WAUCONDA SCHOOL DISTRICT 118
UNIT PLANNING ORGANIZER

Subject: AP Physics 1

Unit 4 - Energy & Work

Pacing: 25 Class Days

STAGE 1 – DESIRED RESULTS

Essential Questions:

1) How is energy stored and transferred?
2) Why are the horizontal and vertical motions of an object independent from each other?

Big Ideas:

- Energy is conserved in a closed system
- Objects and systems have properties such as mass and charge. Systems may have internal structure.
- The interactions of an object with other objects can be described by forces.
- Interactions between systems can result in changes in those systems.
- Changes that occur as a result of interactions are constrained by conservation laws.

CCSS (Priority Standards):

Common Core Standards - English Language Arts:

- CCSS.ELA-LITERACY.RST.11-12.3 - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- CCSS.ELA-LITERACY.WHST.11-12.9 - Draw evidence from informational texts to support analysis, reflection, and research.
- CCSS.ELA-LITERACY.SL.11-12.1 - Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- CCSS.ELA-LITERACY.SL.11-12.1.A - Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
- CCSS.ELA-LITERACY.SL.11-12.1.B - Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed.
- CCSS.ELA-LITERACY.SL.11-12.1.C
    - Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
- CCSS.ELA-LITERACY.SL.11-12.1.D - Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.
- CCSS.ELA-LITERACY.SL.11-12.2 - Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
- CCSS.ELA-LITERACY.SL.11-12.4 - Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing

perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.
- CCSS.ELA-LITERACY.SL.11-12.5 - Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Common Core Standards - Mathematics:
- CCSS.MATH.PRACTICE.MP1 - Make sense of problems and persevere in solving them.
- CCSS.MATH.PRACTICE.MP2 - Reason abstractly and quantitatively.
- CCSS.MATH.PRACTICE.MP3 - Construct viable arguments and critique the reasoning of others.
- CCSS.MATH.PRACTICE.MP4 - Model with mathematics.
- CCSS.MATH.PRACTICE.MP5 - Use appropriate tools strategically.
- CCSS.MATH.PRACTICE.MP6 - Attend to precision.
- CCSS.MATH.CONTENT.HSN.Q.A.1 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- CCSS.MATH.CONTENT.HSN.Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling.
- CCSS.MATH.CONTENT.HSN.Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- CCSS.MATH.CONTENT.HSA.SSE.A.1 - Interpret expressions that represent a quantity in terms of its context.
- CCSS.MATH.CONTENT.HSA.SSE.B.3 - Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- CCSS.MATH.CONTENT.HSA.CED.A.1 - Create equations and inequalities in one variable and use them to solve problems.Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
- CCSS.MATH.CONTENT.HSA.CED.A.2 - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- CCSS.MATH.CONTENT.HSA.CED.A.4 - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
- CCSS.MATH.CONTENT.HSF.IF.C.7 - Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases
- CCSS.MATH.CONTENT.HSF.IF.C.7.A - Graph linear and quadratic functions and show intercepts, maxima, and minima.
- CCSS.MATH.CONTENT.HSS.ID.C.7 - Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- CCSS.MATH.CONTENT.HSS.ID.C.8 - Compute (using technology) and interpret the correlation coefficient of a linear fit.

Next Generation Science Standards:
Energy:
- 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 as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).

Engineering Design:
- HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Advanced Placement Physics Standards:

- Enduring Understandings:

- 3.E: A force exerted on an object can change the kinetic energy of the object.
- 4.C: Interactions with other objects or systems can change the total energy of a system.
- 5.A: Certain quantities are conserved, in the sense that the changes of those quantities in a given system are always equal to the transfer of that quantity to or from the system by all possible interactions with other systems.
- 5.B: The energy of a system is conserved.

STAGE 2 – EVIDENCE

Concepts **(What students need to know)**	**Performance Tasks** **(What students will be able to do)**	**21st Century Skills**
1) Forms of energy storage - Kinetic (translational) - Kinetic (rotational) - Gravitational - Spring - Thermal 2) Conservation of Energy 3) Work = $\Delta E = F \cdot d$	1) Predict the height or speed of an object based on the energy stored in the initial condition.. 2) Determine the initial conditions necessary to set up a bungee jumper that precisely "kisses" an egg when dropped from the ceiling.	1) Utilize computer-based laboratory equipment from Vernier and Pasco scientific 2) Video analysis of motion using Pivot Interactives 3) Comprehensive laboratory write-ups focusing on conceptual understandings and wider applications of the underlying ideas 4) Data analysis through graphical analysis programs including slope, y-intercept, correlation value, and area analysis.

Common Formative/Summative Assessments:

- ➢ Weekly Quizzes
- ➢ Energy Suite of Labs
- ➢ Kiss the Egg Lab Practical
- ➢ Unit 7 - Energy Test

Interim Assessments (Informal Progress Monitoring checks):

- ➢ Whiteboard Meetings
- ➢ Lab Challenges
- ➢ Practice Activities & Problems

Modified Common Assessments:

Modified Interim Assessments:

Suggested Resources/Materials/Informational Texts
AMTA, PhETs, Vernier probeware, Pivot Interactives

Suggested Research-based Effective Instructional Strategies
Whiteboarding, Small group work, Labs, Whole class discussions, Observation Stations

Academic Vocabulary/ Word Wall

Essential Vocabulary:

- Energy
- Kinetic Energy
- Potential Energy
- Elastic Energy
- Gravitational Energy
- Dissipated Energy
- Chemical Energy
- Open System
- Closed System
- Isolated System
- Surroundings
- System Schema
- Conservation of Energy
- Energy Bar Charts

Worth-knowing Vocabulary:

- Changes
- Interactions
- Phase Energy
- Thermal Energy