Design Pattern

Grade 8 Overall Claim Students demonstrate a sophisticated understanding of the core ideas and applications of practices and crosscutting concepts in the disciplines of science.			
Explanatory Statements	Students integrate disciplinary core ideas and crosscutting concepts with scientific practices to investigate and explain how and why phenomena occur, and to design and refine solutions to problems.	Students connect knowledge across the disciplines of science to ask questions, plan and carry out investigations, and analyze and interpret data to support an argument about phenomena in a variety of contexts.	
Measurement Target 2 (Topic 2 Bundle): Students are able to develop and interpret models and use mathematical representations and scientific information to make claims about how waves transfer energy and information through various materials.			
Focal Knowledge, Skills, and Abilities (fKSAs)	**8.2a** Students are able to use a mathematical model to describe wave properties and patterns relating to the amounts of energy present or transmitted.	**8.2b** Students are able to use a model to describe a phenomenon involving reflection, absorption, or transmission properties of different materials for light and matter waves.	**8.2c** Students are able to support a claim about a phenomenon that includes the idea that digitized signals are a more reliable way to encode and transmit information than analog signals.
Rationale	• Students will describe and predict characteristic properties of waves. • Students will recognize patterns as an organizing concept for understanding wave properties. • Students will use models and mathematical thinking to demonstrate understanding of wave properties.	• Students will describe and predict characteristic behaviors of waves when the waves interact with matter. • Students will develop and use models to demonstrate understanding of wave behavior.	• Students will apply an understanding of waves as a means to send digital information. • Students will apply concepts of structure and function. • Students will obtain, evaluate, and communicate information to demonstrate understanding of wave behavior.
Additional Knowledge, Skills, and Abilities (aKSAs)	• Declarative knowledge related to properties of waves • Knowledge that a model explains or predicts • Knowledge of tools and measurements • Knowledge of direct and inverse relationships	• Declarative knowledge related to behavior of waves • Declarative knowledge of phases of matter (gas, liquid, solid) • Declarative knowledge of relationship between wavelength of light absorbed and color of an object • Knowledge that a model explains or predicts	• Declarative knowledge related to transmission of data, including defining a *signal* as a method of transmitting information over a distance • Vocabulary related to structure and function • Knowledge that structures can be designed to serve particular functions • Use evidence and reasoning to construct an evidence-based account of the phenomenon

Potential Observations	• Correct calculations • Appropriate units • Correct description of relationship between components of a model • Correct predictions based on patterns • Correct application of direct and inverse relationships • Correct explanation that sound requires a medium to travel through • Correct use of scientific terminology • Complete and appropriate explanation of relationships	• Correct description of wave behaviors in various mediums • Correct description of relationship between components of a model • Correct explanation that light can travel through a vacuum • Correct use of scientific terminology	• Correct application of wave technologies to communicate information • Correct use of scientific terminology • Correct description of characteristics of digital signals compared to analog signals • Integration of qualitative scientific and technical information
Potential Work Products	• Explanation of relationships among wave properties • Prediction of relationships among wave properties • Model showing relationships among wave properties • Use of mathematical representations to describe and/or support scientific conclusions	• Prediction of wave behaviors when the waves interact with matter • Model representing wave behaviors (i.e., drawing, simulation) • Use of a model to make sense of phenomena involving reflection, absorption, or transmission properties of different materials for light and matter waves	• Comparison of reliability of analog version and digital version of a tool for communicating information • Description of application of wave technologies to communicate information (i.e., transmission of light pulses in fiber optic cables, radio wave pulses in Wi-Fi devices, conversion of stored binary patterns to make sound or text on a computer)
Characteristic Features	• All items require evidence of qualitative and quantitative thinking. • All items must prompt students to make connections between observed phenomenon or evidence and reasoning underlying the observation/evidence (e.g., related to standard repeating waves). • All items must elicit core ideas as defined in *Framework for K-12 Science Education* (NRC, 2012). • All items must include elements from at least two dimensions.	• All items require evidence of qualitative applications related to light waves and mechanical waves. • All phenomena for which a model is developed must be observable (e.g., wave behaviors in various mediums). • All items must elicit core ideas as defined in *Framework for K-12 Science Education* (NRC, 2012). • All items must include elements from at least two dimensions.	• All items require evidence of correct interpretation of qualitative data. • All items must prompt students to make connections between observed phenomenon or evidence and reasoning underlying the observation/evidence (e.g., digital tools as wave pulses). • All items must elicit core ideas as defined in *Framework for K-12 Science Education* (NRC, 2012). • All items must include elements from at least two dimensions.

Variable Features	• Complexity of scientific concept(s) to be modeled • Core idea targeted in model (e.g., the Doppler Effect, transverse and longitudinal waves) • Function of the model: To explain a mechanism underlying a phenomenon; to predict future outcomes; to describe a phenomenon; to generate data to inform how the world works	• Complexity of scientific concept(s) to be modeled • Core idea targeted in model (e.g., light sources, the materials, polarization of light, ray diagrams) • Function of the model: To explain a mechanism underlying a phenomenon; to predict future outcomes; to describe a phenomenon; to generate data to inform how the world works	• Complexity of scientific concept(s) to be described • Core idea targeted in model (e.g., light waves, radio waves, sound pulses, laser pulses, microwaves, and infrared waves) • Devices and functions (e.g., telescopes, cell phones, wired or wireless computer networks)