08: Periodic Motion and Waves (Sound and Light)

Content Area: **Science**
Course(s): **Physics**
Time Period: **June**
Length: **30 days**
Status: **Published**

Unit Overview:

This unit will deal with repetitive motion. It will cover pendulum motion, spring motion, sound waves, waves on a string and light waves. Students will learn to apply the formula for sine curves to the study of waves. Students should learn the terms frequency, wavelength, period, amplitude, and superposition in this unit.

Enduring Understandings:

- Light is a transverse electromagnetic wave
- Moving sources of waves create new wave patterns that can easily be observed.
- Sound is a longitudinal pressure wave
- The amplitude of a wave determines loudness or brightness
- The frequency of a wave determines pitch or color
- The intensity of a wave diminishes with distance in a squared relationship
- The motion of pendulums and springs can be modeled using equations for sine curves
- Waves are a transfer of energy not a transfer of matter

Essential Questions:

- How does our experience of light or sound relate to the waves that make them up?
- How does wave motion differ from the motion of everyday matter?

Standards/Indicators/Student Learning Objectives (SLOs):

- SWBAT calculate all the necessary components for the motion of a pendulum
- SWBAT describe the properties of waves and explain their place in a wave equation.
- SWBAT determine the factors that affect the period of an oscillating spring and calculate it.
- SWBAT determine which factors affect the period of a pendulum and calculate it.
- SWBAT explain how sound waves at precise frequencies are used to create music.
- SWBAT explain the effect of two waves interfering with each other.
- SWBAT explain the effect on a wave as the wave source moves towards or away from the receiver.
- SWBAT explain the factors that affect the speed of a wave

- SWBAT explain what happens to a sound wave as the source is slower than, equal to, or faster than the speed of sound.
- SWBAT explain what happens to the intensity of a wave as the source moves further away.
- SWBAT write an equation for a sine curve and explain the affect of changing each of the variables within it.

9-12.HS-ETS1-4.4.1	Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales.
9-12.HS-ETS1-2.6	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.
9-12.HS-ETS1-3.6.1	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-ETS1-3.ETS1.B.1	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
9-12.HS-PS1-3.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
9-12.HS-PS1-1.2	Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
9-12.HS-PS2-1.2.1	students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
9-12.HS-PS1-4.2.1	Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-PS1-1.2.1	Use a model to predict the relationships between systems or between components of a system.
9-12.HS-PS3-2.2.1	Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-PS2-3.2.1	Systems can be designed to cause a desired effect.
9-12.HS-PS2-5.3	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 and empirical models.
9-12.HS-PS2-5.3.1	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 data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
9-12.HS-PS3-1.4.1	Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.
9-12.HS-PS2-2.4.1	When investigating or describing a system, the boundaries and initial conditions of the

	system need to be defined.
9-12.HS-PS1-2.6	Constructing Explanations and Designing Solutions
9-12.HS-PS2-3.6.1	Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.
9-12.HS-PS2-6.8.1	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).
9-12.HS-PS3-3.PS3.A.1	At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
9-12.HS-PS3-2.PS3.A.2	At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
9-12.HS-PS4-3.PS4.A.1	Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.)
9-12.HS-PS4-3.PS4.B.1	Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.
9-12.HS-PS4-4.PS4.B.1	When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.
9-12.HS-PS2-3.ETS1.A.1	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.
9-12.HS-PS2-3.ETS1.C.1	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Lesson Titles:

- Combining Waves
- Doppler Effect
- Frequency and Wavelength of Waves
- Intensity of Waves
- Music
- Pendula
- Sonic Booms
- Speed of Waves
- Springs
- Wave Equations and Properties

Career Readiness, Life Literacies & Key Skills

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

LA.RH.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem.
LA.RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
LA.RST.11-12.10	By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.
LA.WHST.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
LA.WHST.11-12.1.B	Develop claim(s) and counterclaims using sound reasoning and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
LA.WHST.11-12.1.C	Use transitions (e.g., words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
LA.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.11-12.2.E	Provide a concluding paragraph or section that supports the argument presented.
LA.WHST.11-12.10	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Instructional Strategies/Learning Activities and Levels of Blooms/DOK:

- Class Activity: Color Mixing. In this activity you will determine how much of each primary color need to be combined to create a variety of different other colors.
- Classwork: Learning Logs. A slideshow to help students understand a bit about logs.
- Classwork: Problem Involving Doppler and Decibels. A series of problems dealing with dB and Doppler Effect (NOW WITH ANSWERS)
- Classwork: Problems involving moving sources of waves.
- Classwork: Speed of Waves. This worksheet gives a series of problems dealing with the speed of sound and light waves. (See Answers)
- Homework: Color Mixing Game: In this activity you will combine different amounts of red, green and

blue until you match the given color

- Lab Activity: Introduction to Wave Properties. This activity will give you an understanding of some basic properties of waves.
- Lab Activity: Speed of Sound. In this activity you will test a different way of trying to determine the speed of sound in air.
- Lab Activity: Combining Sounds. In this activity you will be listening to how different sound can be mixed together to form new sounds.
- Lab Activity: Combo Pendulum Lab. A simulation program to allow you to test the pendulum relationships that you were not able to test in class
- Lab Activity: Intensity of Light. Students will look at how distance affects intensity.
- Lab Activity: Musical Instrument Lab without Logger Pro. This lab will allow students to determine the relationship between the length of a wind instrument and the frequency of sound that it produces.
- Lab Activity: Speed of a Wave on a String. This activity will let you explore the factors affecting the speed of a wave on a string.
- Lab Activity: Spring Oscillation Lab. A lab to allow you to investigate the factors that affect the oscillation of a spring.
- Notes dealing with musical instruments. (Video Lesson Thanks to Sean Eberts)
- Notes on intensity and intensity level of waves (Intensity Lesson)
- Notes on Interference of Waves.
- Notes on Pendulums and Oscillation.
- Notes on Springs and Oscillations
- Notes on the Doppler Effect for Waves
- Notes on the Speed of Sound and Sonic Booms
- Notes on the Speed of Waves
- Notes on Wave Properties
- Ownwork: Intensity of Waves Problems. A series of word problems involving calculations with intensity and intensity level.
- Ownwork: Music Problems. A series of problems involving musical instruments.
- Ownwork: Pendulum Problems. A series of problems dealing with the period and frequency of pendulums.
- Ownwork: Sine Curves. An activity that should be done to make sure that you know how to write equations of sine curves
- Pendulum Learning Activity. A google form to help lead you through the important ideas with pendulum motion.

Modifications

- Tutoring During Delsea 1

ELL Modifications:

- Focus on domain specific vocabulary and key words
- Offer sources for specific topics in primary language (Youtube web resources)

- Repeat, reword and clarify
- Digital Translators
- Use real objects when possible

IEP & 504 Modifications:

- Formula sheets and example problems to use on assessments
- Modeling and showing various examples
- Scaffolding notes
- Students will be able to use calculators and/or other math tools

G&T Modifications:

- Extra labs to do outside the classroom
- Provide links to extension videos or other media
- Increase the level of problems and challenge problems

At Risk Modifications

- Utilize Delsea One to complete assignments, try supplemental material or to modify classroom behaviors
- Reach out to parents

Formative Assessment:

- Quiz 8.1 Pendulums and Springs
- Quiz 8.2 Wave Properties and Equations
- Quiz 8.3 Frequency, Wavelength and Wave Speed
- Quiz 8.4 Intensity and Combining Waves
- Quiz 8.5 Moving Sources of Waves

Summative Assessment:

- Lab Assessment: Properties of waves, Sound and Light
- Unit 8 Exam: Wave Properties (Sound and Light)

Alternative Assessments:

Performance tasks
Project-based assignments

Problem-based assignments
Presentations
Reflective pieces
Concept maps
Case-based scenarios
Portfolios

Benchmark Assessments:

Skills-based assessment
Reading response
Writing prompt
Lab practical

Resources & Materials:

- Cell Phone Apps for Video Editing
- Chromebooks
- https://sites.google.com/site/delseaphysics1/Home
- Lab Pro Modules and appropriate sensors
- Meter Sticks/metric rules
- Timing Devices