Unit 06: Work and Energy

Content Area: **Science**
Course(s):
Time Period: **Marking Period 3**
Length: **6 Weeks**
Status: **Published**

Summary

This unit introduces the concept of energy and the conservation of energy. Students will analyze how energy is transferred and transformed in the world around them.

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Standards

9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
9.4.12.CT	Critical Thinking and Problem-solving
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
8.1.12.DA.5	Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
LA.WHST.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
LA.WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
LA.WHST.11-12.9	Draw evidence from informational texts to support analysis, reflection, and research.
LA.SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
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).
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.
HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.

Transfer

- Apply knowledge and skills utilized in their Rube Goldberg Simple Machines project to understand how "things work" and to solve everyday problems.

Essential Questions

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- What is the principle of The Conservation of Energy and what are it's implications for our world?

- How is energy transferred and transformed?

- What forms does mechanical energy take?

- How does power relate to the concept of energy?

Enduring Understanding

- Energy cannot be created or destroyed

- All mechanical energy is eventually transformed into thermal energy

- The total quantity of energy in the universe is fixed

- Energy is transferred and/or transformed by doing Work

Objectives

- Students will be skilled at applying the conservation of energy to predict the motion of objects on incline planes, pendulums, springs, etc

- Students will be skilled at identifying energy transfers and transformations in the world around them

- Students will be skilled at designing and building a Rube Goldberg Machine

- Students will be skilled at calculating the work done and power generated during various weight lifting exercises

- Students will be skilled at determining the efficiency and mechanical advantage of simple machines

- Students will know the forms of mechanical energy

- Students will know that work involves a force acting over a distance

- Students will know the meaning of positive and negative work

- Students will know that energy is conserved quantity

- Students will know how the conservation of energy was originally tested

Learning Plan

- Richard Feynman lecture: "What is energy?"

- Demos and discussion: "Forms of energy"

- Phet Simulation: "Energy Forms and Changes"

- Teacher presentation: "Conservation of Energy"

- Video: "The Mechanical Universe: The conservation of energy"

- Phet Simulation: "Energy Skate Park"

- Lab: Inclines pendulums and springs

- Cooperative problem solving: energy conservation

- Activity: "Doin Work"

- Socratic questioning and class discussion: Work and the transfer/transformation of energy

- Video: Eureka - Work

- Lab: Stopping distance in sand

- Teacher presentation: Simple Machines

- Lab: Determining Mechanical Advantage and Efficiency

- Rube Goldberg Project

Assessment

Formative:

Do Now Questions

Exit Ticket Questions

Whole Class Discussion Participation

Small Group Discussion Participation

Individual Student Questions/Responses

Cooperative Problem Solving *(Conservation of Energy)*

Lab Experiments *(Inclines, Pendulums and Springs; Stopping a ball in the sand; Determining Mechanical Advantage and Efficiency)*

Quizzes

Summative:

Formal Lab Report

Unit Test

Rube Goldberg Project

Benchmark:

Honors Physics Final Exam

Alternative Assessments:

Guided Formal Lab Report

Unit Study Guide

Materials

Textbook PHYSICS: PRINCIPLES WITH APPLICATIONS 6th Edition GIANCOLI, PEARSON

Mechanical Universe Video Series

Video: Feynman Lectures

Cosmos Video Series

Equipment for energy/work demos

Chromebooks for PhET Simulation

Materials for Rube Goldberg Project

Lab Equipment: ramps, ball bearings, stopwatches, slotted masses, meter sticks, bricks, ring stands, spring scales, rubber bands, balances, pulleys, screws, incline planes, sand, springs

Computer / Smart board

¼ inch graph paper

Integrated Accommodation and Modifications

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https://docs.google.com/spreadsheets/d/1XVU7bji7iOgH8W9w9PLxDox44Da1R1oCxiSeoIztRGQ/edit?usp=sharing