MS.PS-WER Waves and Electromagnetic Radiation

DRAFT

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Students who demonstrate understanding can:

a. **Use a drawing or physical representation of simple wave properties to explain brightness and color.** [Assessment Boundary: Qualitative, not quantitative. Restricted to the following wave properties: frequency, wavelength, and amplitude.]

b. **Plan and carry out investigations of sound traveling through various types of mediums and lack of medium to determine whether a medium is necessary for the transfer of sound waves.** [Clarification Statement: Examples of investigations examining a lack of medium could include using a vacuum bell jar.]

c. **Construct explanations of how waves are reflected, absorbed, or transmitted through an object, considering the material the object is made from and the frequency of the wave.** [Assessment Boundary: Qualitative application to light, sound, and seismic waves only.]

d. **Use empirical evidence to support the claim that light travels in straight lines except at surfaces between different transparent materials.** [Clarification Statement: Examples of surfaces between transparent materials can include air and water, and air and glass.] [Assessment Boundary: Only non-computational observations; alterations of the speed of waves is not assessed until high school.]

e. **Ask questions about certain properties of light that can be explained by a wave model of light.** [Clarification Statement: Examples of properties of light can include brightness, color, and the refracting of light in a prism.]

f. **Apply scientific knowledge to explain the application of waves in common communication designs.** [Clarification Statement: Examples of common communication designs can include cell phones, radios, remote controls, and Bluetooth.] [Assessment Boundary: Applications limited to ability to transmit, receive, and encode.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to formulating and refining empirically testable questions and explanatory models.

- Ask questions that arise from phenomena, models, or unexpected results. (e)

Developing and Using Models

Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to explain, explore, and predict more abstract phenomena and design systems.

- Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs. (a)

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

- Plan and carry out investigations individually and collaboratively, identifying independent and dependent variables and controls. (b)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Use qualitative and quantitative relationships between variables to construct explanations for phenomena. (c)
- Apply scientific knowledge to explain real-world examples or events. (f)

Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.

- Use oral and written arguments supported by empirical evidence and reasoning to support or refute an argument for a phenomenon or a solution to a problem. (d)

Disciplinary Core Ideas

PS4.A: Wave Properties

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (a)
- A sound wave needs a medium through which it is transmitted. (b)
- Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. (c)

PS4.B: Electromagnetic Radiation

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (c)
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. Lenses and prisms are applications of this effect. (d)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media (prisms). However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (a),(e)

PS4.C: Information Technologies and Instrumentation

- Appropriately designed technologies (e.g., radio, television, cell phones, wired and wireless computer networks) make it possible to detect and interpret many types of signals that cannot be sensed directly. Designers of such devices must understand both the signal and its interactions with matter. (f)
- Many modern communication devices use digitized signals (sent as wave pulses) as a more reliable way to encode and transmit information. (f)

Crosscutting Concepts

Systems and System Models

Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. Models are limited in that they only represent certain aspects of the system under study. (b),(e)

Structure and Function

Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural and designed structures/systems can be analyzed to determine how they function. Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (a),(c),(d),(f)

Connections to other DCIs in this grade-level: **MS.ESS-SS, MS.ESS-ESP, MS.ESS-EIP**

Articulation to DCIs across grade-levels: **3.SFS, 4.WAV, 5.SSS, HS.PS-W, HS.PS-ER, HS.PS-FM**

Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]

ELA –

SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

SL.6.3 Delineate a speaker's argument and specific claims, distinguishing claims that are supported by reasons and evidence from claims that are not.

SL.7.3 Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and the relevance and sufficiency of the evidence.

SL.8.3 Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.

RST.6-8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.

Mathematics –

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

MP.6 Attend to precision.

6.EE Represent and analyze quantitative relationships between dependent and independent variables.