4th Grade Unit 2 - Energy in Motion - Crashes, Currents, and Creations

Content Area: **Science**
Course(s): **Science Grade 4**
Time Period: **MP2**
Length: **26 days**
Status: **Published**

NJSLS - Science

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.
4-PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object.
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.
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.

Science and Engineering Practices

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)

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

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)

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-PS3-3)

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-PS3-3)

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-PS3-4)

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)

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-PS3-3, 4-PS3-4)

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)

Rationale and Transfer Goals

In this unit, students explore the fundamental concept of energy, focusing on how it relates to motion, transfer, and transformation. Students begin by investigating the relationship between an object's speed and its energy, observing that faster objects possess more energy than slower ones. Through collaborative investigations, students ask questions and predict outcomes about changes in energy that occur when objects collide, examining how energy is transferred from one object to another or transformed into sound, light, heat, or electric currents.

Culminating in an engineering design challenge, students apply their scientific understanding to design, build, and refine a device that converts energy from one form to another. By the end of the unit, students will view energy not as an abstract concept, but as a tangible force that can be observed, measured, and manipulated to solve real-world problems.

Enduring Understandings

The faster an object is moving, the more energy it possesses. If an object is at rest, it has no motion energy.

When objects collide, energy is never destroyed; instead, it is transferred from one object to another, changing the objects' speed and direction.

Energy can transform into completely different forms during a collision or an event.

Scientific knowledge of energy transfer can be used to design and build tools that solve human problems.

Essential Questions

How does the speed of an object relate to the amount of energy it possesses?

What happens to energy when objects collide?

How can we design a device to convert energy from one form into another to solve a practical problem?

Content - What will students know?

- Moving objects possess energy of motion.
- An object's speed is directly related to its energy; a faster-moving object has more energy than the same object moving at a slower speed.
- An object that is not moving has zero motion energy.
- Energy can be passed from one object to another through physical contact or collisions.
- When objects collide, energy transfer changes the motion of the objects (e.g., changing their speed, stopping them, or forcing them to change direction).
- During a collision, some motion energy is always transformed into other observable forms, most notably sound (e.g., a loud crash) and heat (thermal energy produced by friction).
- Energy exists in various forms, including light, sound, heat, motion (mechanical), and electrical energy.
- Energy can be transferred from place to place through electrical currents.
- Devices can be intentionally designed by humans to convert energy from one form to another to serve a useful purpose.
- Engineering involves defining a problem, building a prototype, testing how well it transfers or converts energy, and refining the design based on constraints and criteria.

Skills - What will students be able to do?

- Conduct controlled experiments (e.g., releasing a toy car from different heights on a ramp) to observe how changes in speed affect an object's energy.
- Graph and analyze data to demonstrate the direct relationship between an object's speed and the distance it can move another object upon impact.

- Construct a written evidence-based explanation proving that the faster an object moves, the more energy it possesses.
- Formulate testable questions about what happens to energy when two objects collide.
- Predict outcomes of collisions based on the relative speed and mass of the moving objects.
- Observe and document changes in motion, sound, and temperature during a collision to identify where and how energy was transferred or transformed.
- Define a design problem that can be solved by converting energy from one form to another, keeping track of constraints.
- Design and sketch a prototype of a device that successfully converts energy.
- Build and test the device, collecting data on how efficiently it transfers or transforms energy.
- Refine and optimize the design by identifying failures in the prototype, modifying it, and re-testing to improve its performance.
- Use diagrams and models to map out the flow of energy through a system.
- Argue from evidence during classroom discussions, using proper scientific vocabulary (transfer, transform, collision) to explain everyday energy phenomena.

Activities - How will we teach the content and skills?

- Mystery Science Energy & Energy Transfer Anchor Phenomenon
- Mystery Science Energy & Energy Transfer Lesson 1
- Mystery Science Energy & Energy Transfer Lesson 2
- Mystery Science Energy & Energy Transfer Lesson 3
- Mystery Science Energy & Energy Transfer Lesson 4
- Mystery Science Energy & Energy Transfer Lesson 5

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
- Daily Exit Ticket
- Daily Formative Assessment

Summative Assessments

- Mystery Science Energy & Energy Transfer Performance Task
- Mystery Science Energy and Energy Transfer Unit Assessment
- Grade 4 Science Benchmark Unit 2

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.	• K-PS2-1 Activities • K-PS2-2 Activities • K-PS3-1 Activities • K-PS3-2 Activities • 3-PS2-1 Activities • 3-PS2-2 Activities

	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.	• 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

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).
9.2.5.CAP.1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
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.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.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.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.
W.IW.4.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
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.