Unit 1: Physical Science: Transfer of Energy, Forces, Motion, Waves, and Information Processing

Content Area: **Science**
Course(s):
Time Period: **Trimester 1**
Length: **10-12 weeks**
Status: **Published**

Summary

Introduction:

In this unit of study, fourth-grade students develop an understanding that energy can be transferred from place to place by sound, light, heat, and electrical currents. 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 are able to 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. 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. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another.

Students will also use a model of waves to describe patterns of waves in terms of amplitude and wavelength and to show that waves can cause objects to move. Students use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. 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. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another.

This unit will be taught utilizing the Energy FOSS program kit.

Revision Date: July 2026

Essential Questions/ Enduring Understandings

Essential Questions:

- What evidence lets us know that energy is present?

- How can we solve problems using engineering?

- In what ways does the human use of natural resources affect the environment?

- What factors affect energy transfer in a collision?

- How can we use waves to gather and transmit information?

- How does wavelength and amplitude affect the sounds we hear?

Enduring Understandings:

- 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.

-The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use.

- 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.

Objectives

Students will know:

- Energy is present when there is light, sound, heat, and/or movement.
- Energy is transferred by moving objects.
- Collisions cause a change in direction.
- Objects move they have energy.
- A faster moving object has more energy than a slower moving object.
- An object, in motion, with more mass will have more energy than an object with less mass.
- The speed and mass of an object affect how much energy is transfered in a collision.
- Natural resources are finite materials used for energy.
- Energy is transferred into different forms.

- Properties of waves can affect energy transfer.
- A wave can be described in terms of wavelength and amplitude.
- The amplitude of a wave determines the volume of the sound.
- The wavelength of a wave determines the pitch of the sound.
- Objects have stored energy depending on their position of situation.

Students will be skilled at...

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating and communicating information

Learning Plan

Understanding Energy and Energry Transfer (FOSS Investigation 4-Energy Transfer)

Part 1 Presence of Energy: In this. investigation, students. work in centers to explore evidence of energy when sound, heat, and light are produced, and when objects are in motion. The big idea that students should take away is that energy is present when there is motion, light, sound, or heat. One possible assessment you can do with the students in addition to the I-Checks, you may have students take an object in the classroom and prove how they know that energy is present. For example, the computer has energy because it vibrates(movement), gets warm, the buttons light up, and it sometimes makes a sound.

BrainPOP:

Students do not need to know everything in this video, but it can be used as an introduction for the students.

Forms of Energy: Feeling energized? Or, maybe you're low on energy today? We use the word "energy" in conversation all the time, and it means something similar in science. Energy is what makes things happen! It comes in many forms, but all of them fall into one of two categories: kinetic or potential. Energy is all around us—and within us! Electrical energy powers our devices, chemical energy fuels our bodies, and light energy floods in from the Sun every day. Press "play" for an energy boost!

Part 2 Rolling Balls Down Slopes: In this investigation, students. will roll steel balls of different sizes down ramps and explore the system's variables. They will construct structured investigations to discover how the variables of starting position om the ramp and ball size (mass) affect the. speed of a rolling ball. The big idea

in this investigation that students should know is that a faster moving object has more energy.

BrainPOP- Kinetic Energy: What does kinetic energy help us do? Well...everything! In this BrainPOP movie, Tim and Moby discuss why kinetic energy is important. You'll see how this type of energy plays a part in everything from running a race to typing on a computer. Find out how kinetic energy and potential energy both relate to motion, plus the difference between the two. You'll learn about the role that mass and speed play in an object's amount of kinetic energy. Plus, you'll discover how kinetic energy can be transferred in different ways, like in a collision or domino effect, as well as how it can be transformed into electricity! We promise, this movie will really move you!

Part 3 Collisions: In this investigation, students place an obstacle (cork) in the pathway of a steel ball rolling down a ramp, forcing them to collide. They investigate that variables that determine. how far the. cork will move. along the. runway. Using controlled experiments, students test the variables of mass and starting position to find out how these. variables affect energy transfer. Focus on having students provide evidence that energy was transferred in a collision. For example, the moving object transferred energy to the other object because it moved, and i heard a sound when they collided. This is also a great opportunity to have students construct a line graph. Have them record the distance the cork traveled when the marble was released from 3 different heights on the ramp. Construct a line graph of the data. The big ideas in this lesson that students should take away is that when objects collide, energy is transferred from one object to another, causing a change in motion. Some energy is transferred to the other object, while some is transferred to the air (heat/sound) Students should also know that a faster moving object has more energy, therefore will transfer more energy to another object during a collision (the cork will move further the higher the starting position because the marble will roll faster). Likewise, an object with more mass has more energy than an object with less mass. (the cork will move farther when a larger marble is used).

BrainPOP- Potential Energy: Have you got potential? We think so! Potential energy is all around you—and even within you. But all that potential doesn't stay stored away forever. Whenever there's movement, it's because potential energy is being transformed into kinetic energy. Press "play" to find out what it means when something has potential energy, and what gravity has to do with it. There's enough fun in here to make you potentially obsessed!

Electrical Energy (FOSS Investigation 1- Energy Transfer in a Circuit)

Part 1 Lighting a Light Bulb: In this investigation, students are introduced to electricity and energy. They discover how to make a complete circuit using a D-cell, wires, and a light bulb. Upon successfully lighting their light bulbs, students can discuss the electricity's pathway in the circuit and the function of each of the system's components. They also take a closer look at the anatomy of a light bulb. You can make this an inquiry lesson by giving the students the wires, bulb, and battery and seeing if they can find different ways to light the bulb. You can also use their solutions to introduce the concept of a circuit and how it transfers energy. *Students do not need to know the parts of a light bulb. One form of assessment is Notebook sheet 1 "Lighting Bulbs". The big idea from this investigation is is that energy can move from place to place through sound, light, heat, and electric currents. A circuit is a complete path of and electric current. Students should know that in order to light a bulb, you need a power source, two points of contact on the power source, and

somewhere for the energy to go (bulb/buzzer/etc.). They will also know that Energy can transfer in a circuit. It begins in the battery, or power source, and ends at the bulb because it lit.

BrainPOP- Electric Circuits: Electrical circuits are mighty important — but how do they work? In this BrainPOP movie, Tim and Moby introduce you to the basics of what electrical circuits are all about! First you'll get a working knowledge of the components of a circuit, including the power source, terminals, and switch. You'll also learn what a current is, what a load is, and how batteries and wall outlets supply electricity to your house. Tim and Moby will also teach you why we use insulated copper wires to conduct electricity, and the difference between static electricity and the electrical currents in our homes. Don't get shocked if you become an electrical circuit genius after watching this movie!

Part 2: Conductors and Circuits: In this investigation students are. introduced to a switch and a motor to make a circuit that they can turn on and off. Students use a circuit and a collection of objects to determine which materials can complete the pathway (conductors) and which cannot (insulators). After developing the rule that metals are conductors, students consider foil and use evidence to confirm that foils are indeed metal. The big idea that students know its that some materials are conductors and others are insulators. Conductors allow energy to pass through them easily. Insulators do not allow energy to pass through them easily.

BrainPOP- Electric Circuits: Electrical circuits are mighty important — but how do they work? In this BrainPOP movie, Tim and Moby introduce you to the basics of what electrical circuits are all about! First you'll get a working knowledge of the components of a circuit, including the power source, terminals, and switch. You'll also learn what a current is, what a load is, and how batteries and wall outlets supply electricity to your house. Tim and Moby will also teach you why we use insulated copper wires to conduct electricity, and the difference between static electricity and the electrical currents in our homes. Don't get shocked if you become an electrical circuit genius after watching this movie!

Science and Engineering: At the end of the circuit investigations, you can have the students complete some sort of engineering design challenge to create an alarm system for their bedroom. They would need to consider how the buzzer or bulb will go off to let them know that someone has opened their door. In this case, the door acts like a switch to open and close the circuit. Another STEM idea is Project Circuitry created by the Pathways to Excellence team (Linked on this curriculum)

Properties of Sound Waves & Information Processing (FOSS Investigation 5 -Waves)

Part 1: Forms of Waves: In this investigation students experience waves through firsthand experiences using ropes, demonstrations with waves in water, spring toys, and a sound generator. They also use videos, animations and readings to gather information. Through these experiences, students learn that waves are repeating patterns of motion that transfer energy from place to place. They analyze compression waves (sound waves) to learn the general properties of waves-amplitude, wavelength, and frequency. The big ideas students should take away from this investigation are A wave is a regular pattern of motion. Or, the movement of energy through something (matter).

Here's a good visual: https://www.acs.psu.edu/drussell/demos/waves/wavemotion.html

They should also understand that when we hear, it is because energy has moved through the air and into our ears. They will know that our brain interprets this as sound. Students should know that a wave diagram is used to help study the differences in energy waves. Amplitude refers to how much energy a wave has. A wave with more energy will be taller than a wave with less energy. So, amplitude refers to the height of the wave. For sound waves, the amplitude affects how loud or soft the sound is. More amplitude=louder sound. Wavelength refers to the distance between the peaks of a wave. For sound waves, this affects the pitch. The shorter the wavelength, the higher the pitch. The longer the wavelength, the lower the pitch.

BrainPOP- Waves: Ready to make some waves? In this BrainPOP movie, Tim and Moby discuss all types of waves--from the kind that travel through the ocean to the kind that travel through outer space! You'll learn how water, sound, light and even earthquakes travel in waves, and also about the characteristics between them that we can measure and observe. You'll also find out how to determine how much energy each wave carries and how we use time and frequency to measure different types of waves, whether they're electromagnetic or mechanical. All this talk of waves is enough to make someone want to surf and listen to the radio all at the same time!

Part 2: Light Travels: In this investigation students use mirrors to experience reflecting light. They start by using mirrors outdoors to see objects behind them and to reflect a bright image of the SUN onto walls. In the classroom, they determine that a mirror can be used to reflect light. Students can use flashlights, mirrors, and water to observe light in numerous ways, reinforcing the idea that light can reflect and refract. Students build a conceptual model about how light travels. One misconception students often have is that we see because light enters our eye, then we see the object. That is not the case. The light must first reflect off of a surface and then into our eye. Let them know light must be present in order for us to see. Meaning, if you are in a totally dark room, your eyes will never "adjust". (This is another common misconception.) The mirror challenges are a great way for students to investigate these concepts. The big ideas that students should take away from this investigation is that light travels in straight lines. They will also learn that light reflects, or bounces off, of different surfaces. In order for us to see something, light reflects off of an object and into our eye.

BrainPOP- Light: Wanna know about light? You've come to the right place! In this BrainPOP movie, Tim and Moby will teach you all about artificial light sources and visible light. You'll learn about the two ways in which artificial light can be created, and how fast light can go. Whether you prefer to light your surroundings with a light bulb or a candle, you'll discover enough about each light source to understand how they work! You'll also gather info on natural sources of light — like from the sun and even some animals! Plus, Tim and Moby explain how the electromagnetic spectrum and reflected light help your eyes to see. How enlightening!

Standard not in FOSS

This whole standard:
PS4.C: Information Technologies and Instrumentation Digitized information 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)

To meet this standard, you can have students design a flashlight code, or complete the “How do you send a secret code?” lesson on Mystery Science.

Optional Engineering Design Challenge (Lesson plan provided in "Materials" section

Assessment

Formative: teacher observation, student responses during lessons, exit tickets, science notebook questions/observations

Summative: investigation response sheets, science notebooks, quizzes, Survey/Posttest Questions: 1a, 1b, 2a, 2b, 3a, 3b, 4, 5, 7, 9, 10,

Benchmark: iChecks Science Notebook

Alternative: oral presentation with visual model such as a Google slideshow to demonstrate understanding of concepts, drawing models, FOSS extensions

Standards

4-PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object.
	You can give back in areas that matter to you.
9.2.5.CAP.1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
	Constructing Explanations and Designing Solutions
P.4	Demonstrate creativity and innovation.

	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.
P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
	Use evidence (e.g., measurements, observations, patterns) to construct an explanation.
PS3.A	Definitions of Energy
P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
	The faster a given object is moving, the more energy it possesses.
	Energy and Matter
P.9	Work productively in teams while using cultural/global competence.
	Energy can be transferred in various ways and between objects.
4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
	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.
	Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
PS3.A	Definitions of Energy
	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.
	Energy and Matter
	Energy can be transferred in various ways and between objects.
4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.
	Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.
	Asking Questions and Defining Problems
	Asking questions and defining problems in grades 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.
	Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
PS3.A	Definitions of Energy
	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.
PS3.C	Relationship Between Energy and Forces
	When objects collide, the contact forces transfer energy so as to change the objects' motions.
	Energy and Matter
	Energy can be transferred in various ways and between objects.
4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
	Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.
	Constructing Explanations and Designing Solutions
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.
PS3.B	Conservation of Energy and Energy Transfer
	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.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-PS4	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.
RI.MF.4.6	Use evidence to show how graphics and visuals (e.g., illustrations, charts, graphs, diagrams, timelines, animations) support central ideas.
	Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.
RI.AA.4.7	Analyze how an author uses facts, details and explanations to develop ideas or to support their reasoning.
	Developing and Using Models
PS4.A	Wave Properties
W.AW.4.1.B	Provide reasons that are supported by facts from texts and/or other sources.
	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. (Note: This grade band endpoint was moved from K–2.)
	Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks).
	Patterns

	Similarities and differences in patterns can be used to sort and classify natural phenomena.
4-PS4-2	Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
PS4.B	Electromagnetic Radiation
	An object can be seen when light reflected from its surface enters the eyes.
4-PS4-3	Generate and compare multiple solutions that use patterns to transfer information.
	Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.
	Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.
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.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.
SL.PE.4.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.
SL.II.4.2	Paraphrase portions of a text read aloud or information presented in diverse media and formats (e.g., visually, quantitatively, and orally).
SL.PI.4.4	Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.

Materials

Core Book List

FOSS kit- Unit 1: Energy

Discovery Education/BrainPOP

Science notebook for assessment and journalinG

Brain Pop

Mystery Science

Optional Enginnering Design Challenge

Integrated Accommodations and Modifications, Special Education students, English

Language Learners, At-Risk students, Gifted and Talented students, Career Education, and those with 504's

https://docs.google.com/spreadsheets/d/1ivmYc4cqSjzCUCsZZkB5876Nnt42FhFxq92_3Tx8TOg/edit?usp=sharing