Influence of Waves

STEM Road Map for Elementary School

Edited by Carla C. Johnson,
Janet B. Walton, and Erin Peters-Burton

NSTA press
National Science Teaching Association

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Dr. Erin Peters-Burton is the Donna R. and David E. Sterling endowed professor in science education at George Mason University in Fairfax, Virginia. She uses her experiences from 15 years as an engineer and secondary science, engineering, and mathematics

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teacher to develop research projects that directly inform classroom practice in science and engineering. Her research agenda is based on the idea that all students should build self-awareness of how they learn science and engineering. She works to help students see themselves as "science-minded" and help teachers create classrooms that support student skills to develop scientific knowledge. To accomplish this, she pursues research projects that investigate ways that students and teachers can use self-regulated learning theory in science and engineering, as well as how inclusive STEM schools can help students succeed. During her tenure as a secondary teacher, she had a National Board Certification in Early Adolescent Science and was an Albert Einstein Distinguished Educator Fellow for NASA. As a researcher, Dr. Peters-Burton has published over 100 articles, books, book chapters, and curriculum books focused on STEM education and educational psychology. She received the Outstanding Science Teacher Educator of the Year award from ASTE in 2016 and a Teacher of Distinction Award and a Scholarly Achievement Award from George Mason University in 2012, and in 2010 she was named University Science Educator of the Year by the Virginia Association of Science Teachers.

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3

INFLUENCE OF WAVES MODULE OVERVIEW

Andrea R. Milner, Vanessa B. Morrison, Janet B. Walton, Carla C. Johnson, and Erin Peters-Burton

THEME: Cause and Effect

LEAD DISCIPLINE: Science

MODULE SUMMARY

This module introduces students to the concept of waves as traveling disturbances that move through space and substances to transfer energy. Students apply their understanding and observations of waves in water to understanding sound waves to prepare them for an increasingly sophisticated understanding of the role of sound in communicating over distances. Students also investigate the properties of light and its role in communicating over distances. Students investigate how humans interact with sound and light. The focus on sound and light will lead to the final module challenge in which students use the steps of the engineering design process (EDP) to create musical instruments and work with lighting to stage a musical performance (adapted from Koehler, Bloom, and Milner 2015).

ESTABLISHED GOALS AND OBJECTIVES

At the conclusion of this module, students will be able to do the following:

- Know that there are different forms of waves
- Identify types of waves (e.g., waves in water and sound waves)
- Know that there are various sources of sound and light
- Describe how sound waves travel
- Explain that the body organs (e.g., eyes, ears, and skin) respond to sound and light
- Use technology to gather research information and communicate
- Describe and apply the EDP

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- Design, construct, test, and evaluate models to demonstrate how humans experience and interact with sound and light
- Discuss concepts associated with sound and light when working on models to demonstrate how humans experience and interact with sound and light
- Identify impacts of sound and light on culture and society

CHALLENGE OR PROBLEM FOR STUDENTS TO SOLVE: SHOW ME THE WAVES CHALLENGE

Students will be challenged to design and create musical instruments for a musical show that will demonstrate how sound waves can be used to communicate over distances. Students will also incorporate light, another wave phenomenon, into their shows. Students will present musical performances that demonstrate how sound and light can be used to communicate and entertain.

CONTENT STANDARDS ADDRESSED IN THIS STEM ROAD MAP MODULE

A full listing with descriptions of the standards this module addresses can be found in Appendix C. Listings of the particular standards addressed within lessons are provided in a table for each lesson in Chapter 4.

STEM RESEARCH NOTEBOOK

Each student should maintain a STEM Research Notebook, which will serve as a place for students to organize their work throughout this module (see p. 12 for more general discussion on setup and use of the notebook). All written work in the module should be included in the notebook, including records of students' thoughts and ideas, fictional accounts based on the concepts in the module, and records of student progress through the EDP. The notebooks may be maintained across subject areas, giving students the opportunity to see that although their classes may be separated during the school day, the knowledge they gain is connected. The lesson plans for this module contain STEM Research Notebook Entry sections (numbered 1–33), and templates for each notebook entry are included in Appendix A.

Emphasize to students the importance of organizing all information in a Research Notebook. Explain to them that scientists and other researchers maintain detailed Research Notebooks in their work. These notebooks, which are crucial to researchers' work because they contain critical information and track the researchers' progress, are often considered legal documents for scientists who are pursuing patents or wish to provide proof of their discovery process.

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MODULE LAUNCH

Following agreed-upon rules for discussions, launch the module by holding a class discussion about waves, asking students these questions:

- What are waves?
- Are there different types of waves?
- What kinds of waves are there?
- What makes waves?
- Where and when have you seen waves?

Students will share their ideas with the whole class. After students have shared their ideas about waves, show a video about ocean waves such as the drone video found at *www.wtkr.com/2014/01/17/this-drone-shot-video-of-surfers-in-hawaii-will-blow-your-mind*. Then, hold a class discussion about what students observed about waves in this video.

PREREQUISITE SKILLS FOR THE MODULE

Students enter this module with a wide range of preexisting skills, information, and knowledge. Table 3.1 provides an overview of prerequisite skills and knowledge that students are expected to apply in this module, along with examples of how they apply this knowledge throughout the module. Differentiation strategies are also provided for students who may need additional support in acquiring or applying this knowledge.

Table 3.1. Prerequisite Key Knowledge and Examples of Applications and Differentiation Strategies

Prerequisite Key Knowledge	Application of Knowledge by Students	Differentiation for Students Needing Additional Support
Science • Understanding cause and effect	*Science* • Determine in investigations how sound and light behave and interact with human organs.	*Science* • Provide demonstrations of cause and effect (e.g., dropping egg [cause] and observing breakage [effect]), emphasizing that cause is why something happens and effect is what happens. • Read aloud picture books to the class and have students identify cause-and-effect sequences.

Continued

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Table 3.1. (*continued*)

Prerequisite Key Knowledge	Application of Knowledge by Students	Differentiation for Students Needing Additional Support
Mathematics • Number sense	*Mathematics* • Measure, calculate, compare, and evaluate numbers when investigating sound and light.	*Mathematics* • Model measurement techniques using standard and nonstandard units of measurement. • Read aloud nonfiction texts about temperature, rainfall, wind, and measurement. • Provide opportunities for students to practice measurement in a variety of settings (e.g., in the classroom and outdoors).
Language and Inquiry Skills • Visualizing • Making predictions • Recording ideas and information using words and pictures • Asking and responding to questions	*Language and Inquiry Skills* • Make and confirm or reject predictions. • Share thought processes through keeping a notebook, asking and responding to questions, and use of the engineering design process.	*Language and Inquiry Skills* • As a class, make predictions when reading fictional texts. • Model the process of using information and prior knowledge to use predictions. • Provide samples of notebook entries.
Speaking and Listening • Participating in group discussions	*Speaking and Listening* • Engage in collaborative group discussions in creating musical instruments and planning team Show Me the Waves presentations.	*Speaking and Listening* • Model speaking and listening skills. • Create a class list of good speaking and listening skills. • Create a class list of good collaboration practices. • Read picture books that feature collaboration and teamwork.

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POTENTIAL STEM MISCONCEPTIONS

Students enter the classroom with a wide variety of prior knowledge and ideas, so it is important to be alert to misconceptions, or inappropriate understandings of foundational knowledge. These misconceptions can be classified as one of several types: "preconceived notions," opinions based on popular beliefs or understandings; "nonscientific beliefs," knowledge students have gained about science from sources outside the scientific community; "conceptual misunderstandings," incorrect conceptual models based on incomplete understanding of concepts; "vernacular misconceptions," misunderstandings of words based on their common use versus their scientific use; and "factual misconceptions," incorrect or imprecise knowledge learned in early life that remains unchallenged (NRC 1997, p. 28). Misconceptions must be addressed and dismantled for students to reconstruct their knowledge, and therefore teachers should be prepared to take the following steps:

- *Identify students' misconceptions.*
- *Provide a forum for students to confront their misconceptions.*
- *Help students reconstruct and internalize their knowledge, based on scientific models. (NRC 1997, p. 29)*

Keeley and Harrington (2010) recommend using diagnostic tools such as probes and formative assessment to identify and confront student misconceptions and begin the process of reconstructing student knowledge. Keeley's *Uncovering Student Ideas in Science* series contains probes targeted toward uncovering student misconceptions in a variety of areas and may be a useful resource for addressing student misconceptions in this module.

Some commonly held misconceptions specific to lesson content are provided with each lesson so that you can be alert for student misunderstanding of the science concepts presented and used during this module. The American Association for the Advancement of Science has also identified misconceptions that students frequently hold regarding various science concepts (see the links at *http://assessment.aaas.org/topics*).

SRL PROCESS COMPONENTS

Table 3.2 (p. 28) illustrates some of the activities in the Influence of Waves module and how they align with the self-regulated learning (SRL) process before, during, and after learning.

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Table 3.2. SRL Process Components

Learning Process Components	Example From Influence of Waves Module	Lesson Number and Learning Component
BEFORE LEARNING		
Motivates students	Students will experience waves in water by watching a video and sharing what they learned about waves as a whole class and in their STEM Research Notebooks.	Lesson 1, Introductory Activity/Engagement
Evokes prior learning	Students share what they know about waves from experience and respond to the following questions about waves: • What are waves? • Are there different types of waves? • What kinds of waves are there? • What causes waves? • Where and when have you seen waves?	Lesson 1, Introductory Activity/Engagement
DURING LEARNING		
Focuses on important features	Students participate in the What's the Buzz? investigation by predicting, observing, and explaining how sound waves behave in a communication device.	Lesson 2, Activity/ Exploration
Helps students monitor their progress	After conducting an investigation about light's interaction with various materials, students consider how they could use their findings to use light in their musical performances. Teachers monitor students' responses and help students understand concepts if there are misconceptions.	Lesson 3, Explanation
AFTER LEARNING		
Evaluates learning	Students demonstrate how humans experience and interact with sound waves and light waves through a Show Me the Waves musical performance. Students create guitars and use these guitars and the drums they created in a previous lesson, along with their voices and flashlights wrapped with colored materials, to present a musical performance that demonstrates how sound waves and light can be used to communicate and entertain.	Lesson 4, Activity/ Exploration
Takes account of what worked and what did not work	Students compare their predictions for the Singing Strings activity with actual results. Groups use what they learned from creating drums and guitars to create new instruments in the Incredible Instruments activity.	Lesson 4, Activity/ Exploration

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STRATEGIES FOR DIFFERENTIATING INSTRUCTION WITHIN THIS MODULE

For the purposes of this curriculum module, differentiated instruction is conceptualized as a way to tailor instruction—including process, content, and product—to various student needs in your class. A number of differentiation strategies are integrated into lessons across the module. The problem- and project-based learning approach used in the lessons is designed to address students' multiple intelligences by providing a variety of entry points and methods to investigate the key concepts in the module (for example, investigating waves via scientific inquiry, literature, journaling, and collaborative design). Differentiation strategies for students needing support in prerequisite knowledge can be found in Table 3.1 (p. 25). You are encouraged to use information gained about student prior knowledge during introductory activities and discussions to inform your instructional differentiation. Strategies incorporated into this lesson include flexible grouping, varied environmental learning contexts, assessments, compacting, tiered assignments and scaffolding, and mentoring.

The following websites may be helpful resources for differentiated instruction:

- *http://steinhardt.nyu.edu/scmsAdmin/uploads/005/120/Culturally%20Responsive%20Differientiated%20Instruction.pdf*
- *http://educationnorthwest.org/sites/default/files/12.99.pdf*

Flexible Grouping. Students work collaboratively in a variety of activities throughout this module. Grouping strategies you might employ include student-led grouping, grouping students according to ability level or common interests, grouping students randomly, or grouping them so that students in each group have complementary strengths (for instance, one student might be strong in mathematics, another in art, and another in writing).

Varied Environmental Learning Contexts. Students have the opportunity to learn in various contexts throughout the module, including alone, in groups, in quiet reading and research-oriented activities, and in active learning in inquiry and design activities. In addition, students learn in a variety of ways through doing inquiry activities, journaling, reading a variety of texts, watching videos, participating in class discussion, and conducting web-based research.

Assessments. Students are assessed in a variety of ways throughout the module, including individual and collaborative formative and summative assessments. Students have the opportunity to produce work via written text, oral and media presentations, and modeling.

Compacting. Based on student prior knowledge, you may wish to adjust instructional activities for students who exhibit prior mastery of a learning objective. Since student

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work in science is largely collaborative throughout the module, this strategy may be most appropriate for mathematics, English language arts (ELA), or social studies activities. You may wish to compile a classroom database of research resources and supplementary readings for a variety of reading levels and on a variety of topics related to the module's topic to provide opportunities for students to undertake independent reading.

Tiered Assignments and Scaffolding. Based on your awareness of student ability, understanding of concepts, and mastery of skills, you may wish to provide students with variations on activities by adding complexity to assignments or providing more or fewer learning supports for activities throughout the module. For instance, some students may need additional support in identifying key search words and phrases for web-based research or may benefit from cloze sentence handouts to enhance vocabulary understanding. Other students may benefit from expanded reading selections and additional reflective writing or from working with manipulatives and other visual representations of mathematical concepts. You may also work with your school librarian to compile a classroom database of research resources and supplementary readings for different reading levels and on a variety of topics related to the module challenge to provide opportunities for students to undertake independent reading. You may find the following website on scaffolding strategies helpful: *www.edutopia.org/blog/scaffolding-lessons-six-strategies-rebecca-alber.*

Mentoring. As group design teamwork becomes increasingly complex throughout the module, you may wish to have a resource teacher, older student, or volunteer work with groups that struggle to stay on task and collaborate effectively.

STRATEGIES FOR ENGLISH LANGUAGE LEARNERS

Students who are developing proficiency in English language skills require additional supports to simultaneously learn academic content and the specialized language associated with specific content areas. WIDA (2012) has created a framework for providing support to these students and makes available rubrics and guidance on differentiating instructional materials for English language learners (ELLs). In particular, ELL students may benefit from additional sensory supports such as images, physical modeling, and graphic representations of module content, as well as interactive support through collaborative work. This module incorporates a variety of sensory supports and offers ongoing opportunities for ELL students to work with collaboratively. The focus on sound and light issues affords an opportunity for ELL students to share culturally diverse experiences with music and hearing and their experiences with visual impairments.

When differentiating instruction for ELL students, you should carefully consider the needs of these students as you introduce and use academic language in various language domains (listening, speaking, reading, and writing) throughout this module. To adequately differentiate instruction for ELL students, you should have an understanding

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of the proficiency level of each student. The following five overarching preK–5 WIDA learning standards are relevant to this module:

- Standard 1: Social and Instructional Language. Focus on following directions, personal information, leisure activities, collaboration with peers.
- Standard 2: The Language of Language Arts. Focus on nonfiction, fiction, sequence of story, elements of story.
- Standard 3: The Language of Mathematics. Focus on basic operations, number sense, interpretation of data, standard and metric measurement tools.
- Standard 4: The Language of Science. Focus on light, scientific process, senses, sound.
- Standard 5: The Language of Social Studies. Focus on community workers, jobs and careers, representations of Earth (maps and globes).

SAFETY CONSIDERATIONS FOR THE ACTIVITIES IN THIS MODULE

The safety precautions associated with each investigation are based, in part, on the use of the recommended materials and instructions, legal safety standards, and better professional safety practices. Selection of alternative materials or procedures for these investigations may jeopardize the level of safety and therefore is at the user's own risk. Remember that an investigation includes three parts: (1) setup, in which you prepare the materials for students to use; (2) the actual hands-on investigation, in which students use the materials and equipment; and (3) cleanup, in which you or the students clean the materials and put them away for later use. The safety procedures for each investigation apply to all three parts. For more general safety guidelines, see the Safety in STEM section in Chapter 2 (p. 18).

We also recommend that you go over the safety rules that are included as part of the safety acknowledgment form with your students before beginning the first investigation. Once you have gone over these rules with your students, have them sign the safety acknowledgment form. You should also send the form home with students for parents or guardians to read and sign to acknowledge that they understand the safety procedures that must be followed by their children. A sample elementary safety acknowledgment form can be found on the National Science Teaching Association's Safety Portal at *http://static.nsta.org/pdfs/SafetyAcknowledgmentForm-ElementarySchool.pdf.*

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DESIRED OUTCOMES AND MONITORING SUCCESS

The desired outcomes for this module are outlined in Table 3.3, along with suggested ways to gather evidence to monitor student success. For more specific details on desired outcomes, see the Established Goals and Objectives sections for the module (p. 23) and individual lessons.

Table 3.3. Desired Outcomes and Evidence of Success in Achieving Identified Outcomes

	Evidence of Success	
Desired Outcome	Performance Tasks	Other Measures
Students understand and can demonstrate their knowledge of how sound and light can be used to communicate and how humans interact with sound and light.	• Students complete a variety of investigations related to waves, sound, and light. • Student teams develop and present a musical performance that incorporates sound and light to demonstrate how sound and light can be used to communicate and how humans interact with sound and light. • Students each maintain a STEM Research Notebook that includes what they have learned, responses to questions, and observations.	Students are assessed using the Observation, STEM Research Notebook, and Participation Rubric.

ASSESSMENT PLAN OVERVIEW AND MAP

Table 3.4 provides an overview of the major group and individual *products* and *deliverables*, or things that students will produce in this module, that comprise the assessment for this module. See Table 3.5 for a full assessment map of formative and summative assessments in this module.

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Table 3.4. Major Products and Deliverables in Lead Discipline for Groups and Individuals

Lesson	Major Group Products and Deliverables	Major Individual Products and Deliverables
1	• Waves in Motion investigation • Wave measurements	• STEM Research Notebook entries #1–8 • Lesson assessment
2	• What's the Buzz? communication devices • I Can Hear the Music instruments	• STEM Research Notebook entries #9–18 • Lesson assessment
3	• Lighting the Way investigation • Shady Shadow Puppets investigation • Shady Shadow Puppets show	• STEM Research Notebook entries #19–29 • Shadow image pictures • Partner description pictures • Lesson assessment
4	• Singing Strings activity • Incredible Instruments activity • Show Me the Waves musical performance	• STEM Research Notebook entries #30–33 • Lesson assessment

Table 3.5. Assessment Map for Influence of Waves Module

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
1	Waves in Motion Investigation *performance task*	Group	Formative	• Demonstrate how waves in water move.
1	STEM Research Notebook *entries*	Individual	Formative	• Explain that waves transfer energy. • Demonstrate how waves in water move. • Identify properties of waves.
1	Wave drawing and descriptions *end of lesson assessment*	Individual	Summative	• Explain that waves transfer energy. • Demonstrate how waves in water move.

Continued

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Table 3.5. (*continued*)

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
2	STEM Research Notebook entries	Individual	Formative	• Understand that there are various sources of sound waves and identify sources of sound. • Demonstrate a basic understanding of the human anatomy associated with hearing. • Explain that sound can be used to communicate over distances. • Evaluate the influence sound waves have on culture and society.
2	What's the Buzz? *investigation*	Group	Formative	• Design, construct, test, and evaluate models that demonstrate how humans experience and interact with sound waves. • Explain how sound waves travel to reach human ears. • Explain that sound can be used to communicate over distances
2	I Can Hear the Music Instruments *investigation*	Group	Formative	• Design, construct, test, and evaluate models that demonstrate how humans experience and interact with sound waves. • Explain that sound can be used to communicate over distances.
2	Drawing and description of sources of sound and basic ear anatomy *end of lesson assessment*	Individual	Summative	• Understand that there are various sources of sound waves and identify sources of sound. • Demonstrate a basic understanding of the human anatomy associated with hearing.
3	STEM Research Notebook *entries*	Individual	Formative	• Identify the Sun as a natural source of light. • Describe how light reaches our eyes. • Understand how human eyes respond to light via a basic exploration of the human anatomy of sight. • Identify materials that are transparent, translucent, or opaque. • Identify several ways that humans experience and interact with light waves. • Explain how light can be used to communicate over distances.

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Table 3.5. (*continued*)

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
3	Lighting the Way *investigation*	Group	Formative	• Identify materials that are transparent, translucent, or opaque. • Explain concepts associated with light when working on models to demonstrate how humans experience and interact with light waves. • Explain how light can be used to communicate over distances.
3	Shady Shadow Puppets *investigation*	Group	Formative	• Identify several ways that humans experience and interact with light waves. • Describe and demonstrate how shadows are formed. • Explain how light can be used to communicate over distances.
3	Shady Shadow Puppets *performance task*	Group	Formative	• Describe and demonstrate how shadows are formed.
3	Shadow image pictures *performance task*	Individual	Formative	• Identify the Sun as a natural source of light. • Explain concepts associated with light when working on models to demonstrate how humans experience and interact with light waves. • Describe and demonstrate how shadows are formed.
3	Partner description pictures *performance task*	Individual	Formative	• Demonstrate an understanding of the use of descriptive words and imagery in art and literature.
3	Light drawings and descriptions *end of lesson assessment*	Individual	Summative	• Identify several ways that humans experience and interact with light waves. • Explain how light can be used to communicate over distances. • Identify materials that are transparent, translucent, or opaque.

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Table 3.5. (*continued*)

Lesson	Assessment	Group/ Individual	Formative/ Summative	Lesson Objective Assessed
4	STEM Research Notebook *entries*	Individual	Formative	• Explain that the pitch of a sound is influenced by properties of the material through which the sound waves move. • Demonstrate their understanding of the engineering design process (EDP) by applying it to create musical instruments.
4	Singing Strings *performance task*	Group	Formative	• Explain that the pitch of a sound is influenced by properties of the material through which the sound waves move. • Explain that sound can be used to communicate over distance and create models that demonstrate this.
4	Incredible Instruments *performance task*	Group	Formative	• Demonstrate their understanding of the EDP by applying it to create musical instruments. • Explain that sound and light are used to communicate over distances and identify several examples of this.
4	Musical Show *performance task*	Group	Summative	• Explain that sound can be used to communicate over distances and create models that demonstrate this. • Explain that light can be used to communicate over distances and create a model that demonstrates this. • Demonstrate how humans can experience and interact with sound and light through a musical performance.
4	Sound and light drawing and descriptions *end of lesson assessment*	Individual	Summative	• Identify several ways that humans experience and interact with sound and light. • Explain that sound can be used to communicate over distances and create models that demonstrate this. • Explain that light can be used to communicate over distances and create a model that demonstrates this.

MODULE TIMELINE

Tables 3.6–3.10 (pp. 37–39) provide lesson timelines for each week of the module. The timelines are provided for general guidance only and are based on class times of approximately 30 minutes.

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Table 3.6. STEM Road Map Module Schedule for Week One

Day 1	Day 2	Day 3	Day 4	Day 5
Lesson 1 *Let's Explore Waves!* • Launch the module with group discussion and video about waves in water. • Introduce STEM Research Notebooks. • Discuss and demonstrate energy.	*Lesson 1* *Let's Explore Waves!* • Conduct interactive read-aloud of *Waves: Energy on the Move*, by Darlene Stille. • Introduce wave properties.	*Lesson 1* *Let's Explore Waves!* • Conduct Waves in Motion investigation.	*Lesson 1* *Let's Explore Waves!* • Measure wave amplitudes and wavelengths and make graphs. • Conduct interactive read-aloud of *The Great Wave: A Children's Book Inspired by Hokusai*, by Veronique Massenot. • Create a class list of adjectives to describe *The Great Wave* picture.	*Lesson 1* *Let's Explore Waves!* • Discuss cultural implications of living near an ocean. • Create bar graph of students' wave measurements. • Conduct lesson assessment.

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Table 3.7. STEM Road Map Module Schedule for Week Two

Day 6	Day 7	Day 8	Day 9	Day 10
Lesson 2 *Sounds Like Fun!* • Introduce sound and hearing. • Conduct interactive read-aloud of *What Is Sound?* by Charlotte Guillain. • Observe sound waves using plastic forks.	*Lesson 2* *Sounds Like Fun!* • Students describe sounds using adjectives. • Discuss how sound is used for communication. • Introduce hearing disabilities. • Conduct an interactive read-aloud of *The Sense of Hearing,* by Mari Schuh.	*Lesson 2* *Sounds Like Fun!* • Conduct interactive read-aloud of *Sounds All Around,* by Wendy Pfeffer. • Introduce pitch. • Begin What's the Buzz? Investigation.	*Lesson 2* *Sounds Like Fun!* • Complete What's the Buzz? investigation. • Conduct interactive read-aloud of *A Birthday for Ben,* by Kate Gaynor.	*Lesson 2* *Sounds Like Fun!* • Introduce sound measurements (decibels) and estimates. • Introduce the I Can Hear the Music activity and the engineering design process. • Create class list of collaboration rules.

Table 3.8. STEM Road Map Module Schedule for Week Three

Day 11	Day 12	Day 13	Day 14	Day 15
Lesson 2 *Sounds Like Fun!* • Begin the I Can Hear the Music design activity.	*Lesson 2* *Sounds Like Fun!* • Complete the I Can Hear the Music design activity. • Discuss ways to experience sound waves without hearing through discussion and video.	*Lesson 2* *Sounds Like Fun!* • Introduce American Sign Language. • Conduct lesson assessment.	*Lesson 3* *Lighting It Up!* • Introduce light and sight. • Conduct interactive read-aloud of *All About Light,* by Lisa Trumbauer.	*Lesson 3* *Lighting It Up!* • Introduce the concept of the speed of light. • Conduct an interactive read-aloud of *Day Light, Night Light,* by Franklyn M. Branley. • Introduce vision disabilities.

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Table 3.9. STEM Road Map Module Schedule for Week Four

Day 16	Day 17	Day 18	Day 19	Day 20
Lesson 3 *Lighting It Up!* • Introduce Lighting the Way investigation. • Conduct interactive read-aloud of *Thomas Edison and His Bright Idea*, by Patricia Brennan Demuth	*Lesson 3* *Lighting It Up!* • Conduct Lighting the Way investigation. • Introduce braille. • Conduct an interactive read-aloud of *Six Dots: A Story of Young Louis Braille*, by Jen Bryant.	*Lesson 3* *Lighting It Up!* • Conduct Shady Shadow Puppets activity. • Students create shadow pictures. • Conduct interactive read-aloud of *My Shadow*, by Robert Louis Stevenson.	*Lesson 3* *Lighting It Up!* • Students present puppet shows. • Introduce eye anatomy and vision with an interactive read-aloud of *Eye: How It Works*, by David Macaulay.	*Lesson 3* *Lighting It Up!* • Conduct interactive read-aloud of *Light Is All Around Us*, by Wendy Pfeffer. • Conduct an interactive read-aloud of *The Black Book of Colors*, by Menena Cottin. • Students create partner description pictures.

Table 3.10. STEM Road Map Module Schedule for Week Five

Day 21	Day 22	Day 23	Day 24	Day 25
Lesson 3 *Lighting It Up!* • Conduct interactive read-aloud of *Sending Messages With Light and Sound*, by Jennifer Boothroyd. • Discuss achievements of person with vision impairment. • Conduct lesson assessment.	*Lesson 4* *Show Me the Waves Challenge* • Discuss use of sound and light in musical shows. • Conduct interactive read-alouds of *I Know a Shy Fellow Who Swallowed a Cello*, by Barbara S. Garriel, and *A Picture Book of Helen Keller*, by David A. Adler. • Introduce Singing Strings activity.	*Lesson 4* *Show Me the Waves Challenge* • Finish Singing Strings activity. • Introduce Incredible Instruments activity. • Conduct interactive read-aloud of *Stand in My Shoes: Kids Learning About Empathy*, by Bob Sornson.	*Lesson 4* *Show Me the Waves Challenge* • Complete Incredible Instruments activity. • Students practice for musical performance. • Teams create poster with team name.	*Lesson 4* *Show Me the Waves Challenge* • Students do their musical performance. • Conduct lesson assessment.

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RESOURCES

The media specialist can help you locate resources for students to view and read about waves, sound, light, and related physics content. Special educators and reading specialists can help find supplemental sources for students needing extra support in reading and writing. Additional resources may be found online. Community resources for this module may include musicians, audiologists, optometrists, and mechanical engineers.

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Grade 1

STEM Road Map for Elementary School

Influence of Waves

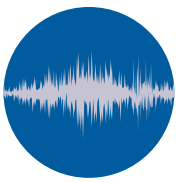
What if you could challenge your first graders to create instruments they can play in their own "Show Me the Waves" musical show? With this volume in the *STEM Road Map Curriculum Series*, you can!

Influence of Waves outlines a journey that will steer your students toward authentic problem solving while grounding them in integrated STEM disciplines. Like the other volumes in the series, this book is designed to meet the growing need to infuse real-world learning into K–12 classrooms.

This interdisciplinary module uses project- and problem-based learning to help young children explore cause and effect. It introduces them to the concept of waves as disturbances that travel through space and substances to transfer energy. Students will draw on physical and biological science, mathematics, engineering, and English language arts to do the following:

- Discover that there are different types of waves, such as water and sound, that come from different sources and travel in various ways.
- Find out that eyes, ears, and skin respond to sound and light.
- Use technology to gather research and communicate.
- Design, test, and evaluate models to demonstrate how people experience and interact with sound and light.
- Put on a show that combines voices and flashlights with guitars and drums they've made themselves to demonstrate how sound waves and light can be used to communicate and entertain.

The *STEM Road Map Curriculum Series* is anchored in the *Next Generation Science Standards*, the *Common Core State Standards*, and the Framework for 21st Century Learning. In-depth and flexible, *Influence of Waves* can be used as a whole unit or in part to meet the needs of districts, schools, and teachers who are charting a course toward an integrated STEM approach.



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Grade 1

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