Bayonne High School

Unit 6: Vibrational Motion

Revised 2022-23

Aligned to the New Jersey Student Learning Standards 2020

Marking Period	Unit Title	Recommended Instructional Days
3	**Vibrational Motion**	

NJSLS - Science: *Title*	NJSLS - Science: *Performance Expectations*	Recommended Activities, Investigations, Interdisciplinary Connections, and/or Student Experiences to Explore NJSLS-S within Unit
Motion and Stability: Forces and Interactions, Energy	**HS-PS2-1:** 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. [Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.] [Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.] **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. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] [Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.]	
FOUNDATION Disciplinary: ***Core Idea***	**FOUNDATION Disciplinary:** ***Statement***	
Forces and Motion, Definitions of Energy, Conservation of Energy and Energy Transfer	**HS-PS2.A:** Newton's second law accurately predicts changes in the motion of macroscopic objects. **HS-PS3.A:**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. **HS-PS3.B:** Conservation of energy means that the total change of energy in any system is always equal to the	**Essential Question/s:** ● What is the difference between simple harmonic motion and repetitive motion? ● How do you represent the simple harmonic motion of a system visually? ● How can you represent the simple harmonic motion of a system mathematically? ● What affects the motion of an object? **Activity Description:** ● **Vertical Spring Mass System Investigation:** Students use a spring suspended from a ring stand and a motion sensor or a cart attached to a spring vibrating on a track to study the position, velocity and acceleration vs. time graphs of a vibrating spring mass system. ● **Pendulum Motion Investigation:** Students use a simple pendulum suspended from a ring stand to study the relationship between

	total energy transferred into or out of the system. **HS-PS3.B:** Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems **HS-PS3.B:** 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. **HS-PS3.B:** The availability of energy limits what can occur in any system.	time-period, mass and length of a pendulum in simple harmonic motion. ● **Horizontal Spring-Mass System Investigation:** Students use a set of videos on PAER-Rutgers, of a horizontal spring mass system to verify the relationship between time-period and system's mass. **Interdisciplinary Connections: Content: NJSLS:** *Connections to NJSLS – English Language Arts* ● **RST.11-12.1:** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. ● **RST.11-12.7:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. ● **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. *Connections to NJSLS – Mathematics* ● **MP.2:** Reason abstractly and quantitatively. ● **MP.4:** Model with mathematics. ● **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. ● **HSN-Q.A.2:** Define appropriate quantities for the purpose of descriptive modeling. ● **HSN-Q.A.3:** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
FOUNDATION **Science and Engineering Practices:** ***Core Idea***	**FOUNDATION** **Science and Engineering Practices:** ***Statement***	
Planning and Carrying Out Investigations: Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical	● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the	

and empirical models. **Analyzing and Interpreting Data:** Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. **Using Mathematics and Computational Thinking:** Mathematical and computational thinking at the 9–12 builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. **Construction Explanations and Designing Solutions:** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.	data (e.g., number of trials, cost, risk, time), and refine the design accordingly. ● Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. ● Use mathematical representations of phenomena to describe explanations. ● Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).	

Obtaining, Evaluating, and Communicating Information: Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.		
FOUNDATION Crosscutting Concepts: ***Core Idea***	**FOUNDATION Crosscutting Concepts:** ***Statement***	
• **Patterns** • **Cause and Effect** • **Systems and System Models** • **Energy and Matter**	• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. • Energy cannot be created or destroyed—only moves between one place and another place,	

	between objects and/or fields, or between systems.	
Social and Emotional Learning: ***Competencies***	**Social and Emotional Learning:** ***Sub-Competencies***	
● Self-Awareness ● Social Awareness ● Relationship Skills	● Recognizing Strengths ● Respect for Others ● Communication ● Social Engagement ● Teamwork	

Assessments (Formative) ***To show evidence of meeting the standard/s, students will successfully engage within:***	**Assessments (Summative)** ***To show evidence of meeting the standard/s, students will successfully complete:***
Formative Assessments: ● Warm-up quizzes, student responses through group work and class discussion	**Benchmarks:** ● District Assessment **Summative Assessments:** ● Vibrational Motion Test

Differentiated Student Access to Content:
Teaching and Learning *Resources/Materials*

Core Resources	**Alternate Core Resources** ***IEP/504/At-Risk/ESL***	**ELL Core Resources**	**Gifted & Talented Core Resources**
● Student Chromebooks ● Lab equipment such as spring scales and Vernier carts, etc. ● Course textbook	● Scaffolded Notes ● Leveled physics games and simulations	● Scaffolded Notes ● Google Translate	● Extension Activities ● Leveled physics games and simulations

Supplemental Resources

Technology:

- Schoology
- Investigative Science Learning Environment Physics Videos
- PhET Physics Simulations
- Physics-related and school-appropriate YouTube videos
- Universe and More Physics Games

Differentiated Student Access to Content:
Recommended *Strategies & Techniques*

Core Resources	**Alternate Core Resources** ***IEP/504/At-Risk/ESL***	**ELL Core Resources**	**Gifted & Talented Core**
● Promote an approach that benefits multiple learning styles exploring phenomena through readings, videos, and collaborative work. ● Establishing proper safety protocols for using specialized equipment and gathering materials. ● Establishing communication protocols for collaborative activities to ensure all students properly communicate and involve every student. ● Demonstrate that the Engineering Design Process is a flexible cycle that allows for steps to be repeated.	● Utilize a multi-sensory approach during instruction, provide multiple presentations of skills by varying the method (repetition, simple verbal explanations, mathematical representations, visual representations, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks.	● Utilize a multi-sensory approach during instruction, provide multiple presentations of skills by varying the method (repetition, simple verbal explanations, mathematical representations, visual representations, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks.	● Create an enhanced set of introductory activities, integrate active teaching/learning opportunities, incorporate authentic components, propose interest-based extension activities, and connect students to related talent development opportunities.

	Disciplinary Concept: Technology Literacy

NJSLS CAREER READINESS, LIFE LITERACIES & KEY SKILLS	***Core Ideas:***	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.
	Performance Expectation/s:	9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
	Career Readiness, Life Literacies, & Key Skills Practices	
	Practice: Utilize critical thinking to make sense of problems and persevere in solving them.	***Description:*** Students readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

New Jersey Legislative Statutes and Administrative Code (place an "X" before each law/statute if/when present within the curriculum map)									
	Amistad Law: *N.J.S.A. 18A 52:16A-88*		Holocaust Law: *N.J.S.A. 18A:35-28*		LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*		Diversity & Inclusion: *N.J.S.A. 18A:35-4.36a*		Standards in Action: *Climate Change*