Honors Physics - Unit 5 - Work and Energy

Unit Focus

Students will explore three different types of mechanical energy: kinetic energy, potential gravitational energy, and potential elastic/spring energy as well as conservation of energy, the work-energy theorem, and power. Students will begin by analyzing the three common types of mechanical energy (kinetic, potential gravitational, and potential elastic). They will analyze the transformation between these types of energy to uncover the conservation of mechanical energy and the transformation of energy from one form to another. They will continue by analyzing the transformation of work in energy and energy into work in order to uncover the work-energy theorem. Students will also engage in real-life application of this theorem as they explore mechanical energy. Students will also investigate the six types of simple machines and their advantages and disadvantages. Students will learn how to calculate actual mechanical advantage, ideal mechanical advantage, and efficiency. Finally, they will uncover the rate the energy transfers is called power. As a part of this unit, students will also spend time looking at the importance of units and unit conversions in calculations and understanding of what units and numbers really mean.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science
High School Physical Sciences: 9 - 12

- Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. *HS-PS2-1*
- 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-PS3-1*

Next Generation Science Standards (DCI)
Science: 11

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. *PS3.9.A2*

Transfer

T1 Use the scientific process to generate evidence that addresses the original questions.
T2 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.

Meaning

Understanding(s)	Essential Question(s)
U1 Each form of energy can be converted into other forms of energy or into work (e.g. kinetic to potential, mechanical to electrical). **U2** While energy within a system is continually changing forms, and being transferred, the total energy of the system is conserved.	**Q1** How can position of an object in a field affect the amount of energy it has stored? **Q2** Where does the energy of a system come from? How does it change? Where does it go?

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
K1 Mechanical energy is the sum of potential and kinetic energy **K2** A force only does work on an object when the object is moved **K3** Distinguish between conservative and non conservative forces	**S1** Be able to calculate kinetic energy, and gravitational potential energy and elastic potential energy **S2** Calculate the work done by friction **S3** Be able to use the Conservation of Energy in problem solving situations.

Stage 1: Desired Results - Key Understandings		
• Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. *PS3.9.B1* • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. *PS3.9.B2* **Madison Public Schools Profile of a Graduate** *Critical Thinking* • Analyzing: Examining information/data/evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)	**K4** If there are no push/pull forces on an object (Fg is NOT a push or pull forces), then the energy added to the object is zero. **K5** Friction is a non conservative force **K6** Work can be positive or negative depending on how the energy of the object changed **K7** Power is the Rate or work being done; the same job can be done quickly (more power) or slowly (less power) **K8** Machines use mechanical advantage to do work	**S4** Be able to determine whether a force does work on an object and to calculate the work done with appropriate units. **S5** Be able to determine the energy added or energy removed to/from an object. **S6** Calculate the power needed to perform a task or the power produced by a motor