Unit 3 Energy

Content Area: **Science**
Course(s): **Sample Course**
Time Period: **JanFeb**
Length: **8 Weeks/Grade 6**
Status: **Published**

Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

ADVANCED PHYSICAL SCIENCE, GRADE 6

UNIT 3 ENERGY

Belleville Board of Education

102 Passaic Avenue

Belleville, NJ 07109

Prepared by: Terrence McCaffrey

Dr. Richard Tomko, Ph.D., M.J., Superintendent of Schools

Dr. Giovanni Cusmano, Director of Elementary Education K -8

Mr. George Droste, Director of Secondary Education

Board Approved: August 30, 2017

Unit Overview

In Unit 3 Energy, students will:

- conclude, through observation, that when two objects interact, it can result in an energy transfer and explore both natural and designed systems that can serve as models of energy transfer and transformation.
- develop models to demonstrate that potential energy is stored energy due to an object's position or condition, kinetic energy is proportional to mass and the square of velocity, gravitational potential is proportionate to mass and height.
- debate the feasability of a perpetual motion machine.
- design a device to demonstrate potential energy.
- explore the many forms that energy can take and how it can be transfered from one object to another.
- observe that thermal energy flows warmer objects to cooler objects
- plan and conduct an investigation into how the thermal energy of an object is affected by it's size and shape.
- explore how heat exchange is part of energy conservation.

Enduring Understanding

- Achieving energy conservation reguires an understanding of the properties of energy.
- Motion energy is properly called kinetic energy and is proportionate to its mass and velocity, growing with the square of its speed.
- A system of objects may contain potential energy depending on its condition or position.
- When designing roller coasters, engineers must understand transformation of potential energy to kinetc energy.
- Temperature is the measure of the average kinetic energy of particles of matter.
- The amount of energy transfer needed to change the temperature of a matter depends on the nature of the matter, the size of the sample, and the environment.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
- Energy can only be transfered or transformed. It can not be created or destroyed.

Essential Questions

- What do we mean by work?
- How can the potential energy of an object change?
- What is the relationship between kinetic and potential energy?
- Desribe how energy transfers from potential to kinetic and back again in a roller coaster.
- Which has more energy a large truck or a small car?
- Can energy be created or destroyed?
- How can we minimize the change in temperature of an object?
- How does heat travel from one object to another?
- How can we move water uphill?
- What does it mean to say that a system is "energy efficient"?
- Is it possible to create a perpetual motion machine?

Exit Skills

By the end of Unit 3, the student should be able to:

- Construct and interpret graphical displays to describe the relationship of kinetic energy to the mass and speed of an object.
- Develop a model to decribe that when the arrangement of objects interact at different distances, different amounts of potential energy are stored in the system.
- Evaluate competing design solutions using systematic process to determine how well they meet the criteria and constraints of the problem.
- Apply scientific principles to design and test a device that either minimizes or maximizes thermal energy transfer.
- Plan an investigation to determine the relatioships between the energy transferred, the type of matter, the mass, and change in average kinetic energy of the particles as measured by the temperature of the sample.
- Construct, use and present arguements to support their understanding of how kinetic energy is transfered to or from and object.

New Jersey Student Learning Standards (NJSLS-S)

6-8.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.
6-8.MS-PS3-5	Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
6-8.MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
6-8.MS-PS3-2	Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
6-8.MS-PS3-2.2.1	Develop a model to describe unobservable mechanisms.

6-8.MS-PS3-4.3.1	Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
6-8.MS-PS3-1.3.1	Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
6-8.MS-PS3-4.3.1	Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
6-8.MS-PS3-2.4.1	Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.
6-8.MS-PS3-5.5.1	Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
6-8.MS-PS3-3.5.1	The transfer of energy can be tracked as energy flows through a designed or natural system.
6-8.MS-PS3-3.6.1	Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.
6-8.MS-PS3-5.7.1	Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon.
6-8.MS-PS3-1.PS3.A.1	Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
6-8.MS-PS3-2.PS3.A.1	A system of objects may also contain stored (potential) energy, depending on their relative positions.
6-8.MS-PS3-4.PS3.A.1	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
6-8.MS-PS3-3.PS3.A.1	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
6-8.MS-PS3-4.PS3.B.1	The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.
6-8.MS-PS3-3.PS3.B.1	Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
6-8.MS-PS3-5.PS3.B.1	When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
6-8.MS-PS3-2.PS3.C.1	When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.
6-8.MS-PS3-3.ETS1.A.1	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.

Interdisciplinary Connections

LA.RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts.
LA.RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
LA.RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
LA.RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
LA.RST.6-8.5	Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
LA.RST.6-8.6	Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.
LA.RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
LA.RST.6-8.8	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
LA.RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
LA.RST.6-8.10	By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.
LA.WHST.6-8.1	Write arguments focused on discipline-specific content.
LA.WHST.6-8.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.6-8.3	(See note; not applicable as a separate requirement)
LA.WHST.6-8.4	Produce clear and coherent writing in which the development, organization, voice, and style are appropriate to task, purpose, and audience.
LA.WHST.6-8.5	With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
LA.WHST.6-8.6	Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.
LA.WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
LA.WHST.6-8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
LA.WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research.
LA.WHST.6-8.10	Write routinely over extended time frames (time for research, reflection, metacognition/self correction, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Learning Objectives

- Observe and explain how energy can be transfered and transformed.
- Differentiate between kinetic and potential energy and the different forms it can take.
- Examine energy transformation in everyday life in context of energy flows.
- Analyze the flow of energy within natural and designed systems.
- Identify and diagram unobservable forces such as kinetic and potential energy, and gravity.
- Construct and interperet graphical displays of data that show the the relationships such as kinetic energy - mass and speed

- Model, analyze, and predict the changes in the kinetic and potential energy in a system of objects.
- Analyze data from a prototype system to propose methods for optimizing its design while solving a problem.
- Gather evidence to explain how in a designed system, motion (kinetic energy) is able to produce light.
- Model the transfers and transformations of energy.
- Examine how simple and complex machines can apply energy transfer to reduce human effort/work.
- Analyze the transfer of between objects as hotter objects transfer out energy into colder objects.
- Explain the Law of Conservation of Energy.
- Explore the three ways that energy is transferred between objects as heat.
- Examine how the nature of the matter of an object affects the magnitude of the thermal conductivity of a substance.

Suggested Activities

From HMH Curriculum Activities:

- Engage: Lesson Phenomenons
- Explore/Explain: Hands on Labs and Engineer It
- Unit Projects
- Unit Performance Tasks

From Defined Stem:

- Performance Tasks
- Literacy Tasks
- Constructed Response

Evidence of Student Learning - Checking for Understanding (CFU)

- Admit Tickets
- Anticipation Guide
- Common benchmarks

- Compare & Contrast
- Create a Multimedia Poster
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit tests

Primary Resources & Materials

HMH Module I Workbook

Laboratory Kits and Materials

Defined Stem

BrainPop

Ancillary Resources

Guest Speakers

Other Internet sources

Outdoor area of school

Laptop Carts for further research

Technology Infusion

- Smart board
- DefinedStem.com
- Document Camera
- Pod-casts video streams
- Discovery Education video streams
- You Tube video streams
- Brain-pop video streams
- Laptops
- Khan Academy
- Power Point presentation
- MS Word

Alignment to 21st Century Skills & Technology

These skills will be aligned to the following core content areas:

- English Language Arts; reading informational text, following procedural steps, orally presenting predictions and opinions, and creating written laboratory reports
- Mathematics; measuring
- Science and Scientific Inquiry (Next Generation); see above
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics; hisitory of science and how the Scientific method has connections to World and American history expansion. Discuss the inpactof scence on society and what kind of moral questions scientists must address.
- World languages; discussion of root words and linguistic origin of vocabulary words.
- Technology; see above
- Visual and Performing Arts: oral and graphic presentation of procedures, results, and conclusion.

21st Century/Interdisciplinary Themes

- Civic Literacy
- Environmental Literacy

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

21st Century Skills

- 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

Differentiation

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 - Science Dollars
- Guided Notes
- Teacher reads assessments allowed
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Dictation to scribe

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Games and tournaments

- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Multiple texts
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
-

Lo-Prep Differentiations

- Exploration by interest
- Flexible grouping
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Varied journal prompts
- Correcting summative and formative assessments
- Retaking the test

Intervention Strategies

- 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 workpresented 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

Special Education Learning

- 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
- 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

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- 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 workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- Provide native language translation when possible
- 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

Sample Lesson

Unit Name: Energy

NJSLS: see link

Interdisciplinary Connection: Math: see link
rst 6.8 1-9 whst 6.8 1-10

Statement of Objective: SWDAT revise our procedure to eliminate inconsistencies in the data.

Do Now: Did the results you got support your hypothezsis in each Experiment?

Anticipatory Set: Class will compare results while teahcer charts them on the Smartboard. Review the activity and instructions on how to fill out the Lab Work Sheet

Learning Activity:

1. Do Now 5 minutes

2. Anticipatory Set 10 minutes
3. SW work with their team to analyze their data and answer questions on lab sheet.
4. Closure Exit ticket: What are three things you would change about the experiments to improve the results?

Student Assessment/CFU's:
1) Do Now Activity
2) In-class questioning
3) In-class reviewing student work
4) Peer Sharing while working in collaborative groups
5) Student answers to question on lab worksheet
6) Closure Activity

Materials: SmartBoard, Student activity worksheets, calculators,

21st Century Themes and Skills: Communication and Collaboraton, Critical Thinking and Problem Solving

Differentiation: small group inquiry, repeat directs, rephrase written directions, pair written with oral directions

Integration of Technology: Smartboard

MA.6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
LA.WHST.6-8.1	Write arguments focused on discipline-specific content.
MA.6.NS.C.8	Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.
LA.WHST.6-8.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
	For example, use the formulas $V = s^3$ and $A = 6s^2$ to find the volume and surface area of a cube with sides of length $s = 1/2$.
LA.WHST.6-8.4	Produce clear and coherent writing in which the development, organization, voice, and style are appropriate to task, purpose, and audience.
LA.WHST.6-8.5	With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
MA.6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
MA.6.EE.B.7	Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.
6-8.MS-PS3-1	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
6-8.MS-PS3-2	Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
6-8.MS-PS3-5	Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
6-8.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.
6-8.MS-PS3-2.2	Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.
6-8.MS-PS3-2.2.1	Develop a model to describe unobservable mechanisms.
6-8.MS-PS3-4.3.1	Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
6-8.MS-PS3-1.3.1	Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
6-8.MS-PS3-4.3.1	Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
6-8.MS-PS3-1.4	Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

6-8.MS-PS3-1.4.1	Construct and interpret graphical displays of data to identify linear and nonlinear relationships.
6-8.MS-PS3-3.5.1	The transfer of energy can be tracked as energy flows through a designed or natural system.
6-8.MS-PS3-5.7.1	Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon.
6-8.MS-PS3-1.PS3.A.1	Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
6-8.MS-PS3-2.PS3.A.1	A system of objects may also contain stored (potential) energy, depending on their relative positions.
6-8.MS-PS3-5.PS3.B.1	When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
6-8.MS-PS3-3.ETS1.A.1	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.