Unit 5:Relationships Among Forms of Energy

CONTENT AREA: General Physical Science	GRADES: 8	UNIT: 1 of 8
Pacing: Approx. 1 Month		
Science and Engineering Practices **Developing and Using Models** • Develop a model to describe unobservable mechanisms. (MS-PS3-2) **Analyzing and Interpreting Data** • Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1) **Engaging in Argument from Evidence** · 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. (MS-PS3-5) - ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS-PS3-5)	**Disciplinary Core Ideas** PS3.A: Definitions of Energy • 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. (MS-PS3-1) • A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) PS3.B: Conservation of Energy and Energy Transfer • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) PS3.C: Relationship Between Energy and Forces • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)	**Crosscutting Concepts** **Scale, Proportion, and Quantity** ● 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. (MS-PS3-1) **Systems and System Models** ● Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2) **Energy and Matter** ● Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5)
Performance Expectations: MS-PS3-1, MS-PS3-2, and MS-PS3-5		
Evidence Statement(s): MS-PS3-1, MS-PS3-2, and MS-PS3-5		
Essential Question: How can physics explain sports?		
21st Century Skills: 9.2.8.B.3, 9.2.8.B.4		
Career Ready Practices: CRP4, CRP6, CRP7		
Technology:HS-ETS1-1 HS-ETS1-3		

Technical Terms (Suggested)	Core Instructional Materials	Assessment Statement
Motion Kinetic Energy Potential Energy Force Momentum Transfer of Energy Thermal Energy ** All terms should be taught in context rather than in isolation. These terms should be addressed after conceptual understanding.**	MS-PS3-1 - Chromebook, internet access, smartboard, notebook, pen, pencil, whiteboard. MS-PS3-2- Computer, Internet access, smartboard, notebook, pen, pencil, whiteboard. MS-PS3-5- Computer, Internet access, smartboard, notebook, pen, pencil, whiteboard.	*Students who understand the concepts can:* ● Construct and interpret graphical displays of data to identify linear and nonlinear relationships of kinetic energy to the mass of an object and to the speed of an object. *Students who understand the concepts can:* • Develop a model to describe what happens to the amount of potential energy stored in the system when the arrangement of objects interacting at a distance changes • Use models to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems. Models could include representations, diagrams, pictures, and written descriptions. *Students who understand the concepts can:* • Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. • Conduct an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object. Do not include calculations of energy.

Modifications			
English Language Learners	Special Education	At Risk	Gifted & Talented
Scaffolding Word walls Sentence/paragraph frames Bilingual dictionaries/translation Think alouds Read alouds Highlight key vocabulary Annotation guides Think-pair-share Visual aides Modeling Cognates	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast	Teacher tutoring Peer tutoring Study guides Graphic organizers Extended time Parent communication Modified assignments Counseling	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Independent research/inquiry Collaborative teamwork Higher level questioning Critical/Analytical thinking tasks Self-directed activities

5E Model	
Performance Expectation: 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.	
Engage: Anticipatory Set	Using the following resource, students will view videos, read articles and engage in interactive simulation s related to kinetic energy. http://www.ck12.org/ngss/middle-school-physical-sciences/energy
Exploration: Student Inquiry	Kinetic and Potential Energy Lab Rotation In these lab activities, students will determine the relationship among the energy transferred, the type of matter, the mass and the change in the average kinetic energy of the particles. Students will construct and interpret grahcial displays on their data dn construct, use, and present arguments to support a claim. http://betterlesson.com/lesson/640019/exploring-the-relationship-between-potential-kinetic-energy Exploring the Relationship Between Potential and Kinetic Energy In this lesson, students will use evidence to explain how movement changes potential and kinetic energy while total energy remains constant. http://betterlesson.com/lesson/640019/exploring-the-relationship-between-potential-kinetic-energy
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): PS3.A: Definitions of Energy 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.

Elaboration: Extension Activity	Rubber Band Cannon Lab Students use rubber band cannons to explore potential and kinetic energy transfer! http://betterlesson.com/lesson/633996/rubber-band-cannon-lab
Evaluation: Assessment	

5E Model	
Performance Expectation: 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.	
Engage: Anticipatory Set	Roller Coast Science: Video http://www.discovery.com/tv-shows/other-shows/videos/time-warp-roller-coaster-science/ Roller Coaster: Engineering and Construction http://www.sciencechannel.com/video-topics/engineering-construction/machines-rollercoaster/
Exploration: Student Inquiry	Building Roller Coasters Students will work in pairs/groups to create a physical roller coaster. Refer to the following website for detailed instructions and student worksheets. https://www.teachengineering.org/view_activity.php?url=collection/duk_/activities/duk_rollercoaster_music_act/duk_rollercoaster_music_act.xml
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): PS3.A: Definitions of Energy A system of objects may also contain stored (potential) energy, depending on their relative positions. PS3.C: Relationship Between Energy and Forces When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.
Elaboration: Extension Activity	Hold discussion on why some roller coasters failed, show videos of X-games events involving energy transformations and motion. Students will be encouraged to participate in discussion about what they viewed and why certain X-games athletes were successful in certain tricks while others failed.

Evaluation: Assessment	

5E Model	
Performance Expectation: 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.	
Engage: Anticipatory Set	Using the following resources have students view videos, read articles and engage in discussion on how kinetic energy changes, energy is transferred to or from objects. Go to the MS-PS3-5 section of the page. http://www.ck12.org/ngss/middle-school-physical-sciences/energy
Exploration: Student Inquiry	Show students videos comparing crash tests on vehicles traveling at different speeds into different barriers and ask students to collaborate and show how energy transfers are occurring in the video. Energy Transfer: Engineering Catapults In this activity, students will describe and model situations in which different amounts of potential energy are stored in a system and support the claim that when the kinetic energy of an object changes, that energy that has been transferred to or from the objects in the system. http://betterlesson.com/lesson/633997/energy-transfer-engineering-catapults
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): PS3.B: Conservation of Energy and Energy Transfer When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
Elaboration: Extension Activity	Egg Projectile Project http://www.ehow.com/how_8405300_do-egg-projectile-project.html
Evaluation: Assessment	

How can physics explain sports?

In this unit, students use the practices of *analyzing and interpreting data*, *developing and using models*, and *engaging in argument from evidence* to make sense of relationship between energy and forces. Students develop their understanding of important qualitative ideas about the conservation of energy. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students also understand the difference between energy and temperature, and the relationship between forces and energy. The crosscutting concepts of *scale, proportion, and quantity*, *systems and system models*, and *energy and matter* are called out as organizing concepts for these disciplinary core ideas. Students use the practices of *analyzing and interpreting data*, *developing and using models*, and *engaging in argument from evidence*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on MS-PS3-1, MS-PS3-2, and MS-PS3-5.

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING PEs and DCIs
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.** *[Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]* **(MS-PS3-1)**	**(MS-PS3-1)**
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.** *[Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]* **(MS-PS3-2)**	**(MS-PS3-2)**
3	**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.** ***[Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]*** **(MS-PS3-5)**	**(MS-PS3-5)**

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Evidence Statements: MS-PS3-1

Analyzing and Interpreting Data

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.

Construct and interpret graphical displays of data to identify linear and nonlinear relationships.

Evidence Statements: MS-PS3-2

Developing and Using Models

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.

Develop a model to describe unobservable mechanisms.

Evidence Statements: MS-PS3-5

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds.

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.

PS3.A: Definitions of Energy

A system of objects may also contain stored (potential) energy, depending on their relative positions.

PS3.C: Relationship Between Energy and Forces

When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.

PS3.B: Conservation of Energy and Energy Transfer

When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

Crosscutting Concepts

Scale, Proportion, and Quantity

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.

Systems and System Models

Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems.

Energy and Matter

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

Connections to Nature of Science **Scientific Knowledge is Based on Empirical Evidence** Science knowledge is based upon logical and conceptual connections between evidence and explanations		

Connections to other DCIs in this grade-band: MS.PS2.A
Articulation of DCIs across grade-bands: 4.PS3.B ; HS.PS3.A ; HS.PS3.B, HS.PS2.B ; HS.PS3.B ; HS.PS3.C
NJSLS Connections: **ELA: RST.6-8.1, RST.6-8.7, SL.8.5, WHST.6-8.1** **Math: MP.2, 6.RP.A.2, 7.RP.A.2, 8.EE.A.1, 8.EE.A.2, 8.F.A.3, RP.A.1, 7**