4th Grade Unit 3 - Energy, Forces, and Motion

Content Area: **Science**
Course(s): **Science Grade 4**
Time Period: **MP3**
Length: **28 days**
Status: **Published**

NJSLS - Science

SCI.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.
SCI.4-PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object.
SCI.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.
SCI.4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
SCI.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.
SCI.4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.
SCI.4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
SCI.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

Asking Questions and Defining Problems

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

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)

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

Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)

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 problem. (3-5-ETS1-2)

Obtaining, Evaluating, and Communicating Information

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

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)

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-PS3-3)

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. (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)

PS3.C: Relationship Between Energy and Forces

When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)

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)

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 the 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-PS3-1, 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)

Science is a Human Endeavor

Most scientists and engineers work in teams. (4-PS3-4)

Science affects everyday life. (4- PS3-4)

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

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)

People’s needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1, 4-ESS3-1)

Interdependence of Science, Engineering, and Technology

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

Rationale and Transfer Goals

In this unit of study, students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents or from objects through collisions. Students also obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment. Students then use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object, and are expected to develop an understanding that energy can be transferred from object to object through collisions. Students use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of cause and effect, energy and matter, and the interdependence of science, engineering, and technology, and influence of science, engineering, and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in the Science and Engineering Practices. Students are also expected to use these practices to demonstrate an understanding of the core ideas.

Enduring Understandings

The faster an object is moving, the more energy it possesses.

The slower an object is moving, the less energy it possesses.

Moving objects, sound, light, and heat all have energy.

Energy can be moved from place to place.

Energy can change forms but cannot be created or destroyed.

Essential Questions

How does energy move?

From what natural resources are energy and fuels derived? In what ways does the human use of natural resources affect the environment?

What is the relationship between the speed of an object and its energy?

In what ways does energy change when objects collide?

How can scientific ideas be applied to the design, test, and refine a device that converts energy from one form to another?

Content - What will students know?

- Energy can be transferred in various ways and between objects.
- Energy can be moved from place to place through sound, lights, or electric current.
- Energy is present whenever there are moving objects, sound, light, and heat.
- Light also transfers energy from place to place.
- Energy can also be transferred from place to place by electric current; the currents may have been produced to begin with by transforming the energy of motion into electrical energy.
- Cause and effect relationships are routinely identified and used to explain change.
- Knowledge of relevant scientific contents and research findings is important in engineering.
- Over time, people's needs and wants change, as do their demands for new and improved technologies.
- Energy and fuels that humans use are derived from natural sources.
- The use of energy and fuels from natural sources affects the environment in multiple ways.
- Some resources are renewable over time and others are not.
- The faster an object is moving, the more energy it possesses.

- 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.
- When objects collide, the contact forces transfer energy so as to change the objects' motions.
- Science affects everyday life.
- Most scientists and engineers work in teams.
- Engineers improve existing technologies or develop new ones.
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.
- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.
- 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.
- 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.
- 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.
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Skills - What will students be able to do?

- Conduct investigations to observe that energy can be transferred from place to place by sound, light, heat, and electrical currents.
- Describe that energy and fuels are derived from natural resources and that their uses affect the environment.
- Obtain, evaluate, and communicate information as they examine cause-and-effect relationships between energy and matter.

- Observe the transfer of heat energy.
- Understand that heat is transferred from warmer to colder objects.
- When an object cools, it loses heat energy. When an object gets warmer, it gains heat energy.
- Build simple electric circuits.
- Observe and describe the ways in which energy is transferred in the circuit.
- Conduct research using books and other reliable media to determine which natural resources are sources of energy.
- Light, heat, sound, and electricity are all forms of energy.
- Determine which energy sources are renewable and which are nonrenewable.
- Conduct research to determine how the use of renewable and nonrenewable resources affects the environment.
- Understand and explain the relationship between an object's speed and its energy.
- Collect data about the relative speed of objects in relation to the strength of the force applied to them.
- Collect qualitative data and observe the impact differing amounts of energy have on the relative speed of the object in motion.
- Observe objects colliding and should be encouraged to ask questions that lead to further investigation.
- Investigate interactions between moving objects.
- Collect observational data, document the types of changes they observe, look for patterns of change in both the motion of objects and in the types of energy transfers that occur, and make predictions about the future motion of objects.
- Apply scientific ideas about force, motion, and energy in order to design, test, and refine a device that converts energy from one form to another.

Activities - How will we teach the content and skills?

- Mystery Science Energizing Everything Anchor Phenomenon
- Mystery Science Energizing Everything Lesson 1
- Mystery Science Energizing Everything Lesson 2
- Mystery Science Energizing Everything Lesson 3
- Mystery Science Energizing Everything Lesson 4

- Mystery Science Energizing Everything Lesson 5
- Mystery Science Energizing Everything Lesson 6
- Mystery Science Energizing Everything Lesson 7
- Mystery Science Energizing Everything Lesson 8

Formative Assessments

- Mystery Science Energy & Energy Transfer Lesson 1 Assessment
- Mystery Science Energy & Energy Transfer Lesson 2 Assessment
- Mystery Science Energy & Energy Transfer Lesson 3 Assessment
- Mystery Science Energy & Energy Transfer Lesson 4 Assessment
- Mystery Science Energy & Energy Transfer Lesson 5 Assessment
- Mystery Science Electricity, Light, & Heat Lesson 1 Assessment
- Mystery Science Electricity, Light, & Heat Lesson 2 Assessment
- Mystery Science Electricity, Light, & Heat Lesson 3 Assessment
- Daily Exit Ticket
- Daily Formative Assessment

Summative Assessments

- Mystery Science Energy & Energy Transfer Performance Task
- Mystery Science Electricity, Light, & Heat Performance Task
- Mystery Science Energy and Energy Transfer Unit Assessment
- Mystery Science Electricity, Light, & Heat Unit Assessment
- Grade 4 Science Benchmark Unit 3

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• Forces are pushes and pulls. • What is speed? • What is motion? • How do forces affect motion?	Kindergarten: When objects touch or collide, they can push one another and can change motion. Kindergarten: Pushes and pulls can have different strengths and directions. Kindergarten: Pushing or pulling on an object can change the speed or direction of its motion or start or stop it. Kindergarten: A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. 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, they add to give a net force of zero on the object. Forces that do not sum zero can cause changes in the object's speed or direction of motion. Grade 3: The patterns in an object's motion in various situations can be observed and measured; when the past motion exhibits a regular pattern, future motion can be predicted from it.	K-PS2-1 Activities K-PS2-2 Activities K-PS3-1 Activities K-PS3-2 Activities 3-PS2-1 Activities 3-PS2-2 Activities 3-PS2-3 Activities 3-PS2-4 Activities

Key Resources

Mystery Science

Switch Energy Project

Wind Generator

Thermal Energy Transfer

Career Readiness, Life Literacies, & Key Skills

PFL.9.1.5.CR.1	Compare various ways to give back and relate them to your strengths, interests, and other personal factors.
WRK.9.2.5.CAP.1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
WRK.9.2.5.CAP.3	Identify qualifications needed to pursue traditional and non-traditional careers and occupations.
WRK.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.
TECH.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).
TECH.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).
TECH.9.4.5.DC.4	Model safe, legal, and ethical behavior when using online or offline technology (e.g., 8.1.5.NI.2).
TECH.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).
TECH.9.4.5.TL.2	Sort and filter data in a spreadsheet to analyze findings.
TECH.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.
TECH.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).
TECH.9.4.5.IML.3	Represent the same data in multiple visual formats in order to tell a story about the data.

Interdisciplinary Connections

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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. (4-PS3-1)

RI.IT.4.3. Describe the impact of individuals and events throughout the course of a text, explaining events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on evidence in the text. (4-PS3-1)

W. IW.4.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)

A. Introduce a topic clearly and group related information in paragraphs and sections; include formatting (e.g., headings), text features (e.g., illustrations, diagrams, captions) and multimedia when useful to aid in comprehension.

B. Develop the topic with facts, definitions, concrete details, text evidence, or other information and examples related to the topic.

C. Link ideas within paragraphs and sections of information using words and phrases (e.g., another, for example, also, because).

D. Use precise language and domain-specific vocabulary to inform about or explain the topic.

E. Provide a conclusion related to the information or explanation presented.

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. (4-PS3-2, 4-PS3-3, 4-PS3-4, 4-ESS3-1)

W.SE.4.6. Gather relevant information from multiple print and digital sources; take notes, prioritize and categorize information; provide a list of sources. (4-PS3-1, 4-PS3-2, 4-PS3-3, 4-PS3-4, 4-ESS3-1)

NJSLS Mathematics

MP.2 Reason abstractly and quantitatively. (4-ESS3-1)

MP.4 Model with mathematics. (4-ESS3-1)