Phoenixville Area School District Understanding by Design (UbD) Science Template

Grade Level &/or HS Subject: Physics **Unit Name: Energy Part 2**

<table>
<tr><th colspan="3">Stage 1 Desired Results</th></tr>
<tr><td rowspan="4">Overarching NGSS & PA Standards:

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.

HS-PS3-2

Develop and use models to illustrate that energy at the macroscopic scale can be accounted for</td><td colspan="2">Transfer</td></tr>
<tr><td colspan="2">Students will be able to independently use their learning to…

Ask questions and define problems
Develop and use models
Plan and carry out experiments
Analyze and interpret data using computational thinking
Obtain, evaluate, and communicate information (supported by evidence)
Construct explanations and design solutions

(Choose the appropriate content-specific transfer goals)</td></tr>
<tr><td colspan="2">Meaning-Making</td></tr>
<tr><td>Students will understand that…

A computational model can be used 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

They can 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 positions of particles (objects)

Devices that work within given constraints to convert one form of energy into another form of energy can be designed, built and refined.

Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system.

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.

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.</td><td>ESSENTIAL QUESTIONS
Students will keep considering...

How is energy transferred and conserved?

What is energy?</td></tr>
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as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects) **** This will be limited to qualitative understanding for electric and magnetic forces/energy 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.* HS-ESS2-2 Analyze geoscience	At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. Although energy cannot be destroyed, it can be converted to less useful forms — for example, to thermal energy in the surrounding environment	
	Knowledge and Skills Acquisition	
	UNDERSTANDINGS *Students will know…*	*Students will be skilled at…*
	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. 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. (**Law of Conservation of Energy**) Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (**Work = F*x** and **Work-Energy Theorem**) Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g., relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. • Kinetic Energy = 0.5mv^2 • Gravitational Potential Energy near Earth's Surface = mgh Although energy cannot be destroyed, it can be converted to less useful forms — for example, to thermal energy in the surrounding environment Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. For potential energies, 0 J is used as a reference.	Design, evaluate, and/or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. Create a computational model or simulation of a phenomenon, designed device, process, or system. Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text

data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. **Which branch(es) of science apply:** **PS ESS**	• For Ug that often means the lowest point in the problem. • For the electric and magnetic energy, that usually means infinitely far away. Power is energy change/time KEY VOCABULARY Energy Kinetic Energy Potential Energy Gravitational Potential Energy Thermal Energy Heat Power Simple Machines	by paraphrasing them in simpler but still accurate terms

Stage 2 – Evidence		
Evaluative Criteria	***Assessment Evidence***	
Successful identification of energy types; accurate application of conservation of energy; attempt to balance cost v performance; ID of limitations of model and	PERFORMANCE TASK(S): **Rollercoaster Calculator Part 2** Goal: Students will build a rollercoaster calculator that will attempt to maximize speed at the bottom while minimizing cost. Every feature of the coaster will have a cost associated with it. The primary features will be coefficient of friction, mass, height, angle, and drag coefficient (aerodynamics). Role: Rollercoaster Designers Audience: Amusement Park Execs Situation: Pairs of students Product/Purpose: Use a spreadsheet to design and optimize the coaster's speed/cost. They will make a report detailing why theirs is the best solution. Standards: See left	Differentiation Considerations: Spreadsheets recommended, but those with experience can use other programming languages; students can choose nature of report (oral, written).

explanation of model.		
Accuracy of answers and explanations; lab/inquiry process skills	OTHER EVIDENCE: • HW – these will consist of a range of questioning goals, from basic things like vocab understanding to conceptual understanding to application • Lab – Hotwheels energy loss lab • Quizzes – MC or FR where work is required; similar to HW, could be fact recall, conceptual understanding or application being assessed. • Test – 1 for the unit, will contain a mix of recall and application focused on the understandings and knowledge from Stage 1 (What evidence will be collected to determine whether Stage 1 goals were achieved?)	Differentiation Considerations: • Notes allowed on some assessments • Partial credit + test corrections