

08_Vibrations and Waves

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **3 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This course is about the nature of basic things such as motion, force, energy, matter, sound, light, electricity and the composition of atoms. Laboratory experiments, demonstrations, applications to daily life and current topics in physics provide students with an appreciation of this most basic science.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Essential question:

- What are the properties and behaviors of waves?

Students will understand:

- Waves transfer energy
- Waves have unique properties
- Math can be used to understand wave patterns

CONTENT AREA STANDARDS

SCI.HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
SCI.HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

HSA.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

LA.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.

MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MA.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
PFL.9.1.K12.P.4	Demonstrate creativity and innovation.
PFL.9.1.K12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
TECH.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will know:

- When energy is transferred from one system to another, the quantity of energy before transfer equals the quantity of energy after transfer. As an object falls, its potential energy decreases as its speed, and consequently its kinetic energy, increases. While an object is falling, some of the object's kinetic energy is transferred to the medium through which it falls, setting the medium into motion and heating it.
- When an object is in simple harmonic motion.
- Waves propagate through a medium by a repeating vibrations in space and time.
- Waves and simple harmonic motion are examples of periodic motion.

The following preconceptions and/or misconceptions will be addressed during the unit:

- A higher amplitude indicates a higher speed.
- All waves travel at the same speed.

Procedural Knowledge

Students will be able to:

HS-PS4-1

- Students identify and describe the relevant components in the mathematical representations:
 1. Mathematical values for frequency, wavelength, and speed of waves traveling in various specified media
 2. The relationships between frequency, wavelength, and speed of waves traveling in various specified media.
- Students show that the product of the frequency and the wavelength of a particular type of wave in a given medium is constant, and identify this relationship as the wave speed according to the mathematical relationship $v = f\lambda$.
- Students use the data to show that the wave speed for a particular type of wave changes as the medium through which the wave travels changes.
- Students predict the relative change in the wavelength of a wave when it moves from one medium to another

(thus different wave speeds using the mathematical relationship $v = f\lambda$). Students express the relative change in terms of cause (different media) and effect (different wavelengths but same frequency).

- Using the mathematical relationship $v = f\lambda$, students assess claims about any of the three quantities when the other two quantities are known for waves travelling in various specified media.
- Students use the mathematical relationships to distinguish between cause and correlation with respect to the supported claims.

HS-PS4-5

- Students use at least two different formats (e.g., oral, graphical, textual, and mathematical) to communicate technical information and ideas, including fully describing at least two devices and the physical principles upon which the devices depend. One of the devices must depend on the photoelectric effect for its operation. Students cite the origin of the information as appropriate.
- When describing how each device operates, students identify the wave behavior utilized by the device or the absorption of photons and production of electrons for devices that rely on the photoelectric effect, and qualitatively describe how the basic physics principles were utilized in the design through research and development to produce this functionality (e.g., absorbing electromagnetic energy and converting it to thermal energy to heat an object; using the photoelectric effect to produce an electric current).
- For each device, students discuss the real-world problem it solves or need it addresses, and how civilization now depends on the device.
- Students identify and communicate the cause and effect relationships that are used to produce the functionality of the device.

EVIDENCE OF LEARNING

Formative Assessments

Strategic questioning

Class/small group discussions

Homework and classwork assignments

Conducting and analyzing labs

Summative Assessments

- Benchmarks – departmental benchmark given at the end of MP1, MP2, and MP3
- Alternative Assessments
 - Lab inquiries and investigations
 - Lab Practicals

- Exploratory activities based on phenomenon
- Gallery walks of student work
- Creative Extension Projects
- Build a model of a proposed solution
- Let students design their own flashcards to test each other
- Keynote presentations made by students on a topic
- Portfolio

RESOURCES (Instructional, Supplemental, Intervention Materials)

The Physics Classroom - <http://www.physicsclassroom.com/>

PhET simulations - <https://phet.colorado.edu/>

Pivot - <https://www.pivotinteractives.com/>

Edpuzzle - <https://edpuzzle.com/>

Vernier labs - teacher lab manual available in classroom

INTERDISCIPLINARY CONNECTIONS

Calculations drive connections with mathematics courses

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.