CCPS Science Unit Plan

Grade	8	**Subject**	Science	**Unit #**	3
Unit Name	Waves		**Timeline**	7 weeks	
How to use the Framework	This Framework should be used to implement daily science instruction. The resources and instructional strategies reflected in the Framework will provide a foundation for effective implementation and student mastery of standards. Please see the hyperlinked abbreviation document to ensure you understand all abbreviations used with this framework.				
Unit Overview	In this middle school science unit on waves, students will embark on a journey to understand wave phenomena. They will explore the fundamental structure of waves, learning about key characteristics such as wavelength, frequency, amplitude, and speed. Through interactive demonstrations and experiments, students will investigate different types of waves, including mechanical waves like sound waves and electromagnetic waves like light waves. They will discover how waves transfer energy and information and how they interact with various media through reflection, refraction, and diffraction. By the end of the unit, students will have a solid grasp of wave properties and behaviors, equipping them with essential knowledge for future studies in physics and technology.				
Lesson Plan guidance document and template	Science SBC Instructional Framework.pdf Department of Science CCPS Lesson Plan Guidance Document .pdf CCPS Lesson Plan Template (Week View) CCPS Lesson Plan Template (Daily View)				

3Dimensional Instruction

GSE	Science and Engineering Practices	Crosscutting Concepts
S8P4. Obtain, evaluate, and communicate information to support the claim that electromagnetic (light) waves behave differently than mechanical (sound) waves. **S8P4.A.** Ask questions to develop explanations about the similarities and differences between electromagnetic and mechanical waves. (Clarification statement: Include transverse and longitudinal waves and wave parts such as crest, trough, compressions, and rarefactions.) **S8P4.B.** Construct an explanation using data to illustrate the relationship between the electromagnetic spectrum and energy. **S8P4.C.** Design a device to illustrate practical applications of the electromagnetic spectrum (e.g., communication, medical, and military).	• Develop and use Models • Engage in Arguments from Evidence • Asking Questions and Defining Problems • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Using Mathematical and Computational Thinking • Constructing Explanations and Designing Solutions • Obtaining, Evaluating, and Communicating Information	• Patterns • Cause and effect • Scale, proportion, and quantity • Systems and system models • Energy and matter • Structure and function • Stability and change

	S8P4.D. Develop and use a model to compare and contrast how light and sound waves are reflected, refracted, absorbed, diffracted, or transmitted through various materials. (Clarification statement: Include echo and how color is seen but do not cover interference and scattering.) **S8P4.E**. Analyze and interpret data to predict patterns in the relationship between density of media and wave behavior (i.e., speed). **S8P4.F.** Develop and use a model (e.g., simulations, graphs, illustrations) to predict and describe the relationships between wave properties (e.g., frequency, amplitude, and wavelength) and energy. **S8P4.G.** Develop and use models to demonstrate the effects that lenses have on light (i.e., formation of an image) and their possible technological applications.		

NGSS Alignment	NGSS Alignment to Disciplinary Core Ideas • **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 how 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.

Weekly Lesson Tasks

Week 1

GSE: **S8P4.** Obtain, evaluate, and communicate information to support the claim that electromagnetic (light) waves behave differently than mechanical (sound) waves. **S8P4.A.** Ask questions to develop explanations about the similarities and differences between electromagnetic and mechanical waves. (Clarification statement: Include transverse and longitudinal waves and wave parts such as crest, trough, compressions, and rarefactions.)	**Focused Concept:** • The focus concept for this element is to determine the similarities and differences between electromagnetic and mechanical waves. Students should understand that electromagnetic waves can travel in a vacuum or through a medium, but mechanical waves must have a medium.
SEP: • Asking questions	**CCC:** • Energy and Matter

• Constructing explanations	
Phenomenon: Ask: Why can you feel thunder? Have students construct an initial explanation for the question. Then, they should view one or all of the videos to observe a tuning fork interacting with water and complete the STW protocol for the videos. Questions to facilitate discussion: • What are tuning forks? (HINT - demonstrate one to students if available) • Why does the water react to the tuning fork? • How is this similar to our opening question on thunder? • What other questions do we need to answer to figure out this phenomenon? Sound Wave Demo with Tuning Forks and a Bowl of Water • (Start at 1:00 and play to end) Tuning Fork and a Bowl of Water Tuning Fork In Water - Ultra Slow Motion Walking Water Effect - 30,000 FPS	**DQ:** • What is a wave? • How are electromagnetic waves and mechanical waves similar? How are they different?

	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Learning Targets	SWBAT identify the parts of a transverse wave and a longitudinal wave. SWBAT explain how the particles of the medium vibrate in relation to the direction in which the wave's energy is traveling for transverse and longitudinal waves. SWBAT ask questions to develop explanations about the similarities and differences between electromagnetic and mechanical waves.	SWBAT identify the parts of a transverse wave and a longitudinal wave. SWBAT explain how the particles of the medium vibrate in relation to the direction in which the wave's energy is traveling for transverse and longitudinal waves. SWBAT ask questions to develop explanations about the similarities and differences between electromagnetic and mechanical waves.	SWBAT identify the parts of a transverse wave and a longitudinal wave. SWBAT explain how the particles of the medium vibrate in relation to the direction in which the wave's energy is traveling for transverse and longitudinal waves. SWBAT ask questions to develop explanations about the similarities and differences between electromagnetic and mechanical waves.	SWBAT identify the parts of a transverse wave and a longitudinal wave. SWBAT explain how the particles of the medium vibrate in relation to the direction in which the wave's energy is traveling for transverse and longitudinal waves. SWBAT ask questions to develop explanations about the similarities and differences between electromagnetic and mechanical waves.	SWBAT identify the parts of a transverse wave and a longitudinal wave. SWBAT explain how the particles of the medium vibrate in relation to the direction in which the wave's energy is traveling for transverse and longitudinal waves. SWBAT ask questions to develop explanations about the similarities and differences between electromagnetic and mechanical waves.

Opening	UNIT PRE-TEST (30 minutes) Teacher Version Student Version *Has been shared with Ms. Muhammad in Illuminate -Teacher will administer UNIT PRE-TEST	Probe: Textbook Page 5 Students will complete the probe and revise their answers at the end of the week. Lesson Phenomenon: Why can we feel thunder? Show an image of a thundercloud with lightning. (Textbook Page 7) Ask: Why can you feel thunder? Have students construct an initial explanation for the question. Then, they should view one or all of the videos to observe a tuning fork interacting with water and complete the STW protocol for the videos. (See the phenomenon section of this week's lesson for videos.)	Ask: What can you add to your explanation of how we feel thunder? Have students revise their explanations and determine if they can answer any of the questions they had on Day 2.	Ask students to revisit the probe on page 5 in their textbook. Read the probe together and discuss whether or not they need to make any revisions to their initial explanations. Facilitate discussion on the probe and review how waves transfer energy and do not carry matter with students.	Final Discussion on Phenomenon: What can you add to our explanation of how we feel thunder? Have students revise their explanations and clear up misconceptions about why we hear thunder and how the water reacted to the tuning fork.
Guided Practice/ Transition	Unit Phenomenon: Show video from Wonders of Science on the Reuben's Tube Have students complete the STW protocol. Questions for Discussion: ● What do you observe taking place in the video? ● Why are you seeing changes in the fire tube? ● How might this connect to waves?	Day 1 of 2-Day Lesson Inquiry Stations: (Adapted from Stemscopes - not all stations are from Stemscopes) Students will complete activities at various inquiry stations. Students will complete questions and drawings in their journals as evidence of completion. HINTS: ● Keep group sizes to ~ 4 students	Day 2 of 2-Day Lesson Inquiry Stations: (Adapted from Stemscopes - not all stations are from Stemscopes) Students will complete activities at various inquiry stations. Students will complete questions and drawings in their journals as evidence of completion. HINTS: ● Keep group sizes to ~ 4 students	Students will take notes on Electromagnetic and Mechanical Waves in their notebooks. The teacher will facilitate discussion and use the activities from the inquiry stations to anchor learning. PPT on Waves (This is a comprehensive PPT. Only use the portion needed for this lesson - slides 1-9.)	Review essential items with students for the quiz - use yesterday's review sheet as a guide. (10-15 minutes) Teacher Version Student Version *Quiz has been shared with Ms. Muhammad

	• What do you need to know to be able to explain this phenomenon? *Have students complete the graphic organizer (linked below) as they discover evidence to answer the unit phenomenon. **Refer to the unit phenomenon 1-2 times per week as you work through the unit. Making Connection… <u>Weekly Vocabulary:</u> Wave Medium Electromagnetic Wave Mechanical Wave Transverse Wave Longitudinal Wave Surface Wave Crest Trough Wavelength Wave Height Compression Rarefaction Photon Energy	• Have filler activities (reading, vocabulary, etc., for early finishers at each station) • Stations 1-4 can be set up around the room • Stations 5-8 are individual and can be completed at students' seats Discuss with students: • Rotations and timing • Tools & materials • Behavior expectations • Evidence of learning Complete the background reading as a whole class and then break into small groups. ***The documents below will need to be adapted to the stations you are completing with students.*** Teacher Guide Student Journal Student Guide 1 - Create models of waves 2 - Sound wave w/bottle 3 - Cork bobbing in water 4 - EM wave sort and chart completion	• Have filler activities (reading, vocabulary, etc., for early finishers at each station) • Stations 1-4 can be set up around the room • Stations 5-8 are individual and can be completed at students' seats Discuss with students: • Rotations and timing • Tools & materials • Behavior expectations • Evidence of learning Complete the background reading as a whole class and then break into small groups. ***The documents below will need to be adapted to the stations you are completing with students.*** Teacher Guide Student Journal Student Guide 1 - Create models of waves 2 - Sound wave w/bottle 3 - Cork bobbing in water 4 - EM wave sort and chart completion		
Independent Practice	Create Frayer Models for New Vocabulary (Frayer Models can be done as homework or during independent work when learning tasks are completed.) Printable FM Template	Stations 5-8 5 - Video with graphic organizer Mechanical Waves … Cornell Notes Organizer 6 - Wave Simulations Longitudinal Wave	Stations 5-8 5 - Video with graphic organizer Mechanical Waves … Cornell Notes Organizer 6 - Wave Simulations Longitudinal Wave	Students will complete a wave review sheet to prepare for their quiz. Waves Review Sheet *Make sure to review answers with students.	Have students take their weekly quiz. (20-25 minutes) Once all students have completed the quiz, have them log their data in their data sheets or data notebooks. (This could be

	Digital FM Template Data Talk While students work independently, pull small groups and have them create their data sheet for unit 3. They should log in their pre-test data and develop goals for post-test performance.	Transverse Wave Surface Waves Comparing Waves 7 - Frayer Models 8 - Reading with questions Data Talk While students work independently, pull small groups and have them create their data sheet for unit 3. They should log in their pre-test data and develop goals for post-test performance.	Transverse Wave Surface Waves Comparing Waves 7 - Frayer Models 8 - Reading with questions Data Talk While students work independently, pull small groups and have them create their data sheet for unit 3. They should log in their pre-test data and develop goals for post-test performance.		completed on the next school day.)
Assessment Summary	TOTD: How will you reach your assessment goals for unit 3? (What 2-3 things will you do to reach the goal?)	TOTD: Compare and contrast mechanical and electromagnetic waves.	TOTD: Draw a model to show the motion of the particles and the direction of the energy flow for mechanical and electromagnetic waves.	TOTD: How will you prepare for tomorrow's quiz?	Reflection: How did your preparation for the quiz help you? Explain what you should change or do differently for the following quiz.
Small Group Tasks (TBA)					

Week 2

GSE:
S8P4. Obtain, evaluate, and communicate information to support the claim that electromagnetic (light) waves behave differently than mechanical (sound) waves.

S8P4.B. Construct an explanation using data to illustrate the relationship between the electromagnetic spectrum and energy.
S8P4.F. Develop and use a model (e.g., simulations, graphs, illustrations) to predict and describe the relationships between wave properties (e.g., frequency, amplitude, and wavelength) and energy.

Focused Concept:
- The focus concept for this element is for students to understand that frequency, energy, and wavelength are inversely proportional in electromagnetic waves. Students should connect that frequency and energy decrease as wavelength increases and increase as wavelength decreases.

SEP:
- Obtain, evaluate, and communicate information

CCC:
- Patterns

• Construct an explanation • Develop and use models	• Cause and Effect • Energy and Matter
Phenomenon: STW using images on [Google Slide.]() *The images are damage done to the skin by UV light from the electromagnetic spectrum.	**DQ:** How are frequency and wavelength related to the energy of an electromagnetic wave?

	Day 6	Day 7	Day 8	Day 9	Day 10
Learning Targets	SWBAT construct an explanation using data to illustrate the relationship between the electromagnetic spectrum and energy. SWBAT explain the relationships between wavelength, frequency, and energy for electromagnetic waves. SWBAT explain that all electromagnetic waves travel at light speed in a vacuum.	SWBAT construct an explanation using data to illustrate the relationship between the electromagnetic spectrum and energy. SWBAT explain the relationships between wavelength, frequency, and energy for electromagnetic waves. SWBAT explain that all electromagnetic waves travel at light speed in a vacuum.	SWBAT construct an explanation using data to illustrate the relationship between the electromagnetic spectrum and energy. SWBAT explain the relationships between wavelength, frequency, and energy for electromagnetic waves. SWBAT explain that all electromagnetic waves travel at light speed in a vacuum.	SWBAT construct an explanation using data to illustrate the relationship between the electromagnetic spectrum and energy. SWBAT explain the relationships between wavelength, frequency, and energy for electromagnetic waves. SWBAT explain that all electromagnetic waves travel at light speed in a vacuum.	SWBAT construct an explanation using data to illustrate the relationship between the electromagnetic spectrum and energy. SWBAT explain the relationships between wavelength, frequency, and energy for electromagnetic waves. SWBAT explain that all electromagnetic waves travel at light speed in a vacuum.
Opening	Introduce the lesson phenomenon - See section above. Inquiry Activity: • Students will work with a small group and be tasked with putting the electromagnetic spectrum in order from low energy to high energy based on the image cards they are given. (Groups will have different cards to	• Show an image of various technologies that use electromagnetic waves. • Have students place the items in order of longest wavelength, or by highest frequency, and energy with their elbow partner. • Have students share why they organized the images the way they did.	Think - Pair - Share: Are ultraviolet waves more dangerous to living things than visible light waves? Why or why not? (This is related to the lesson phenomenon.) Ask the questions to get students talking and sharing their current understanding. Introduce the Guiding Question for the lab.	Discuss the phenomenon for the lesson/lab. Review Investigative Proposals	Discuss the phenomenon for the lesson/lab - have students share their final thoughts on the lesson phenomenon.

	organize.) ● Have students complete the inquiry sheet as you discuss their results. EM Spectrum Card Set Student Inquiry Sheet ● TIP: print cards 2 per page to save on copies and ink. Cut them apart and place them in a sheet protector to use them throughout the unit.	EM Waves Engage	Discuss with students how this lab will help them explain the phenomenon.		
Guided Practice/Transition	Day 1 of 2-Day Lesson Literacy Inquiry Stations: Getting 2 Know the EM Spectrum Student Inquiry Sheet EM Spectrum Stations Students will research the EM spectrum at literacy stations and complete their inquiry sheets for their journals/notebooks. **TIPS:** ● You can complete the activity digitally or printed. ● Break the reading into 2 or 3 stations so students aren't overwhelmed. ● Show the video to the class and discuss as students answer the questions. ● Have the EM	Day 2 of 2-Day Lesson Literacy Inquiry Stations: Getting 2 Know the EM Spectrum Student Inquiry Sheet EM Spectrum Stations Students will research the EM spectrum at literacy stations and complete their inquiry sheets for their journals/notebooks. **TIPS:** ● You can complete the activity digitally or printed. ● Break the reading into 2 or 3 stations so students aren't overwhelmed. ● Show the video to the class and discuss as students answer the questions. ● Have the EM	Day 1 of 3-Day Lesson **ADI Lab 19:** How Do Frequency, Amplitude, and Wavelength of a Transverse Wave Affect Its Energy? **Stage 1: Task** ● Introduce the task to students. (Guiding Question) ● Discuss the phenomenon for the lesson to get students to discuss the properties of waves. **Stage 2: Ideas** ● Students will engage in a close read of the lab handout to better understand what they are investigating. Close Reading Annotation Guide **TIPS:** ● Read lab with the	Day 2 of 3-Day Lesson **ADI Lab 19:** How Do Frequency, Amplitude, and Wavelength of a Transverse Wave Affect Its Energy? **Stage 4: Do** ● Students will collect data based on their investigative proposals. ● Following data collection, students will create a claim that answers the guiding question. ● Claims should be supported by the evidence collected during their investigations.	Day 3 of 3-Day Lesson **ADI Lab 19:** How Do Frequency, Amplitude, and Wavelength of a Transverse Wave Affect Its Energy? **Stage 6: Reflect** Discussion and Reflection: ● SEPs and CCCs used in the investigation ● How can you make your next investigation stronger? ● What were the strengths and weaknesses of your group?

	Spectrum Cards from the Engage portion of the lesson at a center for review. ● Pull a small group to work where needed. <u>Weekly Vocabulary:</u> Electromagnetic Spectrum Frequency Energy Radio Wave Microwave Infrared Light Visible Light Ultraviolet Light X-Rays Gamma-Rays	Spectrum Cards from the Engage portion of the lesson at a center for review. ● Pull a small group to work with where needed.	whole group prior to them reading with their groups ● Students should use highlighters and pencils to annotate. ● Preview the simulation with students before they complete their investigative proposals. Phet Simulation: Waves on a String *Create a data Table as a scaffold. Example 2		
Independent Practice	Have students add to their Frayer Models for new terms.	Have students add to their Frayer Models for new terms.	**Stage 3: Plan** Students will complete the Investigative Proposal for the lab. Investigative Proposal 1 Hypothesis Investigative Proposal 2 Hypotheses Students will review their proposals with the teacher for approval. **TIPS:** ● Review what a good proposal contains - have an example. ● Create data tables for scaffolds. ● Have a set of written procedures for a scaffold.	**Stage 5: Share** ● Students can give and receive feedback on their arguments by sharing them with their peers. ● .Students will have the opportunity to revise their arguments after receiving feedback. **TIPS:** ● Arguments can be shared with another small group or a whole class. ● Students need prompts for giving and receiving feedback. ● Students need to record the feedback they receive.	**Stage 7: Report (CER)** Students will complete their final, revised CER for the investigation.
Assessment/Summary	TOTD: Compare the wavelength, frequency, and energy of Gamma Rays and	Journal Prompt: How would changes to the EM Spectrum impact our daily	TOTD: What successes and challenges did your group have during the	TOTD: Why is it essential to have a plan for an investigation?	Lab Checkout Questions

	Microwaves.	lives?	planning phase?		
Small Group Tasks (TBA)					

Week 3

GSE:
S8P4. Obtain, evaluate, and communicate information to support the claim that electromagnetic (light) waves behave differently than mechanical (sound) waves.
S8P4.C. Design a device to illustrate practical applications of the electromagnetic spectrum (e.g., communication, medical, and military).

Focused Concept:
- This element focuses on students engaging in design thinking to create a device that will demonstrate the practical applications of the electromagnetic spectrum.

SEP:
- Obtain, evaluate, and communicate information
- Construct explanations and design solutions

CCC:
- Energy and Matter
- Structure and Function

Phenomenon:
STW on uses of Radio Waves: STW Week 3 Waves Unit 2024-2025
See-Think-Wonder Organizer

DQ:
How can I design a device to illustrate the practical applications of the electromagnetic spectrum?

	Day 11	Day 12	Day 13	Day 14	Day 15
Learning Targets	SWBAT design a device to illustrate practical applications of the electromagnetic spectrum.	SWBAT design a device to illustrate practical applications of the electromagnetic spectrum.	SWBAT design a device to illustrate practical applications of the electromagnetic spectrum.	SWBAT design a device to illustrate practical applications of the electromagnetic spectrum.	SWBAT design a device to illustrate practical applications of the electromagnetic spectrum.
Opening	STW with the lesson phenomenon on radio wave technologies. (Do not tell students the technologies use radio waves.)	Ask: What did your group discover during your research? Have students discuss this with their groups and share their findings with the class.	Have students revisit the lesson phenomenon and add to their STW or answer the questions in the Wondering section.	How did your group handle challenges during the design phase of this challenge?	Revisit the lesson phenomenon and have students construct a final explanation based on what they've learned about the practical applications of em waves.
Guided Practice/Transition	Think-Pair-Share • List the waves of the magnetic spectrum from lowest to highest frequency. • Discuss students' lists	Discuss goals for today: • Brainstorming and Idea Development Review the brainstorming sheet with students and	Discuss goals for today: • Designing the device • Reference rubric for requirements of the challenge	Discuss goals for today: • Finalizing designs • Prepare for presentation *Most of this class period	Review expectations for presenters and listeners. Review how to give feedback.

	and review the relationships between frequency, wavelength, and energy. <u>Introduce the Engineering Design Challenge</u> Show the video on the Engineering Design Process Have students take notes on the EDP video in their graphic organizers. (3-2-1 Summary, Guided Notes, etc.) Scenario/Problem: The government has asked you to develop a device that uses electromagnetic waves to improve citizens' lives nationwide. Review the rubric for the challenge. Rubric Options	have students work in small groups to complete the sheet.	*Most of this class period should be dedicated to designing and building their devices. .	should be dedicated to finalizing designs and preparing for presentations	Feedback Sentence Starters Students will present their designs to their classmates and receive feedback on them.
Independent Practice	Research Stage: Students will conduct background research on the topic of uses for electromagnetic waves and begin to think about what they might want to design.	Students will brainstorm with their small groups to design a device showcasing one of the EM Waves applications. Students will begin to develop their design ideas.	Students should work on designing/building their own designs (if doing physical models).	Students should work on finalizing their designs, building physical models, and preparing for presentations.	Students will reflect on their group's feedback and decide whether to revise their designs. Students will provide feedback on their peers (group members). Peer Review Sheet
Assessment/Summary	What have you learned about how electromagnetic waves are used in daily life?	How do you need to prepare for tomorrow's prototype design and development?	How did your group decide on your device's design?	Describe the one success and one challenge your group faced during the design and build phase.	Which device do you think would be most beneficial to people? Explain your choice.
Small Group Tasks (TBA)					

Week 4

GSE:
S8P4. Obtain, evaluate, and communicate information to support the claim that electromagnetic (light) waves behave differently than mechanical (sound) waves.
S8P4.D. Develop and use a model to compare and contrast how light and sound waves are reflected, refracted, absorbed, diffracted, or transmitted through various materials. (Clarification statement: Include echo and how color is seen but do not cover interference and scattering.)

Focused Concept:
- The focused concept for this element is to understand how the wave behaviors of reflection, refraction, absorption, diffraction, or transmission occur in different materials. (Both light and sound waves should be modeled)

SEP:
- Obtain, evaluate, and communicate information
- Develop and use a model

CCC:
- Energy and Matter
- Systems and System Models

Phenomenon:
Daniel Kish Uses Echolocation To Navigate (Start video at the 21-second mark.)
Think-Pair-Share: Show the video and have students explain how Daniel can ride a bike even though he's blind. Record student responses on chart paper for later reference.

DQ:
How do light and sound waves behave when they encounter different materials?

	Day 16	Day 17	Day 18	Day 19	Day 20
Learning Targets	SWBAT develop and use a model to compare and contrast how light and sound waves are reflected, refracted, diffracted, transmitted, or absorbed.	SWBAT develop and use a model to compare and contrast how light and sound waves are reflected, refracted, diffracted, transmitted, or absorbed.	SWBAT develop and use a model to compare and contrast how light and sound waves are reflected, refracted, diffracted, transmitted, or absorbed.	SWBAT develop and use a model to compare and contrast how light and sound waves are reflected, refracted, diffracted, transmitted, or absorbed.	SWBAT develop and use a model to compare and contrast how light and sound waves are reflected, refracted, diffracted, transmitted, or absorbed.
Opening	Day 1 of 2-Day Lesson Lesson Phenomenon Daniel Kish Uses Echolocation To Navigate (Start video at the 21-second mark.) Think-Pair-Share: Show the video and have students explain how Daniel can ride a bike even though he's blind. Record student	Day 2 of 2-Day Lesson Ask: How will your group collaborate to make sure you finish all activities today? Review activities from yesterday and discuss how groups will finish today.	Day 1 of 2-Day Lesson Teacher demo: Arrows change direction?! Amazing Arrow Wat… You can show the video or do this as a demo.	Day 2 of 2-Day Lesson Ask: How do you think reflection and refraction are related to our lesson phenomenon (the blind man riding a bike)? Allow time for discussion and for students to add to their understanding of the phenomenon. Review activities from the	Show video: Wave Behaviour | W… Have students complete a graphic organizer as they watch the video. (Pause video to discuss and take notes).

	responses on chart paper for later reference.			prior day and goals for today.	
Guided Practice/Transition	Inquiry: What is wave reflection? Have students complete the following inquiry activities with their lab group: • "X" Marks the spot (laser pointer and mirrors) • Water waves in a pan with a block in the middle • Phet Sim: Sound Waves (Reflection ONLY) • Echo, Echo Lab (textbook pages 46-47) • Study Jams Sound • Law of Reflection - Video TIP: Student Inquiry Answer Sheet - create a digital or physical document for students to use to collect their answers.	Inquiry: What is wave reflection? Have students complete the following inquiry activities with their lab group: • "X" Marks the spot (laser pointer and mirrors) • Water waves in a pan with a block in the middle • Phet Sim: Sound Waves (Reflection ONLY) • Echo, Echo Lab (textbook pages 46-47) • Study Jams Sound • Law of Reflection - Video TIP: Student Inquiry Answer Sheet - create a digital or physical document for students to use to collect their answers.	Inquiry Activity: How do waves refract? Have students complete the following inquiry activities with their lab group: • Coin under a beaker of water • Straw or pencil in a beaker of water • Absorb, Reflect, Refract: StudyJams • Phet Sim: Bending Light • Refraction of sound in wind • FWWU: Why d… TIP: Student Inquiry Answer Sheet - create a digital or physical document for students to use to collect their answers.	Inquiry Activity: How do waves refract? Have students complete the following inquiry activities with their lab group: • Coin under a beaker of water • Straw or pencil in a beaker of water • Absorb, Reflect, Refract: StudyJams • Phet Sim: Bending Light • Refraction of sound in wind • FWWU: Why d… TIP: Student Inquiry Answer Sheet - create a digital or physical document for students to use to collect their answers.	Inquiry Activity: How do waves diffract? Make the Rainbow: Have students take an old CD and use the back side to break light into a rainbow. Diffraction - Phet Sim Inquiry Activity: Which materials absorb and/or transmit waves? Watch the video and then find examples of materials that transmit and absorb waves in our room. Properties of Materi… Optional Video: Exploring How Ligh… TIP: Student Inquiry Answer Sheet - create a digital or physical document for students to use to collect their answers.
Independent Practice	Reading with Cornell Notes (pages 42-44 textbook)	Reading with Cornell Notes (pages 42-44 textbook)	Note-taking from PPT - preview the slides so students only take notes on necessary information. Graphic Organizer	Note-taking from PPT - preview the slides so students only take notes on necessary information. Graphic Organizer	5-7 Question quiz in Illuminate
Assessment/Summary	Explain how light and sound waves reflect.	Give examples of wave reflection in your daily life.	Compare and contrast reflection and refraction.	How does a wave change when it moves from an area of low density to an area of higher density?	Construct a final explanation for the lesson phenomenon. Be sure to discuss wave behaviors as part of your answer.

Small Group Tasks (TBA)					

Week 5

GSE:
S8P4. Obtain, evaluate, and communicate information to support the claim that electromagnetic (light) waves behave differently than mechanical (sound) waves.

Monday - Thursday
S8P4.E. Analyze and interpret data to predict patterns in the relationship between density of media and wave behavior (i.e., speed).

Friday
S8P4.F. Develop and use a model (e.g., simulations, graphs, illustrations) to predict and describe the relationships between wave properties (e.g., frequency, amplitude, and wavelength) and energy

Focused Concept:
S8P4.E.
- The focus concept for this element is for students to understand and predict patterns in the relationship between media density and wave behaviors. Students should understand that sound travels fastest in solids, slightly slower in liquids, and slowest in gases and can not travel in a vacuum. Light travels fastest in a vacuum, slowest in solids, slightly faster in liquids, and even faster in gases.

S8P4.F.
- The focus concept for this element is to use what students previously learned about wavelength, frequency, and amplitude and apply it to the Doppler Effect. Students should understand that the Doppler Effect occurs because of changes in wavelength and frequency as sounds approach and leave.

SEP:
- Obtain, evaluate, and communicate information
- Analyze and interpret data
- Develop and use a model

CCC:
- Energy and Matter
- Systems and System Models
- Patterns

Phenomenon:
Original Death Star Explosion HD (1080p) - Star Wars [Special Edition]

What would the pilots in the video have heard during the Death Star explosion? Have students construct an initial explanation for the phenomenon—revisit it later in the week.

DQ:
How does the density of a medium affect a wave's behavior?

	Day 21	Day 22	Day 23	Day 24	Day 25
Learning Targets	SWBAT analyze and interpret data to predict patterns in the relationship between the density of media and wave behavior.	SWBAT analyze and interpret data to predict patterns in the relationship between the density of media and wave behavior.	SWBAT analyze and interpret data to predict patterns in the relationship between the density of media and wave behavior.	SWBAT analyze and interpret data to predict patterns in the relationship between the density of media and wave behavior.	SWBAT develop and use a model to predict and describe the relationships between wave properties and energy.
Opening	Lesson Phenomenon - See above	Day 1 of 2-Day Lesson	Day 2 of 2-Day Lesson	Have students revisit the lesson phenomenon and	Ambulance Screami…

	Tin Can Phone Probe (textbook pg 35) Hint: Create a model for a demonstration - have students attempt to communicate using the cans and then complete the probe	Think-Pair-Share: Can you think of an example of when you were able to hear sound through a solid or liquid barrier? Have students share answers and facilitate a discussion.	Feeling for the Train Video Clip (Play the video from 52 seconds to 1:08 and then from 2:17 to 2:41) **Adhere to those times due to language used in other parts of the video. Show the video clips and ask why he "felt" the track before they crossed the bridge.	construct a final answer to the question.	STW with the ambulance siren video Questions to consider: How does the location of the ambulance change during the video? How does the location of the observer change during the video? How do the positions of the ambulance and the observer affect the sound of the siren?
Guided Practice/Transition	Inquiry : Domino's Sound Lab Finger tapping on the table (solid and gas) Forks tapping together in water (liquid, solid, gas) Optional: Tin Can Phone vs. Whispering	Adapted from Stemscopes: ● Students will demonstrate the different speeds of a wave in various media. ● Students will analyze and interpret data on density and wave behavior. Student Guide Student Journal Teacher Guide *Activity will need to be adjusted based on material availability or the number of stations the teacher wants to incorporate.	Adapted from Stemscopes: ● Students will demonstrate the different speeds of a wave in various media. ● Students will analyze and interpret data on density and wave behavior. Student Guide Student Journal Teacher Guide *Activity will need to be adjusted based on material availability or the number of stations the teacher wants to incorporate	Students will take notes on how light and sound travel through media of different densities. Tip: Preview slides so that students only get the info they need. PPT Light (EM) Waves PPT 2 - Waves (PPT should only be 15-20 minutes - not the entire class.)	Day 1 of 2-Day Lesson Doppler Effect Simulation Do the simulation as a whole class. Students can work on their laptops, but you should facilitate the discussion while you guide them through the simulation. Jigsaw - Teacher Info Practical Applications of the Doppler Effect Have students complete the graphic organzier on the practical uses of the Doppler effect in astronomy, meteorology, medical imaging, traffic monitoring & law enforcement, GPS systems, and oceanography & seismology. TIPS: ● Create heterogeneous groups of varied

					reading levels ● Vary the research media (article, video, websites, book) ● Have all resources selected and ready before class to reduce transition times between groups
Independent Practice	PBS Article on Sound with discussion questions	Reading Connections Activity	Math Connections Activity	CER - adapted from Stemscopes: What is the relationship between the type of wave (light or sound), media density, and wave speed?	Create a model in your notebook to demonstrate how the wavelength and frequency of sound waves change due to the Doppler Effect.
Assessment/Summary	Lab analysis questions	Why are sound waves classified as mechanical waves?	In a science fiction movie, you might see characters talking to and hearing each other while floating through space. Is this scientifically plausible? Why or why not?	How does the density of a medium affect the wave traveling through it?	How do frequency and wavelength change about the Doppler effect?
Small Group Tasks (TBA)					

Week 6

GSE:
S8P4. Obtain, evaluate, and communicate information to support the claim that electromagnetic (light) waves behave differently than mechanical (sound) waves.

Monday - Wednesday
S8P4.F. Develop and use a model (e.g., simulations, graphs, illustrations) to predict and describe the relationships between wave properties (e.g., frequency, amplitude, and wavelength) and energy

Thursday - Friday
S8P4.G. Develop and use models to demonstrate the effects that lenses have on light (i.e., formation of an image) and their possible technological applications.

Focused Concept:
S8P4.F.
- The focused concept for this element is to connect changes in light and sound waves to changes in wavelength and frequency. Students should understand that high-pitched sounds have high frequencies with shorter wavelengths, while low-pitched sounds have lower frequencies with longer wavelengths. Students should also connect that waves with higher amplitudes create louder sounds and brighter lights than lower-amplitude waves.

S8P4.G.
- This element focuses on helping students understand the effects of lenses on light. Students should understand that convex lenses are thicker in the center and produce larger and farther-away images than the actual object, while concave lenses are thinner in the center and produce smaller and closer images.

SEP:
- Obtain, evaluate, and communicate information
- Develop and use models

CCC:
- Energy and Matter
- Systems and System Models

Week 7

GSE:
S8P4. Obtain, evaluate, and communicate information to support the claim that electromagnetic (light) waves behave differently than mechanical (sound) waves.

S8P4.G. Develop and use models to demonstrate the effects that lenses have on light (i.e., formation of an image) and their possible technological applications.

Focused Concept:
- This element focuses on helping students understand the effects of lenses on light. Students should understand that convex lenses are thicker in the center and produce larger and farther-away images than the actual object, while concave lenses are thinner in the center and produce smaller and closer images.

SEP:
- Obtain, evaluate, and communicate information
- Develop and use models

CCC:
- Energy and Matter
- Cause and Effect
- Systems and System Models

Phenomenon: (Option to show a slide or use real objects for students to view.)
STW S8P4G. Lenses
Show the slide to students and have them engage in the STW protocol.
- Questions to consider:
  - How are these objects alike?
  - How are they different?
  - How are they related to our discussion on waves?

DQ:
How are lenses used in modern technologies?

	Day 31	Day 32	Day 33	Day 34	Day 35
Learning Targets	SWBAT develop and use models to demonstrate the effects that lenses have on light and their possible technological applications.	SWBAT develop and use models to demonstrate the effects that lenses have on light and their possible technological applications.	Unit Test Review: **S8P4.A.** Ask questions to develop explanations about the similarities and differences between electromagnetic and mechanical waves. **S8P4.B.** Construct an explanation using data to illustrate the relationship between the electromagnetic spectrum and energy. **S8P4.C.** Design a device to illustrate practical	Unit Test Review: **S8P4.E**. Analyze and interpret data to predict patterns in the relationship between density of media and wave behavior. **S8P4.F.** Develop and use a model (e.g., simulations, graphs, illustrations) to predict and describe the relationships between wave properties (e.g., frequency, amplitude, and wavelength) and energy **S8P4.G.** Develop and use models to demonstrate the	Unit Test

			applications of the electromagnetic spectrum. **S8P4.D.** Develop and use a model to compare and contrast how light and sound waves are reflected, refracted, absorbed, diffracted, or transmitted through various materials.	effects that lenses have on light (i.e., formation of an image) and their possible technological applications.	
Opening	(Day 2 of 3-Day Lesson) Adapted from Lenses EDP Lesson Plan If possible, pass out magnifying glasses and have students zoom in on a few of their favorite objects. Questions to consider: ● How do lenses change light? ● What kind of lens do you think magnifies an image and why? Article: Lots to Learn About Lenses Have students do a close read of the article. Set The Stage: You've lost power, but your cellphone is fully charged. Your baby cousin wants to watch a cartoon with you, but sharing the phone with a 3-year-old is hard. You decide to build an authentic projector to project the phone screen onto the wall in your room.	(Day 3 of 3-Day Lesson) Adapted from Lenses EDP Lesson Plan If possible, pass out magnifying glasses and have students zoom in on a few of their favorite objects. Questions to consider: ● How do lenses change light? ● What kind of lens do you think magnifies an image and why? Article: Lots to Learn About Lenses Have students do a close read of the article. Set The Stage: You've lost power, but your cellphone is fully charged. Your baby cousin wants to watch a cartoon with you, but sharing the phone with a 3-year-old is hard. You decide to build an authentic projector to project the phone screen onto the wall in your room.	Review the phenomenon for each lesson with students - have them construct explanations for the phenomenon	Review the phenomenon for each lesson with students - have them construct explanations for the phenomenon	Unit Test

	Discuss the challenge: ● Group members ● Expectations and goals of challenge ● Roles ● Timeframe ● Materials (do not give students step-by-step directions on building their projector)	Discuss the challenge: ● Group members ● Expectations and goals of challenge ● Roles ● Timeframe ● Materials (do not give students step-by-step directions on building their projector)			
Guided Practice/Transition	<u>Research</u> Once students are in groups, have them research how projectors work and, specifically, how lenses are part of the process. <u>Brainstorm</u> Have students brainstorm ideas for possible solutions for constructing each part of their projector. They should consider the strengths and weaknesses of each idea before deciding which one provides the best solution. <u>Plan/Design</u> Students plan an organized approach to solving their problem. This may include a design (sketch) of the projector and/or a procedure and a list of any additional materials they may need to solve the problem. <u>Create/Test</u> Students follow their plan, modify their projector, and create a potential solution to their problem. Once they have created their solution, students test it in a	<u>Research</u> Once students are in groups, have them research how projectors work and, specifically, how lenses are part of the process. <u>Brainstorm</u> Have students brainstorm ideas for possible solutions for constructing each part of their projector. They should consider the strengths and weaknesses of each idea before deciding which one provides the best solution. <u>Plan/Design</u> Students plan an organized approach to solving their problem. This may include a design (sketch) of the projector and/or a procedure and a list of any additional materials they may need to solve the problem. <u>Create/Test</u> Students follow their plan, modify their projector, and create a potential solution to their problem. Once they have created their solution, students test it in a	Choose activities to facilitate a review of the elements for today's lesson.	Choose activities to facilitate a review of the elements for today's lesson.	Unit Test

	measurable way to evaluate its effectiveness. Improve After discussing and evaluating their results, students improve their solutions and re-test if possible.	measurable way to evaluate its effectiveness. Improve After discussing and evaluating their results, students improve their solutions and re-test if possible.			
Independent Practice	Communicate Create a social media post to share your device with our community.	Communicate Create a social media post to share your device with our community.	Quizizz Review You will need to create a copy of the Quizizz for students as this is a teacher's copy.	Quizizz Review 2 You will need to create a copy of the Quizizz for students as this is a teacher's copy.	Unit Test
Assessment	Reflection: Discuss the successes and challenges your group faced during this challenge. Cite specific examples of each.	How does your model compare to the project in a movie theater?	How can you prepare for Friday's assessment? (Cite 3 things you will do to prepare.)	Create a goal for your performance on tomorrow's test. SMART Goal Planner	Unit Test
Small Group Tasks (TBA)					

Assessment Prep

Prepare students for assessment by reviewing the following Assessment Prep Presentation.

Unit 3 Test Review

Provide the following guidance:
Ask the students to use what they know about the tasks completed to answer the provided assessment prep question.

- What is the question asking you?
- What do you know about the vocabulary or concept in the question?
- Is this question similar to any investigations or tasks we've completed?
- How can what you've done help you answer this question?
- Just view the assessment question: What is the question asking you?

Guide students to think about how their experience connects to the question.
Using the answer choices provided, ask the students the following:

- Identify a wrong answer: How do I know this answer is incorrect?
- Identify the right answer: How do we know this answer is correct?

Allow the students time to discuss in collaborative groups.

TEACHER NOTE: If students struggle with the question, review it the next day. Do not rush to the next question; instructional time is the only time they have to prepare for the end-of-year assessment.

Following the Unit Test:

- Have students correct any missed test items using one of the test correction templates: Template Option 1 Template Option 2
- Have students create goals for review and remediation of material
- Have students set goals for the next unit

Labs / Investigations

Mandatory Labs	Explore Learning Gizmo	Pivot Interactives/Phet
ADI Lab 19 - How do the amplitude and wavelength of a transverse wave relate to the energy carried by the wave?	S8P4.A. • Longitudinal Waves • Ripple Tank S8P4.B. • Heat Absorption • Radiation S8P4.C. • None at this time S8P4.D. • Basic Prism • Color Absorption • Heat Absorption • Refraction S8P4.E. • Longitudinal Waves • Refraction • Ripple Tank S8P4.F. • Hearing: Frequency and Volume • Ripple Tank • Waves S8P4.G • Basic Prism • Ray Tracing (Lenses)	Phet: Sound Waves Phet: Waves on a String Phet: Waves Introduction Phet: Light and Optics Phet: Bending Light Pivot Learning: Convex and Concave Lenses

Additional Resources/Tasks

Supplemental Resources	**Textbook:** McGraw Hill Inspire Science - Physical Science - Unit 2: Understanding Waves General Information: Waves Organzier Waves Review or Homework S8P4.A. S8P4.B. ● The Electromagnetic Spectrum Video Series & Companion Book - NASA Science S8P4.C. S8P4.D. ● Who Can See Who (Interactive on Mirrors and Reflection) S8P4.E. S8P4.F. ● PBS Learning Wave Simulator ● Waves Simulations S8P4.G ● Optical Experiment Simulator - Javalab