

# Unit 03: Energy and Waves (Week 17-26)

Content Area: **Template**  
Course(s):  
Time Period: **Full Year**  
Length: **6 weeks**  
Status: **Published**

## Standards Alignment

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### PS3.D: Energy in Chemical Processes and Everyday Life

- 6-PS3-3: Apply scientific principles to design, construct, and test a device that converts energy from one form to another.
- 6-PS3-4: Plan and conduct an investigation to provide evidence of the transfer of energy from one form to another.

### PS4.A: Wave Properties

- 6-PS4-1: Use a model to demonstrate that waves can transfer energy without transferring matter.
- 6-PS4-2: Develop a model to describe that waves are reflected, absorbed, or transmitted through various materials.

### PS3.B: Conservation of Energy and Energy Transfer

- 7-PS3-2: Use mathematical representations to describe the transformation of energy from one form to another.
- 7-PS3-3: Apply the law of conservation of energy to design, analyze, and refine a device that converts one form of energy to another.

### PS4.A: Wave Properties

- 7-PS4-1: Plan and conduct an investigation to explore the relationship between frequency and wavelength of a wave.
- 7-PS4-3: Evaluate the claims, methods, and designs of a device that uses wave properties to transfer energy or information.

### PS3.A: Definitions of Energy

- 8-PS3-3: Design, construct, and evaluate a device that converts one form of energy to another (e.g., solar to electrical, mechanical to thermal).
- 8-PS3-5: Construct and interpret graphical representations of data to describe the transfer of energy and energy transformation.

### PS4.A: Wave Properties

- 8-PS4-1: Analyze and interpret data to determine how the frequency and amplitude of waves affect their energy.
- 8-PS4-2: Develop and use a model to explain how waves can be used to communicate information.

## **New Jersey Student Learning Standards**

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### **Crosscutting Statements**

**5. Energy and Matter: Flows, Cycles, and Conservation – Tracking energy and matter flows, into, out of, and within systems helps one understand their system’s behavior.**

Energy can be transferred in various ways and between objects.

Matter is conserved because atoms are conserved in physical and chemical processes.

Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).

### **PS4.B: Electromagnetic Radiation**

Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1- PS4-3)

### **PS4: Waves and Their Applications in Technologies for Information Transfer**

#### **PS4.A: Wave Properties**

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

#### **PS4.B: Electromagnetic Radiation**

An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)

### **PS4: Waves and Their Applications in Technologies for Information Transfer**

#### **PS4.A: Wave Properties**

A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)

A sound wave needs a medium through which it is transmitted. (MS-PS4-2)

#### **PS4.B: Electromagnetic Radiation**

When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object’s material and the frequency (color) of the light. (MS-PS4-2)

The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)

A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)

However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

#### **PS4.C: Information Technologies and Instrumentation**

Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)

SCI.1-PS4	Waves and their Applications in Technologies for Information Transfer
SCI.1.PS4.A	Wave Properties
SCI.1.PS4.B	Electromagnetic Radiation
SCI.1.PS4.C	Information Technologies and Instrumentation
SCI.MS-PS3	Energy
SCI.MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or

	maximizes thermal energy transfer.
SCI.MS-PS3-4	Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
SCI.MS-PS4	Waves and Their Applications in Technologies for Information Transfer
SCI.MS-PS4-1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
SCI.MS-PS4-2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
SCI.MS-PS4-3	Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

## **Integration of Career Readiness, Life Literacies and Key Skills**

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CAEP.9.2.8.B.2	Develop a Personalized Student Learning Plan with the assistance of an adult mentor that includes information about career areas of interest, goals and an educational plan.
CAEP.9.2.8.B.3	Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.
CAEP.9.2.8.B.4	Evaluate how traditional and nontraditional careers have evolved regionally, nationally, and globally.
CAEP.9.2.8.B.6	Demonstrate understanding of the necessary preparation and legal requirements to enter the workforce.
CAEP.9.2.8.B.7	Evaluate the impact of online activities and social media on employer decisions.

## **Technology / Integration of Computer Science and Design Thinking**

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CS.6-8.8.1.8.AP.6	Refine a solution that meets users' needs by incorporating feedback from team members and users.
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## **Interdisciplinary Connections: NJSL for ELA, Social Studies, Science and/or Math Section**

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LA.RL.7.4	Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings; analyze the impact of rhymes and other repetitions of sounds (e.g., alliteration) on a specific verse or stanza of a poem or section of a story or drama.
LA.W.7.1.C	Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), reasons, and evidence.

## **Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media LiteracyNew Section**

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see Crosswalks

## 21st Century Life and Careers

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## Stage I: Desired Results

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### Transfer/Overview/Rationale

#### Transfer / Overview / Rationale

##### Unit Rationale

The purpose of this unit...

We use energy in all its forms almost every day. Every interaction among living and nonliving things is accompanied by the transfer and conversion of energy. Energy is the underlying currency that is necessary for everything humans do whether in the workplace, in their personal lives and with the natural environment that supports them. Waves describe how energy and matter travels. Understanding waves enables scientists to make new discoveries that impact society. For example: microwave ovens, x-ray machines, eyeglasses, tsunami prediction, radios and speakers. Scientists must understand all the properties of waves and how waves can differ from one another in order to design safe and effective products.

## Meaning

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## Essential Questions

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Essential Questions

What is energy?

How does an electrical current produce energy?

How is heat involved in energy changes?

What are the characteristics of waves?

When do we see waves in everyday life, and how are they useful?

How is a wave affected by different materials as it travels?

## **Enduring Understanding/Indicators of Understanding**

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### Enduring Understanding/Indicators of Understanding

Energy exists in various forms and can be transformed from one form to another.

Electricity is a form of energy resulting from the existence of an accumulation of charged particles (static) or dynamically as a current (power).

Electricity is used to generate energy that can be transformed into other forms of energy (sound, light, heat and motion).

Temperature is a measure of the average kinetic energy for the molecules/atoms in a substance.

Electromagnetic waves are produced by changing the motion of charges or by changing magnetic fields.

Light slows down, bends toward the normal and has a shorter wavelength when it enters a medium with a higher index of refraction than the medium in which it was previously traveling.

Vibrating objects produce sound waves that travel through the air.

## **Acquisition (Student Learning Objectives)**

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### **Knowledge**

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Knowledge

Students will know...

*Physics is “the study of matter, energy, and the interaction between them.” As an experimental science, physics utilizes the scientific method to ask fundamental questions based on observations of the natural world.*

**The Definition of Energy:** Energy is the ability to do work, or the ability to move or elicit change in matter. In effect, the amount of energy something has refers to its capacity to cause things to happen. Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the transfer of the different forms of energy.

**Energy Takes Many Forms:** These forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass with energy fields (potential energy).

**Conservation Of Energy And Energy Transfer:** Energy can neither be created or destroyed but can be changed from one form to another. Energy may transfer into or out of a system and it may change forms, but the total energy cannot change.

**Energy Interacting With Materials:** Heat energy is transferred by conduction, convection, and radiation. Heat energy transfers from warmer substances to cooler substances until they reach the same temperature. When a substance absorbs heat energy, the space between the particles expands. Heat energy comes from the random motion of the particles in an object or substance. Temperature is a measure of the motion of the particles.

*Examples of all types of waves are found in nature. Our understanding of the physical world is not complete until we understand the properties and behaviors of waves.*

**Transfer of Energy:** Light energy radiates from a source and travels in straight lines. Light is reflected, refracted, transmitted, and absorbed differently by different materials. To see an object, light energy emitted or reflected from the object must enter the eye.

**Sources of Energy:** Energy from the Sun takes the form of electromagnetic waves such as infrared, visible, and

ultraviolet electromagnetic waves. The radiation from the Sun consists of a range of energies in the electromagnetic spectrum.

**Forms of Energy:** Sound energy is the energy that takes the form of mechanical waves passing through objects or substances. The energy delivered by a wave in a given unit of time is determined by the amplitude and frequency of the wave.

**Wave Application:** The different components of the electromagnetic spectrum are used in different ways on Earth and current technologies utilize the power of each type of wave.

## **Skills**

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Skills

Student will be skilled at ...

### **Energy:**

Students will explore the various forms of energy and how each may transform into another.

Students will discover that electricity in circuits can generate energy in the form of light, heat and magnetism.

Students will differentiate and explain the uses of of the different methods of heat transfer.

Students will predict and describe changes in particle motion, temperature and state when thermal energy is added or removed.

### **Waves:**

Students will investigate how traveling through various media affects a wave.

Students will distinguish the properties of waves and differentiate among transverse, compression, and mechanical waves.

Students will categorize wave behaviors and determine their importance.

Students will connect mathematics skills by isolating algebraic variables to solve wavelength problems for either frequency, wavelength or time.

Students will relate hearing to the sensing of frequency and pitch.

Students will utilize the anatomy of the ear to generate how humans receive and recognize sound.

Students will understand how the human eye interprets light.

Students will understand that all light travels as a wave, and that wavelength defines the various regions of the electromagnetic spectrum.

Students will investigate how light can maneuver using various tools.

Students will observe the visible light spectrum and manipulate the cone cells in their eyes to view various colors.

### **Stage 3: Learning Plan**

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### **Resource and Mentor Texts**

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Resources and Mentor Texts

Internet/Videos

Interactive Notebooks/Materials

Google Presentations

Interactive Websites

Document Camera

Lab Materials

Copies of Student Activity Materials

## **Formative Assessment Strategies**

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Formative Assessment Strategies

Observation/Discussion/Informal Questioning

Interactive Notebook Activities/Graphic Organizers

Quizzes/Checkpoints/Wrap-Ups

Peer/Self Assessments (Reflection)

Notebook Checks

Virtual labs

## **Learning Activities/Unit of Study**

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Learning Activities/Unit of Study

Electricity: Design a Circuit; Virtual Lab

Thermal Energy: Virtual Lab

Light: Seeing is Believing Activity

Sound: Visualizing Sound

[Basic Concepts of Electricity](#)

[Electricity Activities](#)

[Put A Spark In It! - Electricity](#)

[Thermal Energy Virtual Lab](#)

[Heat Transfer Activities](#)

[Seeing is Believing Activity](#)

[Soundinator](#)

[The Science of Sound](#)

[Visualizing Sound](#)

## **Modifications and/or Accommodations**

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### **Suggested Modifications (ELL, Sp. Ed, Gifted, At-risk of Failure)**

#### **English Language Learners**

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson

being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

## **Special Education Students**

**Chunking:** The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

**Checking for Understanding:** It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

**Extra time:** The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

**Oral Reading:** The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

**Timers:** The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

## **Students with 504 Plans**

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## **Gifted & Talented Strategies**

**Extensions/Enrichments:** Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

**Modify/Change Activities:** Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

## Students at Risk of School Failure

**Directions or Instructions:** Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

**Peer Support:** Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

**Alternate or Modified Assignments:** Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

**Increase One to One Time:** When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

**Contracts:** It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

**Hands On:** As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

**Tests/Assessments:** Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

**Seating:** Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.

