WAUCONDA SCHOOL DISTRICT 118
UNIT PLANNING ORGANIZER

Subject: AP Physics 1

Unit 6 - Simple Harmonic Motion (Oscillations)

Pacing: 15 Class Days

STAGE 1 – DESIRED RESULTS

Essential Questions:

1) How can oscillating motions of pendulums and springs be described and predicted?
2) Why do the motions of an oscillating spring and a swinging pendulum parallel 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:
Harmonic Motion:
- HS-PS2-1: 1. 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-PS3.C: Relationship Between Energy and Forces - When two objects interacting through a field change relative position, the energy stored in the field is changed.
- 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.

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.B: Classically, the acceleration of an object interacting with other objects can be predicted by using $\vec{a} = \frac{\Sigma \vec{F}}{m}$.
- 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) Restoring Forces results in oscillatory motion ● Relevant Equations: ○ $T_p = 2\pi\sqrt{\frac{l}{g}}$ ○ $T_s = 2\pi\sqrt{\frac{m}{k}}$ 2) Conservation of Energy 3	1) Design a plan and collect data in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force. 2) Analyze data to identify qualitative and quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion and use those data to determine the value of an unknown. 3) Calculate the expected behavior of a system using the object model (i.e., by ignoring changes in internal structure) to analyze a situation. Then, when the model fails, the student can justify the use of conservation of energy principles to calculate the change in internal energy due to changes in internal structure because the object is actually a system. .	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

- ➢ Lab - Mass on a Spring
- ➢ Lab - Pendulum
- ➢ Lab Practical - Beats by ____ (match oscillators to the beat of a song)

Interim Assessments (Informal Progress Monitoring checks):

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

Modified Common Assessments:

Modified Interim Assessments: