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Sounds

NGSS EARLY IMPLEMENTERS

WestEd

A Collaboration of the K-12 Alliance @ WestEd,
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Acknowledgments

Writers:

Rocío García: First Grade Bilingual Teacher, Tracy Unified SD

Nicole Hawke: First Grade Teacher, Coachella Valley Unified SD

Crystal Howe: TK-12 Science Resource, San Diego Unified SD

Claudio Vargas: Educational Consultant, Sci-Lingual Education

Readers:

Sharon Schmidt, First Grade Teacher, San Diego Unified SD

Michelle Armenta, First Grade Teacher, Vista Unified SD

Field Test Teachers:

Sher Raquel, Primary Teacher, Galt Joint Union Elementary SD

Michael Harris, Primary Teacher, Chico Unified SD

Michelle Baker, Primary Teacher, Palm Springs Unified SD

Reviewers

Achieve Science Peer Review Panel

Introduction

The California K-8 NGSS Early Implementation Initiative, developed by the K-12 Alliance at WestEd with close collaborative input on its design and objectives from the State Board of Education, the California Department of Education, and Achieve is a fast-start demonstration project to build local education agency (LEA) capacity to fully implement the Next Generation Science Standards (NGSS) as a core subject in the elementary grades (K–5) and as the SBE's preferred integrated model in grades 6–8.

The four-year Initiative provides teachers and administrators with in-depth, content-rich professional development to build leadership capacity and teacher acumen to deliver high-quality 3-dimensional learning for K–8 students. In addition, through collaborations among the K-12 Alliance, Achieve, and others, the LEAs in the Collaborative have opportunities to pilot test new NGSS-aligned tools, processes, assessment item prototypes, and digital and other instructional materials. The LEAs serve as resources for NGSS implementation across California, and in other NGSS-adopting states as well.

This resource presents the conceptual storyline for a unit of instruction at a specific grade level, then focuses on a portion of the storyline called a learning sequence. The learning sequence uses the three dimensions of the NGSS (disciplinary core ideas—DCI; science and engineering practices—SEP; and crosscutting concepts—CCC) to build and deepen student understanding of natural phenomena and design challenges.

Participants in the CA NGSS K-8 Early Implementation Initiative developed and field-tested the lessons in the learning sequence. The sequences were vetted by the Science Peer Review Panel using Achieve's EQuiP rubric and found to be aligned with the intent of the NGSS.

Overview

After completing this unit, students will never look at an ambulance or police car the same way again. The anchoring phenomenon for this unit is "Emergency sirens make loud sounds." This unit would be part of a Physical Science unit on Sound and Light. In this unit, students identify that sounds cause vibrations and vibrations cause sound, and that sound is used to communicate over distance. While walking the playground, students observe the sounds that they hear around them. They then conduct investigations into how sound is made and explore the cause and effect relationship between sounds and vibrations. Students will also design devices that use sound to communicate over a distance.

EXAMPLE: Students observe a tabletop siren. They identify the use of sound to communicate and describe how sound and vibrations are related to one another.

The Performance Expectations (PEs) addressed in this unit are:

1-PS4-1 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.

K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Learning Sequence Narrative

The Learning Sequence Narrative briefly describes what students do in each lesson and links the learning between the lessons as a conceptual storyline. At the end of each learning sequence, students make connections to their understanding of the investigative phenomenon (and to the anchoring phenomenon if appropriate).

The anchoring phenomenon for the learning sequence is, "Emergency sirens make loud sounds." The investigative phenomena for the learning sequence are as follows:

- Instruments have parts that vibrate, causing sound. (Lesson 1)
- Devices communicate over a distance using sound. (Lesson 2)
- Sound causes matter to vibrate. (Lesson 3)

Students figure out this phenomenon by:

Science and Engineering Practices (SEPs)

Asking Questions and Defining Problems

Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.

- Ask questions based on observations to find more information about the natural and/or designed world(s).
- Ask and/or identify questions that can be answered by an investigation.
- Define a simple problem that can be solved through the development of a new or improved object or tool.

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- With guidance, plan and conduct an investigation in collaboration with peers.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.
- Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question.
- Make observations (firsthand or from media) to collect data that can be used to make comparisons.
- Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal.
- Make predictions based on prior experiences.

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomenon and designing solutions.

- Make observations (firsthand and from media) to construct an evidence-based account for natural phenomena.
- Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.
- Generate and/or compare multiple solutions to a problem.

Disciplinary Core Ideas (DCIs)

PS4.A: Wave Properties

- Sounds can make matter vibrate and vibrating matter can make sounds.

PS4.C: Information Technologies and Instrumentation

- People use a variety of devices to communicate (send and receive information) over long distances.

ETS1.A: Defining and Delimiting Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.

Crosscutting Concepts (CCCs)

Cause and Effect

- Events have causes that generate observable patterns.
- Simple tests can be designed to gather evidence to support or refute student ideas about causes.

The following Learning Sequence Narrative is based on the conceptual flow found at the end of this section.

Lesson 1: Sound Vibrations

This is the first lesson out of a sequence of three. The lesson begins by connecting to the fact that kids hear sounds all day, every day by going on a sense walk and generating a list of things observed, specifically focusing on sounds heard. The anchoring phenomenon, "Emergency sirens make loud sounds," is introduced in this lesson as one of the sounds that we hear or have heard before. The challenge of engineering a pretend siren for an ambulance that has a broken siren is introduced as the unifying event.

Students are encouraged to ask questions and to determine which ones can be investigated. Students will need support with the practice of asking questions, especially ones that can be investigated, as they usually do not have experience with this concept. Teachers can provide modified levels of support to students depending on their experience and language needs. The focus is on "What causes sound."

As the lesson progresses, students are challenged to use materials at given stations to make sound and figure out what the cause of that sound is. During this time, you will model how to plan and carry out an investigation. The large take-away at the end of the lesson is that vibrating matter makes sound. This idea is built up during the next lesson, where students are challenged to construct devices that make loud sounds as a form of communication.

Lesson 2: Communicate with Sounds

In the previous lesson, students identified that they hear many different sounds. Then they planned and carried out an investigation to try to figure out what causes sound. They used a variety of instruments to find that vibrating material causes sound. This lesson further develops this concept by having students apply their incipient knowledge about what causes sound to solve a challenge and create a device to communicate over a distance. The next lesson will have students investigate how sound causes vibrations.

Lesson 3: See Sounds

This is the third lesson in the learning sequence. In the two previous lessons, students explored the idea that vibrations cause sound. They have also used sound to communicate over a distance. In this lesson, the students explore the phenomenon that sound causes matter to vibrate, which completes the cause and effect relationship between sound and vibrations. They investigate vibrations using a drum and a tuning fork and draw a group model that explains the cause and effect relationship between sound and vibration.

Learning Sequence 3-Dimensional Progressions

SEP PROGRESSION	
Asking Questions and Defining Problems	
Prior Experience	Examples of prior experience from Kindergarten might include challenges of rolling balls onto different surfaces.
Lesson 1	In this lesson, students ask questions based on their observations of the natural world (the school playground), specifically focusing on the sounds they hear. They then ask and/or identify questions, with the help of the teacher, which can be answered by an investigation. The focus of this lesson is for students to gather evidence to answer the question "What causes sound?"
Lesson 2	In this lesson, students define a simple problem ("What would happen if the siren of an ambulance was not working?") that can be solved, within the constraints of available materials, through the development of a new or improved object or tool.
Lesson 3	In this lesson, students ask questions about why sound causes matter to vibrate. They ask and/or identify questions, with the help of the teacher, which can be answered by an investigation. The focus of this lesson is for students to gather evidence to answer the question "What makes sound?"
Planning and Carrying Out Investigations	
Prior Experience	Students are expected to come in with experience in conducting investigations, with guidance, on the effects of pushes and pulls from Kindergarten. This learning sequence will provide students with the opportunity to plan their investigations with less guidance.
Lesson 1	In this lesson, students are introduced to the basic steps in planning and conducting an investigation. They create a chart that includes identifying the question (what causes sound?), the materials to be used (different instruments), and the data collection. With guidance, they collaboratively plan and conduct an investigation to produce observations (data) to serve as the basis for providing evidence to answer a question about vibrating matter causing sound.
Lesson 2	In this lesson, students are challenged to plan, build, and test a device that can be used to communicate over a distance. Building on the previous lesson where they planned and conducted an investigation to collect data on what causes sound, students now have to plan and carry out an investigation to test solutions to a problem (a non-working siren on an ambulance).
Lesson 3	In this lesson, students use their experience from previous lessons to plan and conduct an investigation to provide evidence that sound causes matter to vibrate. They use the What I Wonder T-chart from Lesson 1: Sound Vibrations and identify the question, the materials, and how to collect data.

Learning Sequence 3-Dimensional Progressions (continued)

Constructing Explanations and Designing Solutions	
Prior Experience	Students will have little experience with constructing explanations in Kindergarten. They do come in with some experience designing solutions when they build structures to reduce the warming effect of sunlight on an area, which this lesson sequence will build on by having students design solutions to a problem with a non-functioning siren.
Lesson 1	In this lesson, students make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. They also use information from their observations (firsthand or from media) to construct an evidence-based account for natural phenomena (vibrating matter causes sound) using 1-PS4-1.
Lesson 2	In this lesson, students design a solution to a problem (non-working siren in the ambulance) by building and testing their own device that causes a loud sound to communicate over a distance. They compare their device to that of the other groups and reinforce the notion that vibrating matter causes sound and this pattern is repeated in every device.
Lesson 3	In this lesson, students build explanations about sound causing matter to vibrate. They draw a group model of a drum and a tuning fork making sprinkles vibrate and are asked to label what is vibrating and what is causing the vibrations to happen.

DCI PROGRESSION	
Prior Experience	Students will have no experience with PS4.A (Wave Properties) and PS4.C (Information Technologies and Instrumentation) since those ideas are introduced in Grade 1. They should have had experience with ETS1.A, (Defining and Delimiting Engineering Problems), as they worked to change the speed and direction of an object with a pull or a push in Kindergarten.
Lesson 1	Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound. (PS4.A) Students are introduced to the properties of waves with a focus on how vibrating matter can make sound. They use this understanding and their observations to explain why the instruments make noise.
Lesson 2	Information Technologies and Instrumentation: People use a variety of devices to communicate (send and receive information) over long distances (PS4.C). Students use their experience with vibrating matter (PS4.A) from the previous lesson to answer a challenge: to build a device that can communicate over a distance (ETS1.A).
Lesson 3	Wave Properties: Sound can make matter vibrate, and vibrating matter can make sound. (PS4.A) Students focus on how sound can make matter vibrate.

Learning Sequence 3-Dimensional Progressions (continued)

CCC PROGRESSION	
Cause and Effect	
Prior Experience	Students come in with much experience with cause and effect from Kindergarten. They have used this crosscutting concept to better understand the effect of pushes and pulls on moving objects and the effect of sunlight on Earth's surface. This lesson sequence will give students more practice with cause and effect as they use this crosscutting concept to understand how vibration causes sound. They will also be expected to have experience with patterns as they studied weather patterns over time in Kindergarten.
Lesson 1	In this lesson, students identify causal relationships by observing and describing what causes the sounds heard during a sound walk and during an investigation using musical instruments. They collaboratively use their observations to answer the question, "What is the cause of this event?" and learn that events have causes that generate observable patterns.
Lesson 2	In this lesson students design a test to gather evidence (or refute ideas) about a possible cause and identify cause and effect relationships to explain that vibrating matter causes sound that can be used to communicate over a distance. By comparing their devices, they explicitly identify a pattern.
Lesson 3	In all three lessons, students use this crosscutting concept to build an explanation that vibrating matter causes sound and that sound causes matter to vibrate. In this lesson, they explicitly collect data to describe what causes the movement to occur and draw a model that explains what is vibrating and what causes this vibration. They identify observable patterns in the effects of sound on the drum and tuning fork.

Science and Engineering Practices for K–2

Asking Questions and Defining Problems	Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. • Ask questions based on observations to find more information about the natural and/or designed world(s). • Ask and/or identify questions that can be answered by an investigation. • Define a simple problem that can be solved through the development of a new or improved object or tool.
Developing and Using Models	Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. • Distinguish between a model and the actual object, process, and/or events the model represents. • Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). • Develop a simple model based on evidence to represent a proposed object or tool.
Planning and Carrying Out Investigations	Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. • With guidance, plan and conduct an investigation in collaboration with peers (for K). • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Evaluate different ways of observing and/or measuring a phenomenon to determine which way can answer a question. • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. • Make observations (firsthand or from media) and/or measurements of a proposed object or tool or solution to determine if it solves a problem or meets a goal. • Make predictions based on prior experiences.
Analyzing and Interpreting Data	Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events). • Analyze data from tests of an object or tool to determine if it works as intended.

Science and Engineering Practices for K–2 (continued)

Using Mathematical and Computational Thinking	Mathematical and computational thinking in K–2 builds on prior experience and progresses to recognizing that mathematics can be used to describe the natural and designed world(s). • Decide when to use qualitative vs. quantitative data. • Use counting and numbers to identify and describe patterns in the natural and designed world(s). • Describe, measure, and/or compare quantitative attributes of different objects and display the data using simple graphs. • Use quantitative data to compare two alternative solutions to a problem.
Constructing Explanations and Designing Solutions	Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. • Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. • Generate and/or compare multiple solutions to a problem.
Engaging in Argument from Evidence	Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). • Identify arguments that are supported by evidence. • Distinguish between explanations that account for all gathered evidence and those that do not. • Analyze why some evidence is relevant to a scientific question and some is not. • Distinguish between opinions and evidence in one's own explanations. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. • Construct an argument with evidence to support a claim. • Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence.
Obtaining, Evaluating, and Communicating Information	Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. • Read grade-appropriate texts and/or use media to obtain scientific and/or technical information to determine patterns in and/or evidence about the natural and designed world(s). • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question and/or supporting a scientific claim. • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.

Grade 1 Sounds Instructional Rubric

	Level 1 Emerging	Level 2 Developing	Level 3 Proficient	Level 4 Advanced
Science and Engineering Practice Asking Questions and Defining Problems	• Students do not ask questions or ask general questions about the phenomenon. • Students are unable to define a problem (design) or it is impractical.	• Students ask specific testable questions about the phenomenon that are based on direct observation. • Students define a problem (design) that is minimally aligned to the phenomenon.	• Students ask specific questions about the phenomenon that can be answered through an investigation and require sufficient and appropriate empirical evidence to answer. • Students define a problem (design) statement that is adequately aligned to the intent of the problem.	• Students ask specific questions that require sufficient and appropriate empirical evidence to answer and students explain why it is a testable question. • Students define a problem (design) statement that is completely aligned to the intent of the problem.
Science and Engineering Practice Planning and Carrying Out Investigations	• Students do not plan or conduct an investigation or propose an investigation that will not produce relevant data to be used as evidence to answer the empirical question. • Students do not design a solution that solves a problem or meets a goal.	• Students plan investigations that will produce minimal relevant data to be used as evidence to answer the empirical question. • Students design a solution that minimally solves a problem or meets a goal.	• Students plan or conduct investigations collaboratively to gather some relevant data to be used as evidence to answer the empirical question. • Students design a solution that adequately solves a problem or meets a goal.	• Students plan and conduct an investigation collaboratively that will produce relevant data to be used as evidence to answer the empirical question. • Students design a solution and propose an explanation that solves a problem or meets a goal.
Science and Engineering Practice Constructing Explanations and Designing Solutions	• Students do not construct scientific explanations or use inaccurate or inappropriate scientific ideas. • Students do not use data to evaluate how well the design addresses the problem and the redesign of the original model is incomplete.	• Students use accurate but minimal scientific ideas to construct scientific explanations, and students' explanations are descriptive instead of explaining how or why a phenomenon occurs. • Students use minimal data to evaluate how well the design addresses the problem and outline an appropriate redesign of the original model.	• Students use accurate and adequate scientific ideas to construct scientific explanations, but students' explanations are descriptive instead of explaining how or why a phenomenon occurs. • Students use adequate data to evaluate how well the design addresses the problem and explain an appropriate redesign of the original model.	• Students use accurate and complete scientific ideas, principles, and/or evidence (experimental data) to construct an evidence-based explanation of the phenomenon. • Students use complete data to evaluate how well the design addresses the problem and provides a detailed rationale for the appropriate redesign of the original model.

Grade 1 Sounds Instructional Rubric (continued)

	Level 1 Emerging	Level 2 Developing	Level 3 Proficient	Level 4 Advanced
Disciplinary Core Ideas PS4.A: Sound can make matter vibrate, and vibrating matter can make sound. PS4.C: People use a variety of devices to communicate over long distances.	• Students identify or apply irrelevant content or relevant content with major errors. • Students cannot explain that vibrations produce sound or sound produces vibrations.	• Students identify or apply relevant content with minor errors. • Students can explain that vibrations produce sound or sound produces vibrations with minor errors.	• Students explain and apply relevant and accurate content. • Students can explain that vibrations produce sound or sound produces vibrations.	• Students explain and apply relevant and accurate content. • Students can explain that vibrations produce sound and sound produces vibrations.
Disciplinary Core Ideas (Engineering) ETS1.A: A situation that people want to change or create can be approached as a problem to be solved through engineering.	• Students identify the human problem and solution that do not match the situation and describe features of their tool that are unrelated to the solution.	• Students generally identify a relevant solution to the problem and describe features of their tool that are unrelated to the solution.	• Students accurately identify a relevant solution to the problem and generally describe how the features of their tool are related to the solution.	• Students accurately identify the situation that people want to change and the desired outcome, and clearly describe the features of the tool that would solve the problem based on scientific information and materials available.
Crosscutting Concepts Cause and Effect: Events have causes that generate observable patterns; simple tests can be designed to gather evidence to support or refute student ideas about causes.	• Students do not identify or make connections to the crosscutting concept. • Students cannot explain a cause and effect relationship or use the relationship to explain that vibrations produce sound and sound produces vibrations.	• Students identify or make a connection to the crosscutting concept (with minor errors). • Students can explain a cause and effect relationship or use the relationship to explain that vibrations produce sound and sound produces vibrations, with minor errors.	• Students explain or make an accurate connection to the crosscutting concept. • Students can explain a cause and effect relationship or can use the relationship to explain that vibrations produce sound and sound produces vibrations.	• Students explain and make accurate connections to the crosscutting concept. • Students can explain a cause and effect relationship and use the relationship to explain that vibrations produce sound and sound produces vibrations.

Student Support Strategies

Differentiated student support strategies offer teachers a way to meet all students' needs. The classroom brings together students from different backgrounds with varying degrees of science knowledge. Being an effective teacher, therefore, requires the implementation of creative and innovative teaching strategies in order to meet students' individual needs.

Throughout these lessons, a flag (▶) denotes formative assessment opportunities where you may change instruction in response to students' level of understanding and making sense of phenomena. Below are some strategies you might implement based on those assessments. There is no one strategy that works best for every teacher, so try different strategies to determine which are best for you and your students.

Suggested strategies for students who *have not* met the targeted expectations:

- **Centers:** Set up a center at which students can continue to explore making vibrations and hearing/feeling sound. Pair students so that a student who understands the concept well works with another student who needs help. This also helps those students who have a deeper understanding of the concepts as they refine their thinking through teaching.

- **Small Group Reteach:** Set up a modified investigation in which students can work with the concept of vibrations producing sound. Select a few students who need extra support and question them as they explore the instruments.

- **One-on-One Conferences:** Use silent reading time or other times when students work independently to conference with small groups or individual students.

- **Sticky-note Feedback:** Write comments and questions on sticky-notes about the student's written work in their notebooks. This will help students reflect on their thinking and improve their performance.

- **Group Consensus:** After completing their work, have students work with a partner or a small group to compare answers or notebook entries. They should have a discussion resulting in a response everyone agrees with. Then have them share that response with the class or use the Use of Color or Line of Learning strategy to change the response in their notebook.

- **Key Points:** Have students describe the important points that should have been included in their model. List each of those key points on the board. After the discussion, number all of the important ideas. Have students return to their original work and number each of the key points that they included in their own model.

- **Use of Color:** Have students use color to correct their original work. For instance, they can use green to indicate key points that they already had in their work, use red to delete information, and use blue to add points from the discussion that they feel support their work.

- **Line of Learning:** Similar to Use of Color, after writing in their notebooks, ask students to put a line under their initial ideas. After the class discussion or a group consensus, students can add new ideas presented below the line. This allows students to add to their own initial written ideas with additional thoughts from other students or the teacher, while identifying the origin of the idea.

- **Sentence Starters:** If students are struggling, provide them with sentence starters. It narrows the focus for their ideas.

- **Find a Good Idea:** If students are stuck and productive struggle has failed, have them go and find a good idea. Let them walk around the class to find a good idea in written work or in completing an experiment. Direct them to bring the good idea back and write it in their notebook, citing where they found the good idea, or who it came from. Then direct them to implement the idea.
- **Scaffolds for Cause and Effect:**

  When I <cause>, I notice <effect>.

  If I want <effect>, I need to <cause>.

  I wonder what the effect would be if ___.

  I think ___ is causing ___.

Suggested strategies for students who *have* met the targeted expectations:

- **Self-Direction Opportunities:** Present the activities in a more open-ended fashion so students can deepen their understanding of the relationship between vibrations and sound. This can include exploring changes in volume (soft-loud) or pitch (high-low). They can solve problems in novel ways, formulate their own questions, and plan investigations within the constraints of the classroom and available materials.

- **Grouping:** Advanced students are better served when paired up or in small groups; occasionally group them in same-level groups.

- **Class Discussion:** Have a student who has met your target expectations lead a debate in class about an experiment or question. The student can present his/her idea, and other students can agree or disagree but must give evidence to back up their thinking. To keep the discussion focused, you can ask questions to keep students' thinking on track.

- **Crosscutting Concepts:** While all students can and should interact with the crosscutting concepts, in this case cause and effect, have advanced students use other crosscutting concepts to think about and make sense of the phenomenon of sound. This could include identifying what patterns they see or how the structure of an instrument produces different sounds (structure and function).

- **Four Corners:** Have students individually determine their ideas about a statement, an answer to a problem, or their thinking about an issue. Label each of the four corners of the classroom with a different response. It could be four different responses to a question or how confident they are in their answer (strongly agree, agree, disagree, strongly disagree). Students move to the corner that best aligns with their thinking. When all students have chosen a corner, have their group discuss why they have chosen that corner. If you have a large group in a corner, divide them into sub-groups so everyone can discuss. Tell them anyone in the group may be called on to defend their group's position.

Science Talks

Science Talks will be used throughout these lessons. Below is background information and strategies to use with students.

Scaffolding the Science Talk

Small group discussion (pairs, groups) should always *precede* large group discussion to activate thinking and maximize the likelihood of thoughtful responses in the large group. Small group discussion can serve as a scaffold for English Learners or others less inclined to speak in a large group.

Revisit Classroom Norms

Many teachers *explicitly teach* (through mini lessons) and practice conversation norms prior to launching their first Science Talk. As always, your focus will vary, based on the strengths and challenges of your class.

Possible Norms to Include	Possible Skills to Practice
• Mutual Respect • Attentive Listening • Openness to New Ideas	• Taking turns • Listening to others • Keeping eyes on the speaker • Responding to one another • Staying on focus • Disagreeing respectfully

Characteristics of Science Talks

- Students seated or standing in a circle facing each other (with science notebooks open to the data recorded).
- Set of explicit norms posted for all to see.
- A natural flow to the conversation with a good deal of student-to-student interaction.
- Many students participate, but not necessarily all students each time.
- Conversation is focused on a particular idea where connections are being made.

Making Meaning Science Talk

Purpose: To draw conclusions, explain phenomenon, and raise additional questions

- Comes at end of investigation or unit, based on work already done
- Looks for patterns or relationships in data
- Involves a rigorous examination of data (from notebook or class data table) to identify what data might support a claim
- May include contradictory data or new evidence
- Is not a simple sharing-out of group results

Teacher's Role in Making Meaning Science Talk

Before	• Offer a clearly stated question (often the focus question). • Ensure that small groups have shared procedures and data beforehand.
During	• Reinforce classroom norms. • Maintain focus on investigation question. • Push for analysis and debate. • Guide discussion toward conclusion or next steps. • May gently push for evidence or probe for deeper explanation.
After	• Provide a clear synthesis statement of discussion. • Gently correct misunderstandings or allow for further investigation.

Student Conversation Moves

Some teachers co-develop and post helpful prompts or sentence frames.

Examples:

Scientists CLARIFY	Scientists QUESTION	Scientists AGREE	Scientists RESPECTFULLY DISAGREE
• Can you clarify what you mean? • Can you say more about that idea? • Could you show me how you got that information?	• Why do you think that? • I was wondering about ___?	• I agree with ___ because ___. • My data also supports ___ because ___.	• I had a different result I'd like to share. • That's interesting, but my data show ___. • Even though you said ___, I think ___.

Teacher Prompts or Probes

For inviting participation	• What do you think? • How is what she saw different from what you saw? • What would you like to add to the conversation? • Can you say more about ___? • What are you thinking now?
For encouraging student-student exchange	• Matt, you had a different idea than Maria. Can you share that idea? • Who can build on what ___ just said? • Whose data supports (or disagrees) with what ___ just said?
For refocusing discussion	• Keep that thought, and we'll come back to it if we have time. Right now, we need to be focused on…
*Correcting student misunderstandings**	• What evidence do you have to support that claim? • Do we have enough evidence to support that claim? What could be another explanation? • I think we need to go back and try ___ and see if it holds up.

**Addressing Student Misunderstandings*. Many teachers hold off on correcting misunderstandings until after the Science Talk, though they will probe students for further evidence in the moment. In this way, teachers and students value the knowledge constructed through the discussion itself, rather than looking for the teacher to provide the correct answer.

Considerations for Planning a Science Talk

- What scaffolds (i.e., wait time, quick-writes, or think-pair-shares) will you use to support English Learners or reluctant speakers in the large group setting?
- How long can your students maintain their focus in a large group discussion?
- What is the best seating or standing arrangement that encourages focus while minimizing distractions? *For younger grades*, transition students to holding notebooks on their laps.
- What sentence frames will you use? How many will you provide? At what level of complexity? How will you phase out scaffolds to encourage independence?
- How active or passive of a facilitator do you plan to be?
- What might be expected student responses during the Science Talk?
- What questions and alternative scenarios can you think of presenting to students during the talk to challenge their thinking and get to a deeper level of understanding?

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References

Community Resources for Science (CRS). "Science Talks" Accessed October 22, 2019. http://www.crscience.org/pdf/Science.Talk.Structures.pdf

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Grade 1 Sounds Conceptual Flow

Anchoring Phenomenon
Emergency sirens make loud sounds.

We can hear and feel sound.

Investigative Phenomenon	Investigative Phenomenon	Investigative Phenomenon
Instruments have parts that vibrate, causing sound.	Devices communicate over a distance using sound.	Sound causes matter to vibrate.
PS4.A We hear sounds.	PS4.C People use sound to communicate.	PS4.A We can feel/see some sounds/vibrations.
Use senses. / Matter can vibrate and produce sounds.	Sounds can be loud or quiet. (volume) / Sound travels.	Sounds can make matter vibrate. / Matter can vibrate and produce sounds.
Asking questions / Planning and carry out investigations / Constructing explanations	Defining problems / Asking questions / Designing solutions	Planning and carrying out investigations / Asking questions

Cause and Effect