Madison Public Schools

Honors Physics - Unit 12 - Light and E-M Radiation

Unit Focus

Students will explore electromagnetic radiation with emphasis on visible light. They will begin by exploring electromagnetic radiation and its spectrum in order to correlate frequencies and wavelengths. They will also explore the relationship between the frequency of a wave and its energy and real life applications of this principle. They will further evaluate the relationship between frequency, wavelength and speed as quantitatively described in the wave equation. They will continue exploring light and electromagnetic radiation's Law of Reflection and the principle of refraction and how it manifests in real life in terms of color mixing and polarization. Ultimately students will apply their new learning in exploring Ray diagrams for converging and diverging lens as well as for converging and diverging curved mirrors. If time allows, students will explore lenses as they relate to optical instruments and the functioning of the eye.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science Standards (DCI)
Science: 11

- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. *PS4.9.A1*
- 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. *PS4.9.B1*
- 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. *PS4.9.B3*

Student Growth and Development 21st Century Capacities Matrix
Critical Thinking

- Analyzing: Students will be able to examine information/data/evidence to make inferences and identify possible underlying assumptions, patterns,

Transfer

T1 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.

Meaning

Understanding(s)	Essential Question(s)
U1 Wavelength, frequency, and amplitude are properties of a wave that determine its characteristics such as pitch, color, sound and energy. **U2** When waves encounter objects they can reflect, refract, diffract or absorb depending on the property of material.	**Q1** Why are different forms of radiation used for different purposes? **Q2** How is the wave model of light used to describe optical instruments and the creation of optical phenomena such as rainbows

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
K1 The speed of light in a vacuum/air 3x108m/s **K2** Light bends when it changes mediums. **K3** As a wave's frequency increases, its energy increases **K4** The smaller (wavelength) a wave, the more damaging it may be to cells, biological entities and biological molecules. **K5** Different E-M waves have specific applications in society based on the wave's size and energy. **K6** Visible light is a small portion of the E-M spectrum	**S1** Students will be able to apply the laws of reflection and refraction to calculate the position and size of images formed by lenses and mirrors. **S2** Calculate the index of refraction of a material when given the speed of light in that material. **S3** Apply Snell's Law to a light ray moving from one medium to another. **S4** Determining the critical angle for light in different media.

Stage 1: Desired Results - Key Understandings		
and relationships. *MM.1.2* *Collaboration/Communication* • Collective Intelligence: Students will be able to work respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective. *MM.3.1*	**K7** Light undergoes a Doppler shift and this can be used to understand celestial bodies. **K8** Curved mirrors may make real or virtual images based on their geometry. **K9** The refraction of light is responsible for visible phenomena such as mirages, rainbows and distortion or objects seen underwater. **K10** Telescopes and microscopes are made by combining geometric optical devices (mirrors and lenses). **K11** Fiber optics and sparkling diamonds to name 2 make use of the total internal refraction of light. **K12** Waves are diffracted when they pass through narrow openings; the Huygens principle explains the behavior of waves after they pass through these opening.	