DCI: Waves and Their Applications in Technologies for Information Transfer

MS.PS4.A: Wave Properties

A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)

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MS.PS4.A: Wave Properties

A sound wave needs a medium through which it is transmitted. (MS-PS4-2)

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MS.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. (MS-PS4-2)

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MS.PS4.B: Electromagnetic Radiation

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. (MS-PS4-2)

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MS.PS4.B: Electromagnetic Radiation

A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)

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MS.PS4.B: Electromagnetic Radiation

However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

DCI: Waves and Their Applications in Technologies for Information Transfer

MS.PS4.C: Information Technologies and Instrumentation

Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)

DCI: From Molecules to Organisms: Structures and Processes

MS.LS1.D: Information Processing

Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)

Performance Expectation

MS-PS4-1: Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.
Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.

Performance Expectation

MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.
Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.

Performance Expectation

MS-PS4-3: Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.
Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.

Performance Expectation

MS-LS1-8: Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Clarification Statement: none
Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.

Science and Engineering Practices

Developing and Using Models

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

Develop a model to describe phenomena. (MS-PS4-2)

Science and Engineering Practices

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 6–8 level builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.

Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.

Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.

Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS1-8)

Crosscutting Concepts

Patterns

Graphs and charts can be used to identify patterns in data. (MS-PS4-1)

Crosscutting Concepts

Structure and 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. (MS-PS4-2)

Crosscutting Concepts

Structure and Function

Structures can be designed to serve particular functions. (MS-PS4-3)

Crosscutting Concepts

Cause and Effect

Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8)

Connections to Nature of Science

Science Knowledge Is Based on Empirical Evidence

Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1)

Connections to Nature of Science

Science Is a Human Endeavor

Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)

Common Core State Standards for ELA/Literacy

Reading in Science

RST.6-8.1 - Key Ideas and Details

Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3)

Common Core State Standards for ELA/Literacy

Reading in Science

RST.6-8.2 - Key Ideas and Details

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-PS4-3)

Common Core State Standards for ELA/Literacy

Reading in Science

RST.6-8.9 - Integration of Knowledge and Ideas

Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3)

Common Core State Standards for ELA/Literacy

Speaking & Listening

SL.8.5 - Presentation of Knowledge and Ideas

Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1), (MS-PS4-2)

Common Core State Standards for ELA/Literacy

Writing in Science

WHST.6-8.9 - Research to Build and Present Knowledge

Draw evidence from informational texts to support analysis reflection, and research. (MS-PS4-3)

Common Core State Standards for Mathematics

Ratios & Proportional Relationships

6.RP.A.1 - Understand ratio concepts and use ratio reasoning to solve problems.

Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1)

Common Core State Standards for Mathematics

Ratios & Proportional Relationships

6.RP.A.3 - Understand ratio concepts and use ratio reasoning to solve problems.

Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (MS-PS4-1)

Common Core State Standards for Mathematics

Ratios & Proportional Relationships

7.RP.A.2 - Analyze proportional relationships and use them to solve real-world and mathematical problems.

Recognize and represent proportional relationships between quantities. (MS-PS4-1)

Common Core State Standards for Mathematics

Functions

8.F.A.3 - Define, evaluate, and compare functions.

Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS4-1)

Common Core State Standards for Mathematics

Mathematical Practices

MP.2 - Reason abstractly and quantitatively

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects. (MS-PS4-1)

Common Core State Standards for Mathematics

Mathematical Practices

MP.4 - Model with mathematics

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. A student might apply proportional reasoning to plan a school event or analyze a problem in the community. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose. (MS-PS4-1)