

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.

Updated July 2022

Standards

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.
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.
SCI.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.
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-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
SCI.HS-PS3-5	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.
SCI.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.
SCI.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.
CS.9-12.8.1.12.DA.5	Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
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.
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	Critical Thinking and Problem-solving

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

FOR SPECIAL EDUCATION STUDENTS , ELL, AT RISK AND STUDENTS GIFTED STUDENTS

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