

AP PHYSICS UNIT 4 - ENERGY

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Department of Curriculum and Instruction



Belleville Public Schools

Curriculum Guide

AP PHYSICS 11,12

ENERGY

Belleville Board of Education

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Unit Overview

In Unit 4, students will be introduced to the idea of conservation as a foundational model of physics, along with the concept of work as the agent of change for energy. As in earlier units, students will once again utilize both familiar and new models and representations to analyze physical situations, now with force or energy as major components. Students will be encouraged to call upon their knowledge of Units 1–4 to determine the most appropriate technique and will be challenged to understand the limiting factors of each. Describing, creating, and using these representations will also help students grapple with common misconceptions that they may have about energy, such as whether or not a single object can “have” potential energy. A thorough understanding of these energy models will support students’ ability to make predications—and ultimately justify claims with evidence—about physical situations. This is crucial, as the mathematical models and representations used in Unit 4 will mature throughout the course and appear in subsequent units. As students’ comprehension of energy (particularly kinetic, potential, and microscopic internal energy) evolves, they will begin to connect and relate knowledge across scales, concepts, and representations, as well as across disciplines, particularly physics, chemistry, and biology.

Enduring Understanding

A system is an object or a collection of objects. The objects are treated as having no internal structure. For all systems under all circumstances, energy, charge, linear momentum, and angular momentum are conserved. For an isolated or a closed system, conserved quantities are constant. An open system is one that exchanges any conserved quantity with its surroundings.

An interaction can be either a force exerted by objects outside the system or the transfer of some quantity with objects outside the system.

The placement of a boundary between a system and its environment is a decision made by the person considering the situation in order to simplify or otherwise assist in analysis.

The change in the kinetic energy of an object depends on the force exerted on the object and on the displacement of the object during the interval that the force is exerted.

Only the component of the net force exerted on an object parallel or antiparallel to the displacement of the object will increase (parallel) or decrease (antiparallel) the kinetic energy of the object.

The magnitude of the change in the kinetic energy is the product of the magnitude of the displacement and of the magnitude of the component of force parallel or antiparallel to the displacement.

The component of the net force exerted on an object perpendicular to the direction of the displacement of the object can change the direction of the motion of the object without changing the kinetic energy of the object.

This should include uniform circular motion and projectile motion.

The kinetic energy of a rigid system may be translational, rotational, or a combination of both. The change in the rotational kinetic energy of a rigid system is the product of the angular displacement and the net torque.

The energy of a system includes its kinetic energy, potential energy, and microscopic internal energy.

Examples include gravitational potential energy, elastic potential energy, and kinetic energy.

A rotating, rigid body may be considered to be a system and may have both translational and rotational kinetic energy.

Although thermodynamics is not part of Physics 1, included is the idea that, during an inelastic collision, some of the mechanical energy dissipates as (converts to) thermal energy.

Mechanical energy (the sum of kinetic and potential energy) is transferred into or out of a system when an external force is exerted on a system such that a component of the forces is parallel to its displacement. The process through which the energy is transferred is called work.

If the force is constant during a given displacement, then the work done is the product of the displacement and the component of the force parallel or antiparallel to the displacement.

Work (change in energy) can be found from the area under a graph of the magnitude of the force component parallel to the displacement versus displacement.

Classically, an object can only have kinetic energy since potential energy requires an interaction between two or more objects.

A system with internal structure can have internal energy, and changes in a system's internal structure can result in changes in internal energy.

A system with internal structure can have potential energy. Potential energy exists within a system if the objects within that system interact with conservative forces.

The work done by a conservative force is independent of the path taken.

The work description is used for forces external to the system. Potential energy is used when the forces are internal interactions between parts of the system. Changes in the internal structure can result in changes in potential energy. Examples include mass-spring oscillators and objects falling in a gravitational field.

The change in electric potential in a circuit is the change in potential energy per unit charge.

The internal energy of a system includes the kinetic energy of the objects that make up the system and the potential energy of the configuration of the objects that make up the system.

Since energy is constant in a closed system, changes in a system's potential energy can result in changes to the system's kinetic energy.

The changes in potential and kinetic energies in a system may be further constrained by the construction of the system.

Energy can be transferred by an external force exerted on an object or a system that moves the object or system through a distance; this energy transfer is called work. Energy transfer in mechanical or electrical systems may occur at different rates. Power is defined as the rate of energy transfer into, out of, or within a system. [

Essential Questions

What are the different ways energy affects the motion of objects?

What are examples of systems that convert mechanical energy from one form to another?

Explain the transfer of energy in a roller coaster?

In the real world, can a machine ever be 100% efficient? Why?

How can we use models to illustrate that energy can be accounted for as a combination of energy associated with the motion of particles and the energy associated with the relative position of particles?

How can we model the change in energy of one component of the system when the change in energy of the other component(s) and of the system are known?

How can we use energy to predict the motion or displacement of objects?

How does energy transfer explain change?

How can conservation of energy be used to predict an object's motion?

What does "energy cannot be created or destroyed" mean?

Exit Skills

Describe the relationship between work and energy.

Calculate work.

Calculate the work done by a variable force.

Calculate the power used.

Demonstrate knowledge of the usefulness of simple machines.

Differentiate between ideal and real machines in terms of efficiency.

Analyze compound machines in terms of simple machines.

Calculate efficiencies for simple and compound machines.

Use a model to relate work and energy.

Calculate kinetic energy.

Determine the gravitational potential energy of a system.

Identify how elastic potential energy is stored.

Solve problems using the law of conservation of energy.

Analyze collisions to find the change in kinetic energy.

New Jersey Student Learning Standards (NJSL-S)

[NextGen Science Standards](#)

SCI.HS.PS2.A	Forces and Motion
SCI.HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
SCI.HS.PS2.A	Forces and Motion
SCI.HS-PS2-3	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
SCI.HS.PS2.A	Forces and Motion
SCI.HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
SCI.HS.PS2.B	Types of Interactions
SCI.HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
SCI.HS.PS3.A	Definitions of Energy
	Energy and Matter

SCI.HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
SCI.HS.PS3.A	Definitions of Energy Energy and Matter
SCI.HS.PS3.B	Conservation of Energy and Energy Transfer
SCI.HS.PS3.C	Relationship Between Energy and Forces Energy and Matter
SCI.HS.ESS2.D	Weather and Climate
SCI.HS.ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
SCI.HS.ESS2.D	Weather and Climate
SCI.HS.ESS2.D	Weather and Climate
SCI.HS.ESS3	Earth and Human Activity
SCI.HS.ESS3.D	Global Climate Change
SCI.HS.ESS3.D	Global Climate Change
CS.9-12.8.1.12.DA.2	Describe the trade-offs in how and where data is organized and stored.
CS.9-12.ETW	Effects of Technology on the Natural World

Interdisciplinary Connections

- Explain why an object has gravitational potential, elastic potential and kinetic energy.
- Describe how gravitational potential energy can be converted in kintetic energy.
- Describe how gravitational potential energy can be converted in elastic potential energy.
- Describe how elastic potential energy can be converted in kintetic energy.

Please list all and any additional **Interdisciplinary Connections/Cross-Curricular** New Jersey Student Learning Standards that link to this unit, and which are not included in the NJSLs section above.

MA.A-SSE	Seeing Structure in Expressions
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
LA.RH.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of primary and secondary sources, connecting insights gained from specific details to develop an understanding of the text as a whole.
MA.A-SSE.A.1a	Interpret parts of an expression, such as terms, factors, and coefficients.
LA.RH.11-12.2	Determine the theme, central ideas, information and/or perspective(s) presented in a primary or secondary source; provide an accurate summary of how key events, ideas and/or author's perspective(s) develop over the course of the text.
LA.RH.11-12.3	Evaluate various perspectives for actions or events; determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.
LA.RH.11-12.4	Determine the meaning of words and phrases as they are used in a text, including

	analyzing how an author uses and refines the meaning of a key term over the course of a text (e.g., how Madison defines faction in Federalist No. 10).
LA.RH.11-12.9	Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.
MA.A-APR.A	Perform arithmetic operations on polynomials
LA.RST.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
LA.RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
LA.WHST.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
LA.WHST.11-12.2.E	Provide a concluding paragraph or section that supports the argument presented.
LA.WHST.11-12.6	Use technology, including the Internet, to produce, share, and update writing products in response to ongoing feedback, including new arguments or information.

Learning Objectives

The student will be able to..

- Define open and closed systems for everyday situations and apply conservation concepts for energy, charge, and linear momentum to those situations.
- Make predictions about the changes in kinetic energy of an object based on considerations of the direction of the net force on the object as the object moves.
- Use net force and velocity vectors to determine qualitatively whether the kinetic energy of an object would increase, decrease, or remain unchanged.
- Use force and velocity vectors to determine qualitatively or quantitatively the net force exerted on an object and qualitatively whether the kinetic energy of that object would increase, decrease, or remain unchanged.
- Apply mathematical routines to determine the change in kinetic energy of an object given the forces on the object and the displacement of the object.
- Calculate the total energy of a system and justify the mathematical routines used in the calculation of component types of energy within the system whose sum is the total energy.
- Predict changes in the total energy of a system due to changes in position and speed of objects or frictional interactions within the system.
- Make predictions about the changes in the mechanical energy of a system when a component of an external force acts parallel or antiparallel to the direction of the displacement of the center of mass.
- Apply the concepts of conservation of energy and the work-energy theorem to determine qualitatively and/or quantitatively that work done on a two-object system in linear motion will change the kinetic energy of the center of mass of the system, the potential energy of the systems, and/or the internal energy of the system.
- Create a representation or model showing that a single object can only have kinetic energy and use information about that object to calculate its kinetic energy.
- Translate between a representation of a single object, which can only have kinetic energy, and a system that includes the object, which may have both kinetic and potential energies.
- Calculate the expected behavior of a system using the object model (i.e., by ignoring changes in internal structure) to analyze a situation. Then, when the model fails, the student can justify the use of conservation of energy principles to calculate the change in internal energy due to changes in internal structure because the object is actually a system.
- Describe and make qualitative and/or quantitative predictions about everyday examples of systems with

internal potential energy.

Make quantitative calculations of the internal potential energy of a system from a description or diagram of that system.

Apply mathematical reasoning to create a description of the internal potential energy of a system from a description or diagram of the objects and interactions in that system.

Describe and make predictions about the internal energy of systems.

Calculate changes in kinetic energy and potential energy of a system using information from representations of that system.

Design an experiment and analyze data to determine how a force exerted on an object or system does work on the object or system as it moves through a distance.

Design an experiment and analyze graphical data in which interpretations of the area under a force-distance curve are needed to determine the work done on or by the object or system.

Predict and calculate from graphical data the energy transfer to or work done on an object or system from information about a force exerted on the object or system through a distance.

Make claims about the interaction between a system and its environment in which the environment exerts a force on the system, thus doing work on the system and changing the energy of the system (kinetic energy plus potential energy).

Predict and calculate the energy transfer to (i.e., the work done on) an object or system from information about a force exerted on the object or system through a distance.

Describe the relationship between work and energy.

Calculate work.

Calculate the work done by a variable force.

Calculate the power used.

Use a model to relate work and energy.

Calculate kinetic energy.

Determine the gravitational potential energy of a system.

Identify how elastic potential energy is stored.

Analyze collisions to find the change in kinetic energy.

Describe the force in an elastic spring.

Determine the energy stored in an elastic spring.

Solve problems using the law of conservation of energy.

Demonstrate knowledge of the usefulness of simple machines.

Differentiate between ideal and real machines in terms of efficiency.

Analyze compound machines in terms of simple machines.

Calculate efficiencies for simple and compound machines.

Compare simple harmonic motion and the motion of a pendulum.

Describe the force in an elastic spring.

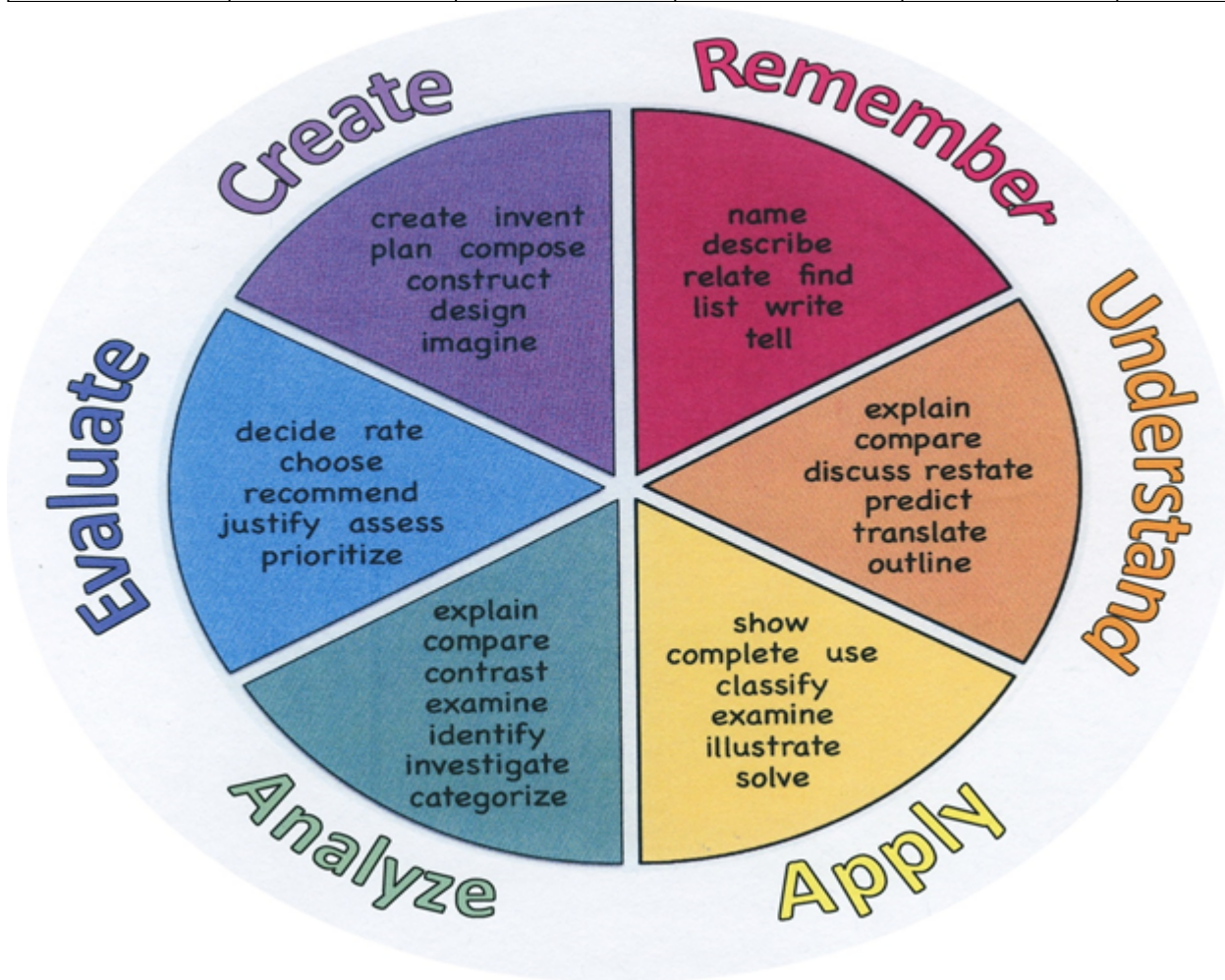
Determine the energy stored in an elastic spring.

Explain the concept of climate change.

Action Verbs: Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

Remember	Understand	Apply	Analyze	Evaluate	Create
Choose	Classify	Choose	Categorize	Appraise	Combine
Describe	Defend	Dramatize	Classify	Judge	Compose
Define	Demonstrate	Explain	Compare	Criticize	Construct
Label	Distinguish	Generalize	Differentiate	Defend	Design
List	Explain	Judge	Distinguish	Compare	Develop
Locate	Express	Organize	Identify	Assess	Formulate
Match	Extend	Paint	Infer	Conclude	Hypothesize

Memorize	Give Examples	Prepare	Point out	Contrast	Invent
Name	Illustrate	Produce	Select	Critique	Make
Omit	Indicate	Select	Subdivide	Determine	Originate
Recite	Interrelate	Show	Survey	Grade	Organize
Select	Interpret	Sketch	Arrange	Justify	Plan
State	Infer	Solve	Breakdown	Measure	Produce
Count	Match	Use	Combine	Rank	Role Play
Draw	Paraphrase	Add	Detect	Rate	Drive
Outline	Represent	Calculate	Diagram	Support	Devise
Point	Restate	Change	Discriminate	Test	Generate
Quote	Rewrite	Classify	Illustrate		Integrate
Recall	Select	Complete	Outline		Prescribe
Recognize	Show	Compute	Point out		Propose
Repeat	Summarize	Discover	Separate		Reconstruct
Reproduce	Tell	Divide			Revise
	Translate	Examine			Rewrite
	Associate	Graph			Transform
	Compute	Interpolate			
	Convert	Manipulate			
	Discuss	Modify			
	Estimate	Operate			
	Extrapolate	Subtract			
	Generalize				
	Predict				



Suggested Activities & Best Practices

Concept-Oriented Demonstration; Release a low-friction cart (mass m) from the top of a ramp, have students time (t) how long it takes to reach the bottom, and measure the release height h and track length L . Have students calculate velocity using $v = L/t$, and then calculate mgh and $\frac{1}{2}mv^2$. The two energies are different; explain what incorrect assumptions lead to the difference in energies.

Desktop Experiment Task; Give each group a spring-loaded ball launcher, scale, and meterstick. Ask them to determine the spring constant of the spring in the launcher.

Four-Square Problem Solving First square; Describe an everyday situation (e.g., “a car goes downhill, speeding up even as the brakes are pressed”) along with a diagram. Second square: Free-body diagram with an arrow off to the side representing the object’s displacement. Third square: Energy bar charts (initial and final). Fourth square: For each force on the free-body diagram, state whether that force performs positive or negative work and what energy transformation that force is responsible for.

Construct an Argument; Ask students to consider a cart that rolls from rest down a ramp and then around a vertical loop. For the cart to complete the loop without falling out, the cart must be released at a height higher than the top of the loop. Have students explain why this is the case using energy and circular motion principles.

Working Backward; Student A writes a conservation of energy equation (either symbolically or with numbers and units plugged in). Student B then describes a situation that the equation could apply to, draws a diagram, and draws energy bar charts.

Measure velocity and position of objects before the experiment starts
Measure velocity and position of objects during the experiment
Measure velocity and position of objects at the end of the experiment

Calculate kinetic energy before the experiment starts
Calculate gravitational potential energy before the experiment starts
Calculate elastic potential energy before the experiment starts

Calculate kinetic energy during the experiment

Calculate gravitational potential energy during the experiment

Calculate elastic potential energy during the experiment

Calculate kinetic energy after the experiment ends

Calculate gravitational potential energy after the experiment ends

Calculate elastic potential energy after the experiment ends

Virtual Lab on conservation of energy (<https://phet.colorado.edu/>)

Virtual Lab on conservation of momentum (<https://phet.colorado.edu/>)

Virtual Lab on simple machines (<https://phet.colorado.edu/>)

Graphing utilization of renewable energy over years

Amistad: a lesson for the humanity: how the African American Scientists made a difference in our society.

Assessment Evidence - Checking for Understanding (CFU)

Student must be able to graph fundamental quantities kinetic energy vs velocity on a cartesian coordinate plane. (Formative)

Student must be able to graph fundamental quantities gravitational potential energy vs height on a cartesian coordinate plane. (Formative)

Student must be able to graph fundamental quantities elastic potential energy vs position on a cartesian coordinate plane. (Formative)

Common, Department Quarterly Benchmarks (Benchmark)

Oncourse Assessment Tools (Formative)

Unit Test/Quiz (Summative)

"Do Now/Exit Ticket" Activity (Formative)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Learning Center Activities
- Multimedia Reports
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep

- Unit tests
- Web-Based Assessments
- Written Reports

Primary Resources & Materials

Textbook, Giancoli AP Edition

Internet

AP Physics Exam, Princeton Review

Masteringphysics.com

Please list all district-provided Primary Resources & Materials and/or those outside that are accessed with district resources.

Ancillary Resources

Teacher Prepared Materials

Lab Materials

Study Guide Materials

United Streaming Videos

The Physics Classroom: www.thephysicsclassroom.com

STEM Lab

AP Central Resources.

Please list all additional resources that will be used to strengthen this unit's lessons.

Technology Infusion

Students must be able to use the photogates to measure the velocity of a moving object.

Students must be able to use airtruck to calculate the loss of energy during the experiments.

Students must be able to use airtruck to calculate the coefficient of friction during the experiments.

Albert.io

AP Collegeboard

What **Technology Infusion** and/or strategies are integrated into this unit to enhance learning? Please list all hardware, software and strategies. Please find a technology pedagogy wheel for assistance while completing this section.

Alignment to 21st Century Skills & Technology

Mastery and infusion of **21st Century Skills & Technology** and their Alignment to the core content areas is essential to student learning. The core content areas include:

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

WRK.9.2.12.CAP.1	Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession.
WRK.9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
WRK.9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
WRK.9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
WRK.9.2.12.CAP.13	Analyze how the economic, social, and political conditions of a time period can affect the labor market.
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.DC.1	Explain the beneficial and harmful effects that intellectual property laws can have on the creation and sharing of content (e.g., 6.1.12.CivicsPR.16.a).
TECH.9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).

TECH.9.4.12.GCA.1

Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).

21st Century Skills/Interdisciplinary Themes

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Please list only the **21st Century/Interdisciplinary Themes** that will be incorporated into this unit.

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

21st Century Skills

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Please list only the **21st Century Skills** that will be incorporated into this unit.

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

Differentiation

Please remember: Effective educational **Differentiation** in a lesson lies within content, process, and/or product.

Please identify the ones that will be employed in this unit.

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes

- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

Determining if the energy of an object is increasing, decreasing, or staying same by checking the variables.

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format

- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

Visualizing conservation of energy by making a poster presentaiton.

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarify
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of work presented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

Comparing kinetic energies of moving objects.

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of work presented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

- Students must be able to solve calculus based problems.

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities

- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

Unit Name: WORK AND ENERGY

NJSLS: SCI.HS-PS3.A, SCI.HS-PS3.B, SCI.HS-PS3.C, SCI.HS-PS2, SCI.HS-PS2-1, SCI.HS-PS2-2, SCI.HS-PS2.A, LA.RH.11-12.7, LA.RH.11-12.9, LA.RST.11-12.1, LA.RST.11-12.2, MA.A-APR.A, MA.A-CED.A.1, MA.A-CED.A.2

Interdisciplinary Connection: Vocabulary and algebra contents

Statement of Objective: The students will demonstrate the ability to produce a lab to measure the conversion between potential energy and kinetic energy by performing experiments with 90% accuracy.

Anticipatory Set/Do Now: convert 50 MJ into mJ

Learning Activity:

Lecture –elastic potential energy. Law of conservation of energy

Small groups activity: measure the conversion between kinetic and elastic potential energy.

Final review: units for energy

Student Assessment/CFU's: Lab report, Exit ticket

Materials: Chromebook

Safety equipments.

Power Point.

21st Century Themes and Skills: Critical thinking and Problem Solving

Differentiation: Different level of questions

Students must be able to calculate potential, kinetic, and mechanical energy . (Gifted and Talented)

Students must be able to rank gravitational potential energy of the objects given. (Special Ed)

Integration of Technology: Power Point

