Rigorous Curriculum Design

Unit Planning Organizer

Subject:	**Science**		Grade:	**8**
Unit Number:	**4**	Unit Name:	**Waves and their Applications**	
Unit Length	**Days: 3 weeks + 1 buffer week**		**Mins/Day: 55**	
Unit Synopsis	**Emphasis is on describing waves with both qualitative and quantitative thinking** **Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions** **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.**			

	NGSS	Science and Engineering Practice(s)
Priority Performance Expectations	**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. **MS-PS4-2.** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. **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.	• **Develop and Use Models** • **Use Mathematics and Computational Thinking** • **Obtain, Evaluate, and Communicate Information** Disciplinary Core Ideas **PS4.A: Wave Properties** • A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) • A sound wave needs a medium through which it is transmitted. (MS-PS4-2) **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) • 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) • 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) • However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

	Assessment Boundaries:	**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)
Crosscutting Concepts	• **Patterns** • **Structure and Function** • **Stability and Change**	

Supporting Performance Expectations	NGSS	Math CCSS	Literacy CCSS
	MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **MS-ETS1-2.** Evaluate competing design Solutions using a systematic Process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3.** Analyze data from tests to Determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such	**MP.2** Reason abstractly and quantitatively. (MS-PS4-1) **MP.4** Model with mathematics. (MS-PS4-1) **6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1) **6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS4-1) **7.RP.A.2** Recognize and represent proportional relationships between quantities. (MS-PS4-1) **8.F.A.3** 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)	**RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3) **RST.6-8.2** 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) **RST.6-8.9** 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) **WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3) **SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1),(MS-PS4-2)

	that an optimal design can be achieved.		
Interdisciplinary Connections	NG ELD Standards	Literacy / Science / History / Other	
	I6. Reading closely literary and informational texts and viewing multimedia to determine how meaning is conveyed explicitly and implicitly through language P10. Writing literary and informational texts to present, describe, and explain ideas and information, using appropriate technology P11. Justifying own arguments and evaluating others' arguments in writing P12. Selecting and applying varied and precise vocabulary and language structures to effectively convey ideas.	MS.LS1.D (MS-PS4-2)	

Unwrapped Priority Performance Expectations

PE:MS-PS4-1				
Skills	Concepts	Bloom's	DOK (Rigor Matrix)	Language Demand
Use	Mathematical Representations	Apply	2	
To Describe	A simple model for waves (that includes how the amplitude of a wave is related to the energy in a wave)	Analyze		

PE:MS-PS4-2 Skills	Concepts	Bloom's	DOK (Rigor Matrix)	Language Demand
Develop Use	A model	Create	3	
To Describe	That waves are reflected, absorbed, or transmitted through various materials	Understand		

PE:MS-PS4-3 Skills	Concepts	Bloom's	DOK (Rigor Matrix)	Language Demand
Integrate	Qualitative scientific and technical information	Analyze	3	
To Support	The claim that digitized signals are a more reliable way to encode and transmit information than analog signals	Evaluate		

Learning Progressions of Skills and Concepts

PE: DCI(s):	**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.

Previous Course 4th Grade	Current Course	Next Course_____
4.PS3.A **4.PS3.B** **4.PS4.A** **Definition of Energy**. Energy can be moved through light, sound, motion, and heat. **Conservation of energy and energy transfer**. Energy in light, sound, motion, and heat. Energy transfer changes motion. Energy can transfer as electrical current, sound, light, or heat. **Wave Properties**. Waves are pattern of motion, can be shown in water. Waves can differ in amplitude and frequency.		**H.S.PS4.A** **H.S.PS4.B** **Wave Properties**. Waves can add or cancel each other as they cross. **Electromagnetic Radiation**. Model of wave to show electromagnetic radiation.

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

Previous Course 4th	Current Course	Next Course_____
4.PS4.B **Electromagnetic Radiation**. Object can be seen when light reflected.		**H.S.PS4.A** **H.S.PS4.B** **H.S.ESS1.A** **H.S.ESS2.A** **H.S.ESS2.C** **H.S.ESS2.D**

		Wave Properties. Waves can add or cancel each other as they cross. **Electromagnetic Radiation**. Model of wave to show electromagnetic radiation. **The Universe and Its Star**. Study of star lights and brightness to identify properties. Nuclear fusion within stars. Supernova. **Earth Materials and Systems**. Earth's systems cause change **Role of Water on Earth's Surface**. **Weather and Climate**. The foundation of climate is dependent of the sun.

PE: DCI(s):	**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.

Previous Course 4th Grade	Current Course	Next Course High School
4.PS4.C **Information technologies and instrumentations**. Digitized information can be transmitted over long distance.		**HS.PS4.A** **HS.PS4.C** **Wave Properties**. Waves can add or cancel each other as they cross. **Informational Technologies and Instrumentations**. Multiple technologies used to measure waves. Essentials for producing, transmitting, and capturing signals.

Big Idea(s)	Corresponding Essential Question(s)
1. PS4-1: The amplitude of a wave is proportional to its energy. 2. PS4-1: The major components of a wave include amplitude, wavelength, crest, and trough.	1. PS4-1: How does amplitude relate to the energy of waves? 2. PS4-1: What are major components of a wave?

3. PS4-2: Waves may be absorbed, reflected, or transmitted. 4. PS4-2: Mechanical waves require a medium to move. 5. PS4-3: Digital signals are more reliable than analog signals.	3. PS4-2: What can happen to light waves when they hit another medium? 4. PS4-2: Why does light transmit through outer space but not sound? 5. PS4-3: Why are digital signals more reliable than analog signals?

Unit Vocabulary Words	
Academic Cross-Curricular Vocabulary (Tier 2)	Content/Domain Specific Vocabulary (Tier 3)
Waves Amplitude Frequency Reflect Absorb Transmit Medium Encode Transparent Pulse	Wavelength Digitized signal Analog signal Mechanical waves Refraction
Supporting Vocabulary (Tier 2)	**Supporting Vocabulary (Tier 3)**

Resources for Vocabulary Development (Strategies, Routines and Activities)

1. Post vocabulary around the room
2. Require using vocabulary terms in written and verbal responses.
3. Use vocabulary notecards/foldables
4. Highlighting vocabulary terms
5. Construct picture or graphic representation of term
6. Peer study/quiz vocab terms
7. Using terms in different context
8. Using graphic organizer
9. Prefixes/word root
10. Word splatter
11. Vocabulary web: definition, sentence, illustration, example
12. Looping vocab cards

21st Century Skills	
☐ Creativity and Innovation	☐ Initiative and Self-Direction
☐ Critical Thinking and Problem Solving	☐ Social and Cross-Cultural Skills
☐ Communication and Collaboration	☐ Productivity and Accountability
☐ Flexibility and Adaptability	☐ Leadership and Responsibility
☐ Globally and Financially Literate	☐ _____
☐ Communicating and Collaborating	☐ _____

Connections between 21st Century Skills, NGSS, and Unit Overview:

Costa & Kallick, 2008

Unit Assessments	
Pre-Assessment	Post-Assessment
Please see www.alvordschools.org/cfa for the most current EADMS CFA ID numbers.	Please see www.alvordschools.org/cfa for the most current EADMS CFA ID numbers.
Scoring Guides and Answer Keys	
Unit 4 8th Grade_assessment_planner_science.docx	Unit 4 8th Grade_assessment_planner_science.docx

Assessment Differentiation			
Students with Disabilities	***Accommodations*** Reference IEP to ensure appropriate testing environment ***Modifications***	English Language Learners	Emerging Expanding

Engaging Scenario Overview (Situation, challenge, role, audience, product or performance)	
Description: You are a member of the information distribution department of a multimedia company. Select one type of media (Text, sound, picture, or video) and write a proposal for whether your company should use digital or analog waves for distributing your type of media over long distances. Your proposal should be directed at the board of directors of your company, who do not understand the difference between digital and analog waves. Proposals should also include information about how each type of wave is used to transmit the selected type of media as well as the advantages and disadvantages of using each type of wave before coming to a conclusion that one type of wave is more reliable for your company.	Suggested Length of Time Days: 10-15 Mins/Day:
Engaging Learning Experiences Synopsis of Authentic Performance Tasks	

Authentic Performance Tasks	Description	Suggested Length of Time
Task 1: Students will write to describe observations about different characteristics of waves. Students will make diagrams to represent different models of waves.	Problem Solving: Find and describe patterns and characteristics of waves. Use observation to inquire about the properties of different types of waves. SEP: **Ask Questions/Define Problems** **Develop and Use Models** **Engage in Argument from Evidence**	Days: 10-15 Mins/Day: 1-2
Task 2: Students will read articles, write notes, make foldables, practice vocabulary development, and/or annotate diagrams.	Problem Solving: Gather information from text, presentations, models, or diagrams to synthesis meaningful resources and communicate new learning. **SEP:** **Develop and Use Models** **Obtain, Evaluate, and Communicate Information**	Days: 2 Mins/Day:
Task 3: Students will perform laboratory activity to make observation and find evidence about light or sound waves.	Problem Solving: Be able to make prediction and carry out experimentation to test prediction. Collect and analyze data to evaluate prediction and communicate new understanding. **SEP:** **Ask Questions/Define Problems** **Plan and Carry Out Investigations** **Analyze and Interpret Data**	Days: 3-5 Mins/Day:
Task 4:	Problem Solving: Design, test, and modify a solution to a problem.	Days: 2-3

Students will design and construct/arrange different apparatuses to bend light waves (from a laser pointer or flashlight) using materials such as mirrors and prisms to hit one target or multiple targets. Students will be expected to diagram the path of the light against and through various materials.	**SEP:** **Construct Explanations and Design Solutions**	Mins/Day:

Authentic Performance Task 1

Name:	Wave Exploration	Suggested Length	Days: 1-2 Mins/Day:

	Priority Standards	
	NGSS	Science and Engineering Practice(s)
Performance Expectations / Standards Addressed	**MS-PS4-2.** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	• **Ask Questions/Define Problems** • **Develop and Use Models** • **Engage in Argument from Evidence** Disciplinary Core Idea(s) **PS4.A: Wave Properties** A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) A sound wave needs a medium through which it is transmitted. (MS-PS4-2) **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)

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)

Crosscutting Concept(s)

- **Cause and Effect: Mechanism and Explanation**
- **Systems and System Models**

Supporting Standards

NGSS	CCSS Math	CCSS Literacy	NG ELD

Teaching and Learning Progression

Exploratory activities to introduce students to concepts to be taught. Activities could include demonstrations, video clips, articles, simple hands on activities, making predictions, brainstorming, etc. Students will be expected to draw diagrams to record their observations and see attempt to explain what they using scientific principles.

Purpose: Students will make observations and predictions using light, sound and other types of waves
Specific Examples for Unit 4: Reflecting light through prisms, slinky movement, observing water waves

Bloom's	DOK
	2

Scoring Rubric

- ☐ **Proficient**: All diagrams accurately reflect observations. Questions and theories are directly related to observations.
- ☐ **Progressing**: Some diagrams are completed and accurate. Questions and theories are partly related to observations.
- ☐ **Beginning**: Diagrams are inaccurate or incomplete. Questions and theories do not reflect observations.

Instructional Strategies

All Students	SWD	ELs	Enrichment

	Accommodations	Emerging	
		Expanding	
	Modifications		
		Bridging	

Authentic Performance Task 2

Name:	Information gathering and synthesis	Suggested Length	Days: 2 Mins/Day:

Performance Expectations / Standards Addressed	Priority Standards	
	NGSS	Science and Engineering Practice(s)
	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. **MS-PS4-2.** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	**Develop and Use Models** **Obtain, Evaluate, and Communicate Information** Disciplinary Core Idea(s) **PS4.A: Wave Properties** A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) A sound wave needs a medium through which it is transmitted. (MS-PS4-2) 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) 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) However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2) Crosscutting Concept(s)

			• **Scale, Proportion, and Quantity** • **Systems and System Models** • **Structure and Function**	
	Supporting Standards			
	NGSS	CCSS Math	CCSS Literacy	NG ELD

Teaching and Learning Progression	Teacher preferred method for information gathering: vocabulary activities, notes, foldables, articles, reading text, PowerPoint presentation, etc Focus is on student output in visual and/or written format. Possible outputs can include foldables, annotated diagrams, poster, IVF summary, pictures with captions, etc	Bloom's	DOK
			2
		Scoring Rubric	
		☐ **Proficient**: Information is complete and accurate. Diagrams and definitions are original work and show synthesis of information. ☐ **Progressing**: Information is mostly accurate. Diagrams and definitions show little original work. ☐ **Beginning**: Information is limited and/or incorrect. Diagrams and definitions are copied or incorrect.	

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
		Expanding	
	Modifications	Bridging	

Authentic Performance Task 3

Name:	Lab/Hands-on Experience	Suggested Length	Days: 3-5 Mins/Day:

Performance Expectations / Standards Addressed

Priority Standards

NGSS	Science and Engineering Practice(s)
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. **MS-PS4-2.** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	• **Ask Questions/Define Problems** • **Plan and Carry Out Investigations** • **Analyze and Interpret Data**
	Disciplinary Core Idea(s)
	PS4.A: Wave Properties A sound wave needs a medium through which it is transmitted. (MS-PS4-2) **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) 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) 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) However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)
	Crosscutting Concept(s)
	• **Cause and Effect: Mechanism and Explanation** • **Systems and System Models** • **Energy and Matter: Flows, Cycles, and Conservation**

Supporting Standards

NGSS	CCSS Math	CCSS Literacy	NG ELD

Teaching and Learning Progression	Students will have some type of hands-on experience, using and showing understanding of the concepts and vocabulary they have just learned. Purpose: Students will collect evidence to show changes in the path of light waves and/or sound waves as they encounter various materials and are transmitted, reflected or absorbed. Students may use flashlights or laser points as a source of light. Different materials may include mirrors, glass, aluminum foil, prism, water, etc. Relate that the different behaviors of light/sound waves to the ability to manipulation of transmission of data and information.	Bloom's	DOK
			4
		Scoring Rubric	
		☐ **Proficient**: Procedures and write-up are completed accurately. Students can use lab results to prove and support DCIs ☐ **Progressing**: Most procedures and write-up completed. Students can make some connections between the lab and the DCIs ☐ **Beginning**: Difficulty completing procedures and write-up. Students cannot relate write up to lab.	

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
		Expanding	
	Modifications		
		Bridging	

Authentic Performance Task 4

Name:	Solving an engineering problem using waves	Suggested Length	Days:2-3 Mins/Day:

<table>
<tr><td rowspan="5">Performance Expectations / Standards Addressed</td><td colspan="4">Priority Standards</td></tr>
<tr><td colspan="2">NGSS</td><td colspan="2">Science and Engineering Practice(s)</td></tr>
<tr><td colspan="2">MS-PS4-2.
Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</td><td colspan="2">Construct Explanations and Design Solutions</td></tr>
<tr><td colspan="4">Disciplinary Core Idea(s)</td></tr>
<tr><td colspan="4">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)

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)
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)

However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)</td></tr>
<tr><td colspan="4">Crosscutting Concept(s)</td></tr>
<tr><td colspan="4">• Cause and Effect: Mechanism and Explanation
• Systems and System Models</td></tr>
<tr><td colspan="4">Supporting Standards</td></tr>
<tr><td>NGSS</td><td>CCSS Math</td><td>CCSS Literacy</td><td>NG ELD</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Teaching and Learning Progression</td><td colspan="2" rowspan="4">Students are challenged to bend light waves (from a laser pointer or flashlight) using materials such as mirrors and prisms to hit one target or multiple targets. Students will be expected to diagram the path of the light against and through various materials.</td><td>Bloom’s</td><td>DOK</td></tr>
<tr><td></td><td>3</td></tr>
<tr><td colspan="2">Scoring Rubric</td></tr>
<tr><td colspan="2">☐ <u>Proficient</u>: Final solution is effective and efficient. Diagram is accurate. Choices are justified using DCIs.</td></tr>
</table>

		☐ **Progressing**: Able to construct a final solution. Difficulty diagramming solution and/or justifying choices. ☐ **Beginning**: Difficulty constructing a solution due to a lack of understanding basic functions of components.

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
		Expanding	
	Modifications	Bridging	

Engaging Scenario

Detailed Description (situation, challenge, role, audience, product or performance)
Students. Description: You are a member of the information distribution department of a multimedia company. Select one type of media (Text, sound, picture, or video) and write a proposal for whether your company should use digital or analog waves for distributing your type of media over long distances. Your proposal should be directed at the board of directors of your company, who do not understand the difference between digital and analog waves. Proposals should also include information about how each type of wave is used to transmit the selected type of media as well as the advantages and disadvantages of using each type of wave. Include a conclusion that one type of wave is more reliable for your company then the other.

Instructional Strategies			
All Students	SWD	ELs	Enrichment

	Accommodations	Emerging	
		Expanding	
	Modifications	Bridging	

Scoring Guide:

<u>Advanced</u>: Everything in proficient plus: Advantages and disadvantages are thoroughly explored. Sources are correctly cited using an academically accepted format. Written proposal is professional in appearance.

<u>Proficient</u>: Accurate, original information is presented clearly and concisely in the proposal and used to justify a final conclusion. Advantages and disadvantages of each type of wave are explored. Sources are cited.

<u>Progressing</u>: Some original information is accurate. Few advantages and disadvantages are presented. Final conclusion is somewhat based on information presented.

<u>Beginning</u>: Information is inaccurate or plagiarized. Final conclusion not backed up with evidence

Feedback to Curriculum Team

Reflect on the teaching and learning process within this unit of study. What were some successes and

challenges that might be helpful when refining this unit of study?		
	Successes	Challenges
Student Perspective		
Teacher Perspective		