Eighth Grade Science

Unit 1: Energy in Motion

Number of Days: 35

Unit Focus	Essential Questions	Next Generation Standards	Disciplinary Core Ideas(DCI)
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. Students will create designs that emphasize energy transformations and evaluate them towards an optimal design. Students are also expected to articulate their position of a modern day issue that requires understanding of core ideas via argumentative essay writing.	• **How is energy defined?** • **What types of energy make up mechanical energy?** • **How is mechanical energy transferred from one form to another?** • **How can Physics explain everyday applications all around us?** **Links to Unit 1** **https://njctl.org/courses/science/8th-grade-science/forces-motion/** **https://njctl.org/courses/science/8th-grade-science/energy-of-objects-in-motion/** *All teachers must register at https://njctl.org	**MS-PS3-1** **MS-PS3-2** **MS-PS3-5**	• **PS3.A: Definitions of Energy** • **PS3.B: Conservation of Energy and Energy Transfer** • **PS3.C: Relationship Between Energy and Forces**

NGSS Framework:		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
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)	**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)	**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, and energy of motion). (MS-PS3-5)

English Language Arts	**Mathematics**

Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. *(MS-PS3-1),(MS-PS3-5)* **RST.6-8.1** 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). (MS-PS3-1) **RST.6-8.7** Write arguments focused on discipline content. *(MS-PS3-5)* **WHST.6-8.1** 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. (MS-PS3-3) **WHST.6-8.7** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-PS3-2)* **SL.8.5**	Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-5) **MP.2** Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1),(MS-PS3-5) **6.RP.A.1** Understand the concept of a unit rate a/b associated with a ratio a:b with $b \neq 0$, and use rate language in the context of a ratio relationship. (MS-PS3-1) **6.RP.A.2** Recognize and represent proportional relationships between quantities. (MS-PS3-1),(MS-PS3-5) **7.RP.A.2** Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1) **8.EE.A.1** Use square root and cube root symbols to represent solutions to equations of the form x^2 square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. (MS-PS3-1) **8.EE.A.2** Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1), (MS-PS3-5) **8.F.A.3**

Unit 1A: Kinetic Energy

Standard(s):

- **MS-PS3-1-ENERGY-***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.*

Student Outcomes	Inquiry Based Learning Activities	Materials/Resources

Stu*dents will know that:** • Kinetic energy is related to the mass of an object and to the speed of an object. • Kinetic energy has a relationship to mass separate from its relationship to speed. • Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of the object's speed. • The difference between mechanical and non-Mechanical energy. • The variables that kinetic energy depend upon. • Mathematics is a tool used to model objects, events, and relationships in the natural and designed world. • Data can be organized in a clear and useful manner • Graphs may be used to represent the physical characteristics of motion. • The same basic rules govern the motion of all bodies, from planets and stars to birds and billiard balls. • Motion is a 'relative' concept needing a 'frame of reference' in order to make predictions. **Students will be able to:** • ***Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the	**STEM EDA Activity –Apply Catapult Kit-nicerc.org** **http://nicerc.org/product/8th-grade-apply-catapults-kit/** • **Kinetic Energy Lab***-Lab questions/ **write up** **Kinematics Energy Lab write up-njctl.org** • **Linear Functions: Graphs and Equations-Nearpod Interactive webinar** **Nearpod.com-Linear Functions**	**Materials Needed:** **Apply Catapult Kit-nicerc.org** • craft sticks • rubber bands • string • cup hooks • poplar sticks • foam board • poster board • foam golf balls • foam bowls • lock nuts • salt • bucket • gummy candies • assorted dowel rods **Kinetic Energy Lab** • Lab sheet • Calculator • Stopwatch • incline plane apparatus • cart with wheels • set of masses • scale • books • meter stick • tape **Kinetic Energy Interactive** • Access to Nearpod.com • Tablets • Drawing stylus

speed of an object. • ***apply*** the qualitative definition of acceleration (speeding up, or slowing down, and/or changing direction) to determine if an object is accelerating. • ***determine*** velocity by taking the slope of a position-time graph, and determine acceleration from the slope of a velocity-time graph • ***correlate*** negative and positive slopes with positive and negative velocities.		***Resources:*** • **www.NJCTL.org** • **www.nicerc.org** **Additional Technology Resources:** • ***Explore Learning*** • ***Nearpod.com*** • ***Edpuzzle.com*** • ***Brainrush.com*** • ***YouTube*** • ***Socrative.com*** • ***Phet*** • ***Teacher Tube***

Differentiated Instruction:	**ELL Modifications:**
• Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Provide ELL students with multiple literacy strategies. • Structure the learning around explaining or solving a social or community-based issue. • Collaborate with after-school programs or clubs to extend learning opportunities. • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)	

Assessments:

- Nearpod.com-Linear Functions
- **DOQ-Edconnect**

Camden City School District

Unit 1b: Potential Energy

Standard(s):

- **MS-PS3-2-ENERGY**-*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.*

Student Outcomes	Inquiry Based Learning Activities	Materials/Resources
***Stu*dents will know that:** • When the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. • A system of objects may contain stored (potential) energy, depending on the objects' relative positions. • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the objects. • Models that could include representations, diagrams, pictures, and written descriptions of systems can be used to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems. **Students will be able to:**	**STEM EDA Apply Roller Coaster Kit-**: Engineering Design Process-Prototype Design **nicerc.org** **http://nicerc.org/product/apply-roller-coaster-kit-8th-grade/** • **Potential Energy-Nearpod Interactive webinar** **Nearpod.com-Potential & Kinetic Energy** • **Gravitational Potential Energy Ball Drop Heights Lab*** **Gravitational Potential Energy Lab write**	**Apply Roller Coaster Kit** • assorted colors of card stock • marbles • poster board • masking tape **Potential Energy Interactive** • Access to Nearpod.com • Tablets • Drawing stylus **Gravitational Potential Energy Lab** • lab sheet • bouncy ball • meter stick • calculator • pencil

Students will be able to: • 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. • Create a roller coaster prototype design and evaluate it for progress towards an optimal design.	**up-njctl.org**	***Resources:*** • **Nearpod.com-Potential & Kinetic Energy:** • **www.nicerc.org** • **www.NJCTL.org** **Additional Technology Resources:** • ***Explore Learning*** • ***Nearpod.com*** • ***Edpuzzle.com*** • ***Brainrush.com*** • ***YouTube*** • ***Phet*** • ***Teacher Tube***

Differentiated Instruction:	**ELL Modifications:**
• Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Provide ELL students with multiple literacy strategies. • Structure the learning around explaining or solving a social or community-based issue. • Collaborate with after-school programs or clubs to extend learning opportunities. • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)	

Assessments:

- Nearpod.com-Potential & Kinetic Energy
- DOQ-Edconnect

Unit 1C: Energy Transfer & Conservation of Energy
Standard(s):

- **MS-PS3-5-ENERGY**-*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.*

Student Outcomes	Inquiry Based Learning Activities	Materials/Resources
***Stu*dents will know that:** • When the kinetic energy of an object changes, energy is transferred to or from the object. • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. • Kinetic energy may take different forms (e.g., energy in fields, thermal energy, energy of motion **Students will be able to:**	***STEM activity****-Discover Roller Coaster: Engineering Design Process-***Optimal Design*** **(students self and peer evaluate prototypes towards an optimal design)* **http://nicerc.org/product-category/stem-eda/roller-coaster/** • **Conservation of Energy Lab***-Lab questions/ **write up** **Conservation of Energy Lab write up**	**Materials Needed:** **Discover Roller Coaster STEM Lab** • Discover Roller Coaster Kit **Conservation of Energy Lab** • Computer • Colored pencils **Energy Conversion Lab** Physics Supply Kit

• Create a roller coaster prototype design and evaluate it for progress towards an optimal design. • 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).	• **Conservation of Energy-Edpuzzle interactive** **Edpuzzle.com-Bozeman Science video-formative assessment** • ***STEM activity****-Energy Transfer-Electric Circuits **http://nicerc.org/product-category/physics/**	***Resources:*** • **www.NJCTL.org** • **www.nicerc.org** • **http://www.edpuzzle.com** **Additional Technology Resources:** • ***Explore Learning*** • ***Nearpod.com*** • ***Edpuzzle.com*** • ***Brainrush.com*** • ***YouTube*** • ***Phet*** • ***Teacher Tube***

Differentiated Instruction:	**ELL Modifications:**
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Assessments:

- Edpuzzle.com-Bozeman Science video- formative assessment
- DOQ-Edconnect