10_Light, Reflection, Refraction and Geometric Optics

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **3-4 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 questions:

- In what ways does light behave like a wave?
- How can the reflection and refraction of light be used to produce images?

Students will understand:

- Waves transfer energy
- Waves have unique properties
- Math can be used to understand wave patterns
- Light is a small part of the electromagnetic spectrum
- Equations can be used to locate images formed by mirrors and lenses
- Ray diagrams for mirrors and lenses can be used to locate images

CONTENT AREA STANDARDS

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.
SCI.HS-PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

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.

MA.K-12.2	Reason abstractly and quantitatively.
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MA.K-12.4	Model with mathematics.
PFL.9.1.K12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
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.
LA.RH.11-12.8	Evaluate an author's claims, reasoning, and evidence by corroborating or challenging them with other sources.
LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.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.
LA.RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
WRK.K-12.P.4	Demonstrate creativity and innovation.
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:

- Only light that is reflected and directed toward your eyes can be seen.
- Only when the medium the light is entering has a larger index of refraction than the incident medium, the light will bend toward the normal.
- Light is a form of a wave constructed by oscillating electric and magnetic fields
- Light comes as both a wave and a particle, the energy of the particle depending on the wavelength
- The way light interacts with different boundaries to create reflection and refraction
- How to draw ray diagrams to describe basic optics.

Procedural Knowledge

Students will be able to:

- 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-PS4-3

- Students identify the given explanation that is to be supported by the claims, evidence, and reasoning to be evaluated, and that includes the following idea: Electromagnetic radiation can be described either by a wave model or a particle model, and for some situations one model is more useful than the other.
- Students identify the given claims to be evaluated.
- Students identify the given evidence to be evaluated, including the following phenomena:

1. Interference behavior by electromagnetic radiation
2. The photoelectric effect.

- Students identify the given reasoning to be evaluated.
- Students evaluate the given evidence for interference behavior of electromagnetic radiation to determine how it supports the argument that electromagnetic radiation can be described by a wave model.
- Students evaluate the phenomenon of the photoelectric effect to determine how it supports the argument that electromagnetic radiation can be described by a particle model.
- Students evaluate the given claims and reasoning for modeling electromagnetic radiation as both a wave and particle, considering the transfer of energy and information within and between systems, and why for some aspects the wave model is more useful and for other aspects the particle model is more useful to describe the transfer of energy and information

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.