Carter County NGSS Science Curriculum

Unit Title/Topic: Waves	Grade: 11	Time: 2 week

Performance Expectations:

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength,
and speed of waves traveling in various media. **[Clarification Statement: Examples of data could include electromagnetic radiation traveling in a
vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to
algebraic relationships and describing those relationships qualitatively.]**

HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information. **[Clarification
Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and
copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.]**

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.
**[Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples
of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment does not include using quantum
theory.]**

HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of
electromagnetic radiation have when absorbed by matter. **[Clarification Statement: Emphasis is on the idea that different frequencies of
light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials
could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [Assessment Boundary: Assessment is limited to qualitative
descriptions.]**

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.* **[Clarification Statement: Examples could
include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [Assessment Boundary: Assesments are limited**

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. **[Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]**

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theory.]**

HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. **[Clarification Statement: Emphasis is on the idea that different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [Assessment Boundary: Assessment is limited to qualitative descriptions.]**

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.* **[Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [Assessment Boundary: Assesments are limited**

Learning Targets/I Cans:

1. **I can calculate wave frequency.**
2. **I can calculate wave length.**
3. **I can calculate wave speed.**
4. **I can draw and label a sine wave.**
5. **I can determine wave interference.**
6. **I can determine the most effective digital tramission and storage devices based on wave properties.**
7. **I can distinguish between wave models.**
8. **I can distinguish between longitudinal and transverse waves; electromagnetic waves and sound waves.**
9. **I can describe how waves are produced.**
10. **I can describe and explain how waves are used in current technology.**

Asking Questions and Defining Problems

Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- **Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. (HSPS4-2)**

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9-12 level 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.

- **Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)**

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.

- **Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3)**

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.

- **Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. (HS-PS4-4)**
- **Communicate technical information or ideas**

Disciplinary Core Ideas

PS4.A: Wave Properties

- 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. (HS-PS4-1)
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HSPS4-5)
- [From the 3–5 grade band endpoints] 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.) (HS-PS4-3)

PS4.B: Electromagnetic Radiation

- 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. (HS-PS4-3)
- 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. (HS-PS4-4)

Crosscutting Concepts

Systems and System Models

- 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. (HS-PS4-3)

Stability and Change

- Systems can be designed for greater or lesser stability. (HS-PS4-2)

(e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematic	▪ Photovoltaic materials emit electrons when they absorblight of a high-enough frequency. (HS-PS4-5) **PS4.C: Information Technologies and Instrumentation** ▪ Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-	

Critical Content Vocabulary:
Frequency, wavelength, crest, trough, transverse, longitudinal, rarefraction, interference, vibrations, refraction, Doppler effect, speed of light

Resources:
Discovery Education, Internet, Various lab equipment