.4.5.IML.3	Represent the same data in multiple visual formats in order to tell a story about the data.
9.4.5.TL.2	Sort and filter data in a spreadsheet to analyze findings.
9.4.5.TL.3	Format a document using a word processing application to enhance text, change page formatting, and include appropriate images graphics, or symbols.

Interdisciplinary Connections

4.OA.A.1	Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.
4.OA.A.3	Solve multi-step 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.
RI.CR.5.1	Quote accurately from an informational text when explaining what the text says explicitly and make relevant connections when drawing inferences from the text.
RI.CR.4.1	Refer to details and examples as textual evidence when explaining what an informational text says explicitly and make relevant connections when drawing inferences from the text.
RI.MF.5.6	Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, timelines, animations, or interactive elements on web pages) and explain how the information contributes to an understanding of the text in which it appears.
RI.CT.5.8	Compare and contrast the authors' approaches across two or more informational texts within the same genre or about texts on the same or similar topics.
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.
W.WR.5.5	Establish a central idea about a topic, investigation, issue or event and use several sources to support the proposed central idea.
W.SE.5.6	Gather relevant information from multiple valid and reliable print and digital sources; summarize or paraphrase information in notes and finished work, making note of any similarities and differences among ideas presented; and provide a list of sources.
W.WR.4.5	Conduct short research projects that use multiple reference sources (print and non-print) and build knowledge through investigation of different aspects of a topic.
W.SE.4.6	Gather relevant information from multiple print and digital sources; take notes, prioritize and categorize information; provide a list of sources.
SL.UM.4.5	Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.