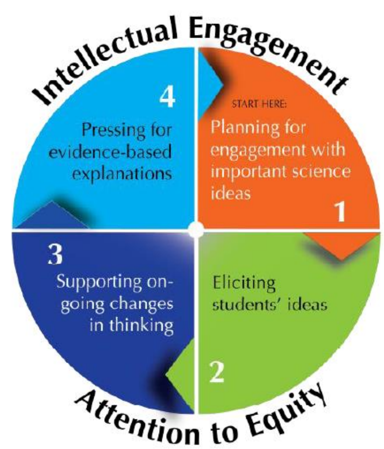
Sound Unit
Grade 1

Contents of this file:

Unit Synopsis:

Students investigate a phenomenon of kitchen drums. A musician group uses kitchen implements, including pots and pans, to play a song. How do they make loud sounds? Soft sounds? High sounds? Low sounds? How does the material or where the object is matter in the kind of sound it can make when we hit it? This unit is structured with alternating science lessons with "create" lessons so students have multiple opportunities to explore each science concept and then link them together over time. Ultimately, the models students develop can be of other sound-related phenomena to see that the same big science ideas about sound help us explain the kitchen drums that help us understand why we can hear cars outside or why we need to use soft footsteps when walking in the hallway.

Ambitious Science Teaching Framework

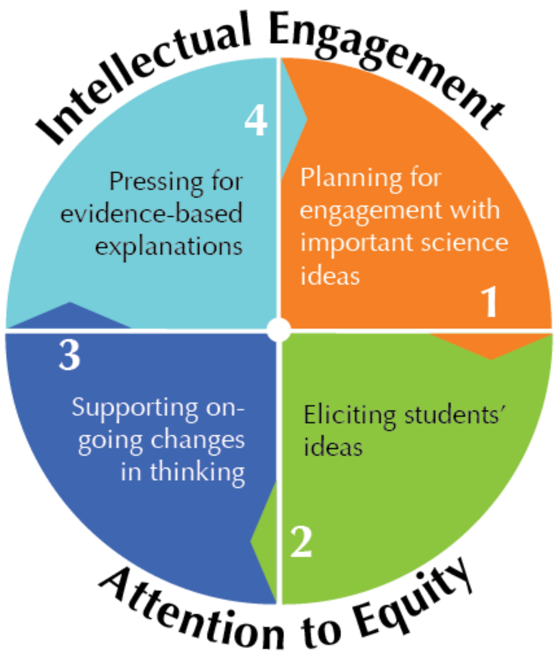


Guide created by Carolyn Colley, PhD with input and feedback from K-2 teachers and students at Sartori Elementary, Renton Public Schools, ccolley@rentonschools.us

[This page intentionally left blank.]

Ambitious Science Teaching

We provide here a vision of ambitious teaching—teaching that is effective, rigorous and equitable. But more than that, we provide a framework of research-based teaching practices that are consistent with this vision and a wide range of tools that can transform how students learn in your classroom. The vision, practice, and tools will furnish a common language about teaching for a group of science educators committed to the improvement of teaching. You will be able to identify "what we will get better at" and how to get started.



Ambitious teaching aims to support students of all racial, ethnic, and social class backgrounds in deeply understanding science ideas, participating in the talk of the discipline, and solving authentic problems. This teaching comes to life through four sets of teaching practices that are used together during units of instruction. These practices are powerful for several reasons. They have consistently been shown through research to support student engagement and learning. They can each be used regularly with any kind of science topic. And finally, because there are only four sets of practices, we can develop tools that help both teachers and students participate in them, anyone familiar with the practices can provide feedback to other educators working with the same basic repertoire, teachers can create productive variations of the practices, and everyone in the science education community can share a common language about the continual improvement of teaching.

The four Ambitious and Equitable Science Teaching Practices are summarized in the below.

Practices	What does it LOOK like?
Planning for engagement with important science ideas	• Planning a unit that connects a topic to a phenomena that it explains (Chemical Reactions – Bike Rusting, Photosynthesis – Seed Becoming a Tree) • Teaching a topic within a real-world context
Eliciting students' ideas	• Asking students to explain HOW and WHY they think a phenomena happens (How did the bike change? Why did it change? What is happening at the unobservable level?)
Supporting on-going changes in thinking	• Using ALL activities/lessons to explain the phenomena. • Giving students opportunities to revise their thinking based on what they're learning
Pressing for evidence-based explanations	• Allowing students to create a final model or explanation about the phenomena • Pressing students to connect evidence to their explanation

Many teachers want to know what their classrooms should look like and sound like—they want to understand how to interact with their students about science ideas and students' ideas. This is especially true now that the *Next Generation Science Standards* are being used in many states.
As a result of the last 30 years of classroom research, we know enough about effective instruction to describe in clear terms what kinds of teaching practices have been associated with student engagement and learning. This research tells us that there are many ways that teachers can design and implement effective instruction, but that there are common underlying characteristics to all these examples of teaching that can be analyzed, described, and learned by professionals. These practices embody a new form of "adaptive expertise" that EVERY science educator can work towards. Expert teaching can become the norm, not reserved for a select few. Ambitious teaching is framed in terms of practices that any teacher can learn and get better at over time. What would we see if we entered classroom of a science educator using ambitious teaching? To give you a sense of what ambitious teaching looks like, we have described below some features common to all science classrooms where ambitious teaching is being implemented (listed on right). These features address everyday problems with learning and engagement that teachers face (listed on left).

Common problems in supporting student engagement and learning	**What you'd see in a science classroom where ambitious teaching is the aim**
The problem: *Students don't see how science ideas fit together.* Each day is perceived by students to be the exploration of ideas that are unconnected with previous concepts and experiences.	At the beginning of the unit, students are focused on developing an evidence-based explanation for a complex event, or process. Students know that throughout unit, most of the activities, readings and conversations will contribute to this explanation.
The problem: *An oversimplified view of what it means "to know."* Science ideas perceived to be straightforward and learnable within a lesson—either you get it or you don't."	An idea is never taught once and for all, but revisited multiple times. Students' science explanations are treated as partial understandings that have to be revisited over time to become more refined and coherent.
The problem: *Lack of student engagement.* Students' experiences and interests not elicited or seen as relevant. Student ideas treated as "correct" or "incorrect."	Students' ideas and everyday experiences are elicited and treated as resources for reasoning; students' partial understandings are honored as a place to start. They are made public and built upon.
The problem: *Students reluctant to participate in science conversations.* Teachers dominate the talk, ask primarily for right answers, get brief responses from students.	Teachers use a varied repertoire of discourse moves to facilitate student talk. Guides and scaffolds for talk help students feel comfortable interacting with peers.
The problem: *Some students have little support for accomplishing tasks that would otherwise be within their grasp.* Little or no guidance for students' intellectual work. Giving "clear directions" is seen as enough to ensure participation in activities.	There is scaffolding that allows students to participate in science-specific forms of talk, in group work, and in science practices.
The problem: *Invisibility of student ideas and reasoning.* Teacher does not know what students think—their heads are a black box. Cannot then work on students' ideas. Students cannot take advantage of the ideas or ways of reasoning by their peers.	Students' thinking made visible through various public representations (tentative science models, lists of hypotheses, question they have, etc.). The teacher can see how students think and how that thinking could change over time. Students benefit from seeing and hearing the reasoning of others.
The problem: *Illusion of rigor.* Students reproduce textbook explanations, lean on vocabulary as a substitute for understanding. Talk of evidence and claims are rare.	The teacher presses for complete, gapless explanations for unique real-life events or processes, and press for the use of evidence to support claims.

As you will see, ambitious teaching is not a "method," and the teaching practices are not scripts. It is a set of principled practices that must be adapted to your classroom needs. Coaches and other teachers can work with you to do this ambitious work.

Making Music: Sound Energy Unit Plan, Grade 1

Unit Phenomenon & Anchoring Question

Students watch "Kitchen Drums" video where musicians use kitchen objects, including pots and pans, to make a melody. Share observations. *What different sounds are made with pots and pans?* Students try it for themselves by tapping on a pan or lid. Tap hard. Tap soft. Tap in the middle. Tap on the edge. Feel the pan while tapping. Try a small pan and compare to a large pan. *What do you notice? What patterns do you find? How can you change the sounds that one pan makes?*

Next Generation Science Standards

- 1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. *[Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]*
- 1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. *[Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]*
- Additional/Created*. Develop and interpret models that show properties of sound and that sound can travel over a distance. *[Clarification Statement: Examples of properties of sound include volume and/or pitch as well as representing vibrations in a model. Includes ideas about matter and energy to show that sound energy can move through different materials like air and wood.)*

Science & Engineering Practices	Disciplinary Core Ideas	Cross-cutting Concepts
Planning and Carrying Out Investigations Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. (1-PS4-1) **Constructing Explanations and Designing Solutions** Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4) **Developing and Using Models** Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller) and/or patterns in the natural and designed worlds.	**PS4.A: Wave Properties** Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1) **PS4.C: Information Technologies and Instrumentation** People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4) **PS3.A: Definitions of Energy** Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **PS3.C: Relationship Between Energy and Forces** A bigger push or pull makes things speed up or slow down quicker than a smaller push or pull	**Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1), **---ETS---Influence of Engineering, Technology, and Science, on Society and the Natural World** People depend on various technologies in their lives; human life would be very different without technology. (1-PS4-4) **Patterns.** Patterns in the world can be observed. **Energy and Matter: Flows, Cycles, and Conservation.** Energy can be transferred in various ways and between objects.

** NGSS is all about providing three-dimensional learning opportunities for students. The performance expectations provided by NGSS are starting places; however, teachers can create their own three-dimensional expectations to better meet particular student and lesson needs. Here are some additional expectations that are appropriate for this unit.*

Background Content Knowledge: Key Ideas about Sound Energy Phenomena

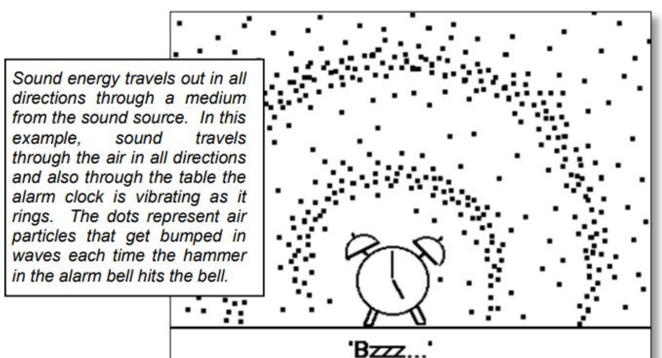
1. **Patterns**: There is a relationship between energy, forces, and matter when it comes to sound energy traveling. Sounds make matter vibrate and vibrating objects make* sound. The stronger the force that starts the vibration, the louder we hear the sound. The weaker the initial force/vibration, the weaker or softer the volume. Another pattern with sound has to do with the size of the object being vibrated. Bigger objects often make lower pitches and smaller objects make higher pitched sounds. This is shown in the kitchen drum video and can be demonstrated on a variety of objects (i.e. longer xylophone keys have lower sounds than shorter keys that have a higher pitch). *(Note: If you use bottles to make a water xylophone, blowing over the top of the bottle is the reverse pitch than tapping the bottle! Weird and interesting! Why?)*

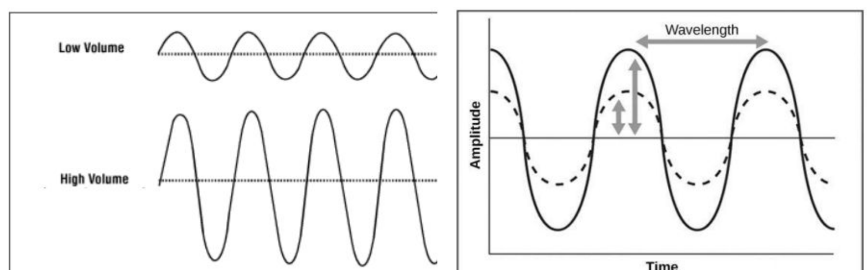
   * Sound is a form of energy. Energy is never produced, created, "made" or conversely destroyed. Energy is transferred and transformed. Students may use the terms "make" instead of "transform". Vibrating objects do "produce" sound that we can hear but really the vibrating object is transferring mechanical energy (motion of vibration) into sound. This language of "make sound" is imprecise but it makes sense to students.

2. **Sound waves**: Sound waves have regular patterns of motion. They can differ in: volume (amplitude, height of wave) and pitch (frequency, distance between wave peaks). Any representation of sound should be able to illustrate differences in volume and pitch. Sound can be represented in a variety of ways through a model. Keep an eye out for readings and videos that show sound and look at how they chose to show sound *(Note: At the early elementary level, focus more on volume. Pitch gets tricky.)* For Grade 1 students, encouraging them to represent sound using symbols they come up with but ask them how they would change the symbol to show louder volume (make it bigger, darker, thicker) or more vibrations (more lines, more squiggles).

3. **Energy and matter** *(This is really for upper elementary but no harm in thinking about this now!)*: Scientists describe energy as taking different forms even though energy is energy. Scientists have developed a language to describe ways we can observe (see or feel) energy. Generally they use terms like: chemical, mechanical, sound, light, heat, electricity. For the "kitchen drums" story, mechanical energy (moving hands vibrate the pan) transforms or changes into sound energy (vibrating pan jiggles air which hits our ears). Sound energy moves or transfers through matter. Matter is made of particles. Particles can bump into each other to transfer energy, in this case, the wave of energy we perceive as sound. The volume of sound decreases over distance as it is transferred through matter (air) and this force of particles bumping is transferred in all directions.

Below are just two of many ways that sound energy is often represented. There are advantages and disadvantages to any symbolic representation. This is a great opportunity for student discussion and critique! For example, the "dots" representation (below, left) helps to show how sound energy is transferred by air molecules bumping into each other. It shows the sound energy pulsing as the hammer hits the alarm bell by showing the pushing of the air molecules in clusters emanating outwards in all directions. From this dots representation, it is not really clear how loud (volume) this sound is based on this representation of sound. The "wave" representation (below, at right) is a common representation as it easily shows both volume (amplitude/height of wave, the vertical) and pitch (wavelength/width of wave, the horizontal). What this "wave" representation has difficulty showing that (1) sound moves away from a source in all directions, and (2) that sound needs a material/matter in order to move/transfer.





LEFT: These sounds have the same pitch (wavelength measured from crest to crest is equal) but different volume (amplitude, or height of wavelength). Volume is related to force. The top sound has less pressure when traveling through air than the sound on the bottom. RIGHT: Diagram labeling the amplitude (height of the wave) which is related to volume and the wavelength (from crest to crest) which is related to pitch.

Additional resources for teacher content knowledge (geared for adults): Sound Crash Course Physics Video (9:38) / Science Transmission of Sound Video (5:20)

Materials list

This materials lists assumes purchasing for one class with 24 students (6 table groups of 4 students). Adjust total quantity and estimated price based on your needs and class size. Better pricing may be available from other vendors if ordering for multiple classrooms in bulk. By staggering schedules, classes can share non-consumable materials. List does not include schools supplies (colored pencils, crayons, white glue, notebooks, pencils, sticky notes, chart paper, makers) or costs of making copies.

Prices as of 02/28/19, Estimated costs only based on prices at Dollar Tree, Amazon, and local grocery stores. Estimate does not include sales tax or shipping.

Item	Qty	Price
Rubber bands (link)	3	$3
12 inch balloons, bag of 15 count (link)	5	$5
Dried beans, 24 oz bag (link)	1	$1
Paperclips, 80 pk (link)	1	$1
Plastic cups, 12-16 oz, 20 pk (link)	2	$2
Plastic cups, 2-3 oz, 20 pk (link)	2	$2
Plastic drinking straws, 180 ct (link)	2	$2
Spool of string, 200+ feet (link)	2	$8
Skein of yarn, super saver 364 yd (link)	1	$3
SUBTOTAL, consumable	**$27**	

Non-Consumable/Reusable Items	Qty	Price
Book: The Listening Walk by Showers (link)	1	$7
Book: Sounds All Around by Pfeffer (link)	1	$7
Book: How Does Sound Change? by Johnson (link)	1	$8
Ice pick or awl (teacher use only) (link)	1	$7
Flexible shatterproof ruler (link)	10	$9
Burner covers, set of 2 sizes (DollarTree link)	12	$13
Tuning fork, high pitch set of 8 (link)	1	$33
Tuning fork, low pitch set of 8 (link)	1	$33
SUBTOTAL, non-consumable	**$117**	

Student collected	Qty	Price
Empty, clean aluminum or tin cans	24	free
Empty, clean glass bottles	24	free
Assorted clean cans, tubes, corrugated cardboard, empty tissue boxes, tins,	48+	free
SUBTOTAL, collected	**FREE**	

Optional items	Qty	Price
Plastic coffee stirrers, small diameter 250 pkg	1	$1
Plastic Boba straws, large diameter, 100 pack	1	$7
Tuning forks, economy, set of 8 (link)	1	$27
Decibel meter (link)	1	$20
Book: Max Found Two Sticks by Pinkney (link)	1	$8
Old vinyl records from thrift shops ($1/record)	1	$1
Straight pin	1	$1
Ada's Violin by Susan Hood (link)	1	$10
Junkyard Drummer Robot (link, $17 each)	6	$102
SUBTOTAL, optional	**$177**	

Unit Outline *with approximate timeline of 6 weeks* *Parent communication text to copy/paste/use on newsletters* [8]

Pacing: This unit takes about 6 weeks if you have science time 3-4 times per week. This may take more time than indicated when you are responsive to your students' needs and questions and if you choose to include all of the optional lessons. NGSS note: The science and engineering practices should be used in combination in lessons. Below lists NGSS 3-dimension combination foregrounded but learning opportunities can include others.

Wk	Lesson	Purpose	Terms	Back-pocket Questions/Prompts	Next Generation Science Standards (NGSS)	Materials
1	Pre-unit: Go on a Listening Walk to Describe Sounds	Practice language needed to describe observations about sounds	sound loud quiet *(Students add descriptive words to list)*	➢ Listen carefully. What do you hear? ➢ What words help to describe that sound? *Make a list of sound words.* ➢ Students write about sounds they heard *(e.g. I heard footsteps on carpet. They are soft and sneaky. I heard a loud short beep of a car horn outside.)* ➢ *Option:* Go on a hunt around the school building. Where can we find the quietest places? The loudest places? Are there any problems with noise in our building? If so, where, when, and/or who is making noise? What do you wonder?	**Nature of Science: Scientific Investigations Use a Variety of Methods** *Scientists use different ways to study the world. Science investigations begin with a question.* **SEP: Plan and carry out investigations.** *Make observations firsthand to construct an explanation for a phenomenon* **DCI: PS4.A: Wave Properties** *Sound can make matter vibrate, and vibrating matter can make sound.* **CCC Patterns** *Patterns in the world can be observed.*	➢ **Teacher lesson guide (Link)** ➢ Chart paper & markers ➢ Book: The Listening Walk by Paul Showers or video *(alternative: All Kinds of Sounds (MyOn) by Ellen Gregoire)* ➢ Clipboards, paper, pencils or notebook *(optional)* ➢ List of sound words *(optional)* (PDF)
1	L1: Introduce phenomenon, elicit ideas, create initial models 1-2 days *(Keep students initial models to compare in Lesson 7.)*	Elicit students' understandings of what causes sounds and why sounds change.	sound model represent	➢ What sounds can you make on a pan? ➢ How do you change the sound? ➢ How can you show sound in a drawing? ➢ How many different ways have we used to draw sound in our class?	**SEP Developing and Using Models** *Scientists use models to represent their current understanding of a system under study, to aid in the development of questions and explanations, and to communicate ideas to others.* **DCI: PS4.A: Wave Properties** *Sound can make matter vibrate, and vibrating matter can make sound.* **PS3.C: Relationship bet. energy and forces** *A bigger push or pull makes things speed up or slow down quicker than a smaller push or pull* **CCC: Cause and Effect** *Simple tests can be designed to gather evidence.*	➢ **Teacher lesson guide (link)** ➢ Kitchen Drums (video) ➢ Model scaffold (PDF) ➢ 1 pot, pan, or metal lid per group/pair of students ➢ Chart paper & markers *Optional: Sticky Notes*
1	L2: Student-Generated Representations of Sound	Gather symbols students drew to show sound on a chart. List hypotheses about what makes sound change and list questions and problems about sound to revisit throughout unit.	represent model symbol	➢ How many different ways did we come up with as a class to show sound? How are they similar/different? ➢ How can we draw sound that is LOUDER? Softer or quieter? ➢ What questions do you have about sound? *(Option: Which questions can we test? Which questions could we read about to find out more?)*	**SEP Developing and Using Models** *Scientists use models to represent their current understanding of a system under study, to aid in the development of questions and explanations, and to communicate ideas to others.* **DCI: PS4.A: Wave Properties** *Sound can make matter vibrate, and vibrating matter can make sound.* **CCC Patterns** *Patterns in the world can be observed.*	➢ **Teacher lesson guide (link)** ➢ Individual Models from L1 ➢ Chart paper & markers ➢ *Optional: Sticky Notes* **NOTE: Send message home to bring empty, clean tin cans for creating Balloon Bongos next week.**

2	L3: Making Loud and Soft Sounds Recognize the Force-Volume Pattern	Force is a push or a pull. Pushes are claps, hits, or taps. Pulls are like plucking a string. Students will observe that more force creates louder sounds and less force results in quieter sounds by using different amounts of force clapping, knocking, and stomping.	volume force (decibel)	➢ You use force to clap. How do you make a clap louder? Softer? ➢ You use force to knock. How do you make a knock louder? Softer? ➢ You use force to stomp. How do you make the stomp louder? Softer? ➢ How does this help us understand how the drummer made different sounds with the kitchen drums? **NOTE: Send message home to bring empty, clean tin can or container for creating Balloon Bongo later this next week.**	**Nature of Science: Scientific Knowledge is Based on Empirical Evidence** *Scientists look for patterns and order when making observations about the world.* **SEP: Plan and carry out investigations.** *Plan and conduct investigations collaboratively to produce evidence to answer a question* **DCI: PS4.A: Wave Properties** *Sound can make matter vibrate, and vibrating matter can make sound.* **PS3.C: Relationship bet. energy and forces** *A bigger push or pull makes things speed up or slow down quicker than a smaller push or pull* **CCC Patterns** *Patterns in the world can be observed.*	➢ **Teacher lesson guide (link)** ➢ Student sheet (link) ➢ Video clip about volume of sound (video 1:04) ➢ GoNoodle Brain Break Make Some Noise (3:19) *Optional math extension:* Learn about decibels: How loud is it? ➢ *Book:* Sounds All Around *by Wendy Pfeffer p.28-32* ➢ *Video: Loudness comparison in decibels (video 4:25)* ➢ *Decibel meter (tool) or phone app (many available for free)*
2	L4: Feeling Vibrations Vibrating objects make sound	Sound vibrates objects and vibrating objects create sounds. Students use tuning forks to feel vibrations and hear volumes made with different forces.	vibration vibrate	➢ How can you make the vibrations bigger? Smaller? How can you start and stop the vibrations? ➢ How does the amount of change the vibration? change the volume? ➢ Draw a model of what you did today that shows the pattern between the force, the amount of vibration, and the volume of the sound.	**SEP: Plan and carry out investigations.** *Plan and conduct investigations collaboratively to produce evidence to answer a question* **DCI: PS4.A Wave Properties** *Sound can make matter vibrate, and vibrating matter can make sound.* **PS3.C: Relationship bet. energy and forces** *A bigger push or pull makes things speed up or slow down quicker than a smaller push or pull* **CCC: Cause and Effect** *Simple tests can be designed to gather evidence.*	➢ **Teacher lesson guide (link)** ➢ Student sheet (link) ➢ Book: How Does Sound Change? by R.Johnson pp 4-7 ➢ Per group of 4 students: ○ 1 flexible shatterproof ruler ○ 1 tuning fork ○ 1 rubber band
2	L4 Create: Balloon Bongo Drum & Rhythm Algorithms *Science, Music, & Computer Science Integration Opportunity* *(2 days)*	Students make a drum and use their bodies to change the volume of the sounds as well as the tempo.	vibration volume (tempo) algorithm debug loop	Students will need help from partners to make their balloon bongos. ➢ Did the bongo design work? What evidence do you have the drum works? What could be improved? ➢ What do you need to do to make louder sounds? Quieter sounds? ➢ Did you partner follow your rhythm algorithm correctly? Did you debug? Optional read aloud drum circle activity*:* *Max Found Two Sticks by Brian Pinkney* (or video) Read-and-drum lesson idea (see video) - *Music teacher may have rhythm sticks or use hands on carpet to drum together at appropriate points in the story.*	**SEP: Analyze and Interpret Data** *Analyze data from tests of an object or tool to determine if it works as intended.* **DCI: PS4.A: Wave Properties** *Sound can make matter vibrate, and vibrating matter can make sound.* **CCC Patterns** *Patterns in the world can be observed.* **Music: MU:Cr1.1.1** *Generate and conceptualize artistic ideas and work (Suggestion for students: Students create short rhythmic patterns.)* **Computer science: 1A-AP-14** *Debug (identify and fix) errors in an algorithm or program that includes sequences and simple loops. (P. 6.2)*	➢ **Teacher lesson guide (link)** ➢ Bongo directions (video) ➢ *For each student:* ○ scissors, ○ glue/tape ○ markers, ○ 1- tin can, ○ 1- rubber band, ○ 1 - handful dried beans, ○ 1 - 12 inch balloon *Optional book : Max Found Two Sticks by Pinkney with drum circle*

3	L5: Vibrations Travel through Matter	Make connections with everyday sounds and how we hear them over distances and through objects	vibrate vibration travel	➢ What did you notice about the volume of the clapping sound? ➢ When do you hear clapping the loudest? Quietest? ➢ What did you notice? ➢ What did you learn about how sound travels through air?	**SEP: Obtain, Evaluate, and Communicate Info** *Use media to obtain information to determine patterns in the natural world.* **DCI: PS4.A Wave Prop.** *Sound can make matter vibrate, and vibrating matter can make sound* **CCC: Cause and Effect** *Simple tests can be designed to gather evidence.*	**Teacher lesson guide (link)** Student sheet (link) Video: SciShow What is sound? (3:57)
3	L5 Create: Make a String Thing *Make and test string phones and/or laughing cups* (2 days)	Students observe, model, and discuss the concept of vibrations that we can hear and that travel over a distance using a string phone or laughing cup.	vibration distance volume represent symbol	➢ Where does sound come from? Where does it go? ➢ Do you think the sound would be different if we used a different size cup? Thicker string? Thinner string? ➢ Draw a model to explain how it makes sound. How will you show volume, vibration, and sound traveling in a drawn model?	**SEP: Construct Explanation** *Make observations from several sources to construct an account for phenomena.* **PS4.C: Info Technologies and Instrumentation** *People also use a variety of devices to communicate (send and receive information) over long distances* **CCC: Cause and Effect** *Simple tests can be designed to gather evidence.*	➢ **Teacher lesson guide (link)** *For making a laughing cup,:* 1 cup w /hole in bottom for string, 1 paper clip, 1 length of yarn, small cup of water *For making a string phone:* 2 plastic cups (same size) each w/hole poked in bottom, 2 paper clips, 1 length of string
4	L6: Changing Pitch - Size Matters	Students observe, model, and discuss the pattern that smaller vibrating objects create higher pitched sounds than larger vibrating objs..	pitch vibration size	➢ What are some high sounds? ➢ What are some low sounds? ➢ How do you make the sounds higher? Lower? ➢ How does the sound change when more ruler hangs off the table? less?	**SEP: Analyze and interpret data** *Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions* **DCI: PS4.A Wave Prop.** *Sound can make matter vibrate, and vibrating matter can make sound* **CCC Patterns** *Patterns in the world can be observed.*	➢ **Teacher lesson guide (link)** ➢ Student sheet (link) ➢ Shatterproof plastic rulers ➢ Tuning Forks (2 sizes) ➢ Rubber bands ➢ Video: What is pitch? (5:16) ➢ Brain Break GoNoodle Weird Sounds (2:24)
4	L6 Create: Straw Flute *Optional demo: Water bottle xylophone*	Students demonstrate their understanding of pitch and how sound travels by making, exploring, and explaining a straw flute (or bottle xylophone)	pitch vibration size	➢ What's the pattern between the size of the object and the sound it makes? ➢ What does length have to do with the amount/length of air being vibrated? ➢ What other materials could we try in this design? What if …? How do you think that would change…? ➢ Model-to-explain how your flute makes different pitches and volumes.	**SEP: Analyze and interpret data** *Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions* **DCI: PS4.A Wave Properties** *Sound can make matter vibrate, and vibrating matter can make sound* **CCC Patterns** *Patterns in the world can be observed.*	➢ **Teacher lesson guide (link)** ➢ Straw Flute directions (video) Materials: Video says 8 straws per student but can do it with 2-4; scissors, tape ➢ Xylophone directions (video) Materials: glass bottles, water, wooden or plastic mixing spoon or pencil
4	L7 Revisit Class Model & Question List (2 days)	Review summary charts and notebooks. Update class model (or create new class model) using recent learning and evidence	model symbol represent pattern	➢ Review of charts with partner talk: What have we learned so far? ➢ With this information, what are the really important ideas we need to make sure are on our models? ➢ How will/did you show ___ in your model?	**SEP Developing and Using Models** **DCI: PS4.A: Wave Properties** **PS3.C: Relationship bet. energy and forces** **CCC Patterns**	➢ **Teacher lesson guide (link)** ➢ Model scaffold sheet, per student - Print a variety or select one for students to use (GoogleSlides) ➢ Summary charts from prior lessons

5	L8: How we use sound to communicate & Send your own message (2 days)	Design and/or use a code to transmit a message using sound. Day 1: Learn about Talking Drums and Morse code. Define criteria and make a plan to send your message. Day 2: Build, test, refine, final test.	criteria prototype	➢ How do we use sound around our school to signal or communicate? ➢ Brainstorm: What are some different ways we can make sounds that travel across a distance? *(e.g. the full length of the hallway)* ➢ Audience: How will we understand what you are communicating? *(e.g. what is the code?)*	**SEP: Analyze and interpret data** *Use observations from media to describe patterns in the natural world in order to answer scientific questions* **PS4.C: Info Technologies & Instrumentation** *People use variety of devices to communicate (send/receive info) over long distances* **CCC: Cause & Effect** *Simple tests designed to gather evidence.* **Computer Science 1A-IC-16** *Compare how people live and work before/after implementation/adoption of new computing technology.*	➢ **Teacher lesson guide** (link) ➢ Talking Drums one-page (link) ➢ Video:Talking Drums (0:51) ➢ Video: Morse Code (1:15) ➢ Morse Code alphabet (link) ➢ Materials for creating a way to send a sound signal/message: balloons, cups, cans, string, paper clips, rubber bands, etc. **Send message home to bring empty, clean items to create instruments**
5	*L9:* ***Optional lesson:*** Store and retrieve sound, exploring record technology *Science, Music, & Computer Science Integration Opportunity*	Explore how vinyl records store and retrieve sound information and use knowledge of how vibrations cause sound to hypothesize about how records work	vibration data storage	➢ What do you notice? wonder? ➢ How do you think records work? ➢ How does the needle going over such a tiny bump in the record groove make such a loud sound? Draw a model using zoom-ins. *Optional: Experiment with materials in demo* ➢ *Does this work with other pins? paper?* ➢ *What might help stabilize the record from wobbling when it spins?*	**DCI: PS4.A: Wave Prop.** *Sound can make matter vibrate, and vibrating matter can make sound.* **Computer Science 1A-IC-16** *Compare how people live and work before/after implementation/adoption of new computing technology.* **1A-DA-05** *Store, copy, search, retrieve, modify, delete information using a computing device and define the information stored as data. (P 4.2)*	Teacher lesson guide outline (link) ➢ Photo: Record grooves (link) ➢ Video: How-to play a record (link) For teacher demo or use video (1:08) ➢ 1 old vinyl record ➢ 1 sheet computer paper ➢ 1 straight pin ➢ tape ➢ 1 pencil ➢ 1 plastic cup w/hole in bottom
5	*L10:* ***Optional lesson:*** Junkyard Drummer *Science, Music, & Computer Science Integration Opportunity*	A Junkyard Drummer is a robot that students program to perform different rhythms. Students observe and model-to-explain how the junkyard drummer works.	algorithm debug rhythm force volume pitch	➢ How does the junkyard drummer make sounds? ➢ How can you change the pattern, pitch, and volume of the sounds? ➢ How well did your group do following the role cards? ➢ How well did you group do writing, performing, and debugging algorithms today? ➢ *Optional Q w/video: How is the junkyard drummer similar or different from video of motorcycle sounds on a bike?*	**SEP: Analyze & Interpret Data** *Analyze data from tests of a tool to see if it works as intended.* **DCI: PS4.A: Wave Prop.** *Sound can make matter vibrate, and vibrating matter can make sound.* **CCC Patterns** *Patterns in the world can be observed.* **Music: MU:Cr1.1.1** *Generate and conceptualize artistic work (Suggestion: Students create short rhythmic patterns.)* **Computer science: 1A-AP-14** *Debug errors in algorithm/program includes sequences and simple loops.*	*[L10 does not have teacher guide]* Per table group: ➢ 1 Junkyard Drummer, pre-assembled (link) ➢ 1 pair of pliers ➢ Variety of cans, boxes ➢ Programming strips (link) ➢ 1 set of role cards (link) *Optional video: Baseball card motorcycle sounds (video)*
6	L11: ***Optional lesson:*** Recycled Orchestra Plan, refine, build, perform with your recycled instrument (4 days)	Use the engineering design process to create a musical instrument from recycled materials	prototype redesign	**Part 1: Plan** based on criteria **Part 2: Build and Test** -- Build a prototype, test it, and refine it. **Part 3: Refine the design** -- Get peer feedback. Improve design. Create model & explain how instrument works. **Part 4: Perform!** -- Create a rhythm/song to perform together. Write the algorithm. Perform for audiences.	**SEP Construct Explain. & Design Solutions** *Compare multiple solutions to a problem.* **DCI ETS1.C: Optimize Solutions** *more than one possible solution, compare and test designs.* **CCC Patterns** *Patterns in the world can be observed.* **Music: MU:Cr1.1.1** *Generate and conceptualize artistic ideas (Suggestion: Students create short rhythmic patterns.)*	*[L11 does not have teacher guide]* ● Variety of recyclable item ● Variety of supplies (tape, rubber bands, glue, scissors, duct tape, balloons, wax paper, etc.) *Optional: Learn about a recycled orchestra of Paraguay:* ➢ *Book: Ada's Violin by S.Hood (video)* ➢ *Wideo: Watch the Recycled Orchestra (video)*

Analyzing Student Understanding

Some examples of what to look/listen for throughout the unit across multiple lessons. What do you hear students talking about and/or drawing/writing about? What experiences or opportunities during lessons help students approach and meet expectations?

Disciplinary Core Idea	1 - Below	2 - Approaching	3 - Meets Standard	4 - Exceeds Standard
PS3.C: Relationship between energy and forces -- A bigger push or pull makes things speed up or slow down quicker than a smaller push or pull	No mention of force or motion of objects	Recognizes that pushes (taps, shakes, blow) or pulls (pluck) can make objects move that makes sounds.	Describes patterns between the strength of force (push or pull), the size of vibration, and the volume of the sound.	Connects the pattern that the amount of force used to start a vibration is related to the amount of energy (volume) with the size of distance that energy can travel.
PS4.A: Wave Properties --Sound can make matter vibrate, and vibrating matter can make sound. Vibrations create waves with back-and-forth or up-and-down movements.	No mention or use of the idea of vibrations or that vibrations are needed to hear sound or waves.	Uses language or simple representation of "sound waves" or indicating awareness of vibrations without further description or explanation.	Tells or shows that sound travels in waves through vibrations back-and-forth and that sound energy can cause something else to move back-and-forth..	Combines ideas about energy and matter to use the idea of waves to explain how sound energy travels through matter in waves and that properties of the waves tell information about the sound such as volume and pitch.
PS4.C: Information Technologies and Instrumentation -- People use a variety of devices to communicate (send and receive information) over long distances.	Not able to provide any examples used by humans or animals about how sound is used to communicate over a distance.	Retells examples of how sound is used to communicate over a distance (humans, animals, etc)	Designs and builds a device that uses sound to communicate over a distance and describes what the device does. Describes, shows, models, or explains *that* sound can move over a distance to communicate.	Models or explains *how* the device moves sound energy over a distance using a combination of ideas about waves, energy, forces, and/or particulate nature of matter (bumping into each other moves the wave along).
Engineering ETS1.B: Developing Solutions--Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for solutions to other people. *(Problem: We need to create a instruments to form a band with these materials. Solution: Design an instrument that can make different sounds.)*	No attempts to design through sketches, drawing or physical models to create an instrument, communication device, or to solve a sound-related problem.	Conveys a designed solution through sketches, drawings, or physical models. Does NOT explain decisions relating to size/shape/ material. *(e.g. invents a double drum, one large, one small without noting how the sound would be different or why the materials would/wouldn't work for the design.)*	Designs can be conveyed through sketches, drawings, or physical models to explain how the material properties relates to the function or solution. These representations communicate ideas for a solutions to other people. *(e.g. Students show how the musical instrument they designed makes different volumes, pitches, moves sound over a distance, and explains material choices.)*	Testing the design helps to identify failure points or difficulties, which suggest the elements of the design that need to be improved *(e.g. Playing the instrument with more force caused part to break off and student identifies the failure point to improve it. OR Student prototypes with a weaker material (paper) and realizes needs a stronger material (cardboard) because the sound is too weak.)*

Focal Scientific Practices	1 - Below	2 - Approaching	3 - Meets Standard	4 - Exceeds Standard
Developing and Using Models Building and revising simple models and using models to represent events: ● 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 world.	No representation of sound (picture nor analogy). Statement of observation only *(i.e. The drum is loud)* Not participating during tasks for revising, comparing, or discussing representations of sound.	Communicates *that* sound is present, absent, or changing in a model of a specific phenomenon Recognizes *that* there are different ways to symbolically represent sound but has difficulty using more than one representation.	Virtual classroom visit: ***1st grade video example*** Manipulates a representation to communicate attributes of an entity AND uses modeling to show patterns in data *(such as varying the height, size, thickness, and quantity of a symbol to show changes in volume, pitch, or sound going through matter).* Compares and/or selects particular representation of sound in order to express a specific principle *(i.e. dots with arrows communicates how sound travels by pushing particles into each other.)*	Identify limitations of a model (critique) Develop a model using an analogy, example, or abstract representation to describe a scientific principle *(i.e. dominoes falling into each other moves a wave, just like air molecules bumping into each other move a sound wave)*
Constructing Explanations Using evidence to construct explanations, describe and predict phenomena. Use information from observations (first-hand or from media) to construct an evidence-based account of phenomena.	Retells what happened (observations) without relationships, patterns, or cause-effect statements *(e.g. The man played the pots and pans with sticks.)*	Makes factual claims based on observations, patterns in data, and/or secondary sources but does not attempt to supply evidence. *(e.g. A hard knock makes a loud sound.)*	Use information from observations (firsthand or from media) to construct an evidence-based account for natural phenomena. Supports claim with general connections to evidence *(e.g. It was loud because I knocked hard and I heard it.* -- Citing personal experience as evidence.*)*	Constructs and evidence-based explanation AND relates it to important science concepts and relationships *(e.g. More/Stronger force makes a louder volume happen because when I knocked hard it was louder than when I knocked softly because the vibrations pushed the air harder.)*

[This page intentionally left blank.]

Pre-Unit - Listening Walk

Purpose

In this lesson, students will have the opportunity to think about how to use language to describe sound. This vocabulary and comparisons will be useful to students throughout this sound unit. Start a word chart and add to it over the unit to help anchor students' descriptive language.

Responsibilities

Teacher's primary responsibilities:

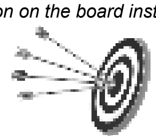
- Provide a context for making observations about sound
- Facilitate noticing/observing and describing sounds using language
- Recording words and phrases useful to describing sounds

Students' primary responsibilities:

- Listen carefully
- Move silently so others can hear
- Describe what they hear using descriptive language
- Use language to compare and contrast sound they hear

Learning Target

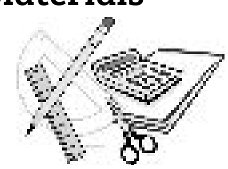
You do not need to post a target, but you can if that is part of your routine. You could pose a question on the board instead.



I can **listen carefully** and **make observations**

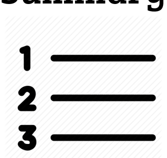
about what I hear.

Materials



- Chart paper & markers
- Book: The Listening Walk by Paul Showers
    - If you do not have a copy, use a read aloud on video
- *Optional: Paper/notebook, pencils, clipboard*
- *Optional: List of sound words (PDF)*

Lesson Steps Summary



Approx. 30-40 mins

1. **Framing/Teaching Point**: Introduce new unit topic of sound (general) and language to describe sound. Use the book to get students into listening carefully and looking for words that help describe sounds.

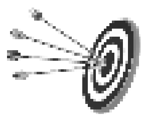
2. **Explore**: Take students on a listening walk. Pause to listen. And then describe (could be turn-and-talk or silent writing)

3. **Summarize**: Return to class and share what you heard (or wrote) with a partner. Add to the list of words or phrases to describe different kinds of sounds.

4. **Lesson closing**: Preview next class that we will start learning more about how different kinds of sounds are created.

Lesson Steps

1) Framing/Teaching Point: Describing Sounds.

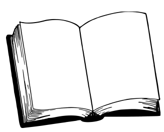


Learning Target

a) Orient students to today's lesson. Something like: *This week we start our new science unit about sound and how different sounds are made. Today we will be noticing the sounds around us. First, we will read a book and identify different sounds in the story and how the girl describes them. Then, we will make a list of different sound describing words. Finally, we will go on our own listening walk (...and write a few sentences about what we hear). So today:* ***I can listen carefully and make observations about what I hear.***

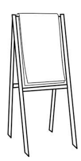
Turn-and-Talk

b) Show students the cover of the book. Ask students to think and then pair-share with what sound they might hear if they were the girl walking on the sidewalk outside. ***What do you think you might hear around you if you were the girl in the picture?***



Read Aloud

c) Tell students that you will pause while reading to have students identify the sounds in the story and the words used to describe those sounds.



Public Record

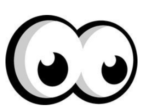
d) Add additional words students share to "descriptive words" column for describing sounds (optional: see also this list).

The Listening Walk: Describing Different Sounds

Sounds in the Story	Spelling out sounds
dog toenails	twick twick
lawn mower	dop dup dop dup
lawn sprinklers	zzzzooooommmmm
new cars	Thhhh whithh whithh
old cars	brack-a brack-a
car tires turning	whrrrrrrrr
car brakes	eeeeeeeeeee
bicycle bell	trring trring
baby crying	waaa awaaa awaaa
jet	eeeeyowwooooo
boy with basketball	bomp bomp bomp
lady in high heels	
bus stopping	
jackhammer	
footsteps on a path	
pigeons	
ducks	

Descriptive Words

scratching	noisy
very quiet	whispering
quiet	ringing
crying	very noisy
loud	banging



Observations

2) Explore: Take Students on a Listening Walk

Have students go on a listening walk around the school or outside on the playground. Remind students about different ways they can describe sounds because when they return to the class they will talk about the sounds they heard. *(Optional: Bring a notebook/pencil and have students sit and write at 2 stopping places along the listening walk).*

Turn-and-Talk

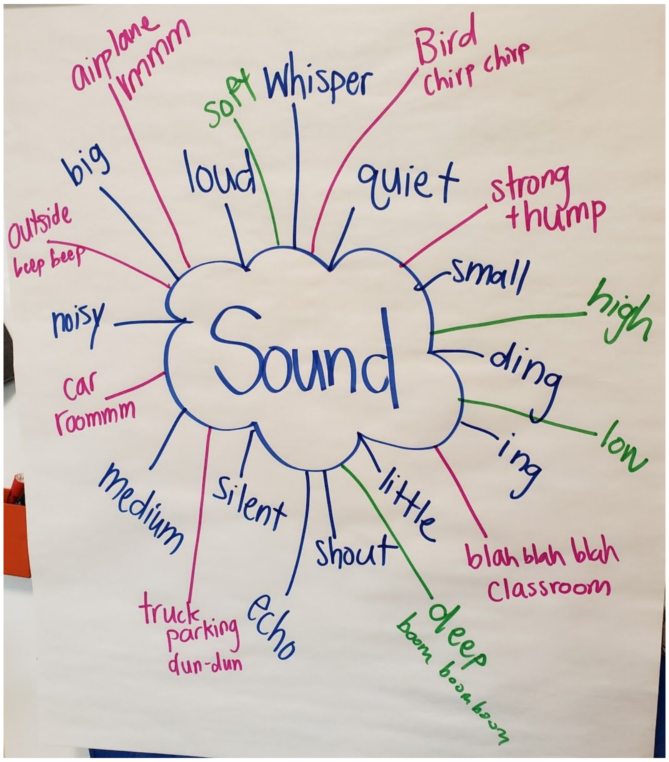
3) Summarize: What did you hear?

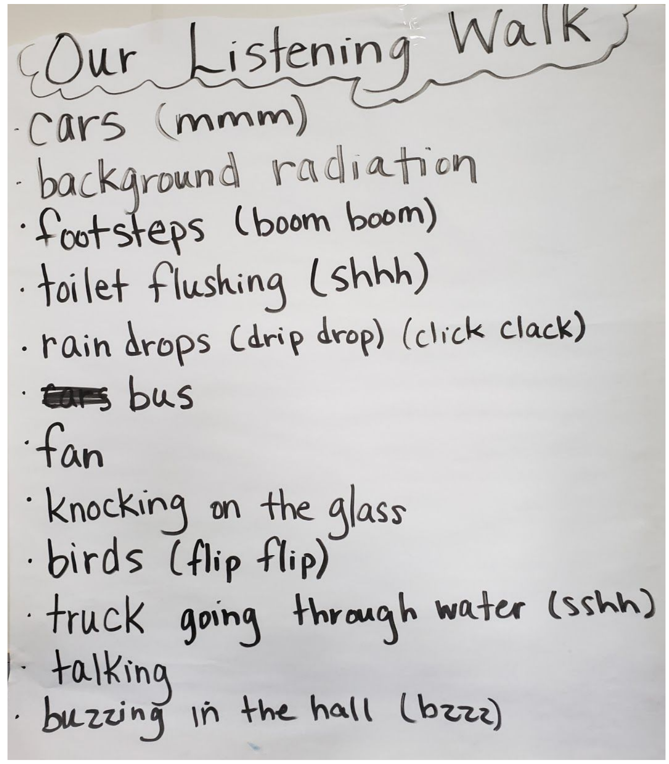
Have students turn-and-share about the different sounds they heard. Prompt students to use some of the words they heard in the story. Add to the list of "descriptive words" if students use other words.

Lesson Closing

4) Closing: Let students know that throughout this unit they observe different sound so to keep in mind these words (on the "descriptive words") list to help them communicate about what they hear. Tomorrow we will start thinking about how and why different kinds of sounds happen,

Examples of Listening Walk Summary Charts from Two Classrooms





[This page intentionally left blank.]

Lesson 1 - Eliciting Ideas about Sound

Purpose

In this lesson, you will introduce the unit phenomenon, elicit students' initial explanations and lived experiences related to the phenomenon, and engage students in constructing their initial models of the kitchen drums: *How can one drum make so many different sounds?*

Responsibilities

Teacher's primary responsibilities:

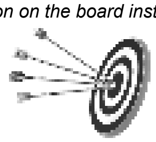
- Setting the context for student reasoning;
- Asking questions to elicit students' observations, ideas, experiences, and questions;
- Supporting students to interact with each other's ideas.

Students' primary responsibilities:

- Representing sounds in a drawing and with words
- Making a model about what caused the sounds to change
- Listening-to-understand their peers' ideas and questions

Learning Target

You do not need to post a target, but you can if that is part of your routine. You could pose a question on the board instead.

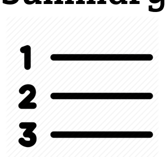


I can **make a model** about what **causes** different **sounds.**

Materials

- Chart paper & markers
- Kitchen Drums (video)
- Metal can lids or stove burner covers (1 per pair)
- *Additional pots or pans (optional)*
- Model scaffold per student (11x17)

Lesson Steps Summary



You can teach this lesson in one longer 40-45 minute session or break this lesson over 2 days (20-25 minutes each).

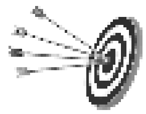
Part 1: Introduce Phenomenon (~20 mins)

1. **Frame**: Introduce phenomenon of kitchen drums
2. **Explore**: Students tap and observe big and small lid/pans with chopsticks or pencils. How can you make a loud sound? A quiet sound? What happens if you touch the pan when you tap?
3. **Summarize:** Add to the list of observations as a class based on students' experiences.

Part 2: Individual Student Models (~25 mins)

4. **Frame:** Recap observations, elicit hypotheses. Then review: What is a model? What do scientists include? How can we show our ideas?
5. **Explore**: Students engage in modeling task (individual). How can you draw different sounds with symbols, color, or arrows?
6. **Summarize**: Share out some ideas. Preview tomorrow's lesson of making a class model about the large and small pans and writing down some questions we have about sounds.

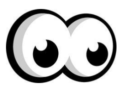
Part 1: Introduce the Phenomenon



Learning Target

1) Frame: Introduce the phenomenon. Make observations

a) Open with a statement of purpose for this new science unit and today's learning target. Something like: *Today, we will start to work together as scientists to explore and explain how we can make different kinds of sounds. To do that we will observe a kitchen band, try a smaller version for ourselves, and then create a model using pictures and words to show our science ideas.*



Observations

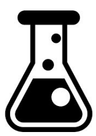
b) Show students the video of the kitchen drums once. Then play it again asking students to pay attention to where and how he hits the different objects to make sounds.

Questions to ask:
- *How is the drummer touching the pan? What sound to you hear?*
- *What do you notice about the size of the pan/pot and the sound?*
- *How can you describe the sounds you hear?*

Turn-and-Talk

c) Have students turn and talk about their observations. Record some on a class chart about "Drum Observations"

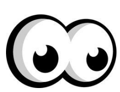
Sentence frame possibilities:
- *When he… the sound is….*
- *The pot sounds… but the lid sounds…*
- *He make the sound louder when he...*



Explore & Experiment

2) Explore: Play a pan and observe the sounds

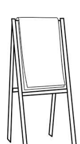
a) Tell students they will now have a chance to explore making sounds by tapping different pans with their fingers and hands.
   i) *Silent signal:* Remind students if they hear/see your silent signal they need to stop and listen. Practice your silent signal. This will be very important during this unit as students will need to make noises to make their observation.
   ii) *Turn taking:* Let students know they will be taking turns with their partner and sharing their "drum" so figure out who will drum and who will listen first.



Observations

b) Pass out 1 pan to each pair of students.Students tap the "drum" with their fingers and palms and listening to the sounds. Circulate. Ask questions. Listen to students' observations.

Questions to ask:
- *What do you notice?*
- *What do you hear?*
- *What do you feel?*
- *What did you figure out?*
- *How can you make the sound louder? Softer?*
- *How does the sound change?*

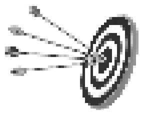


List of Observations

3) Summarize: Share observations whole group

Gather students. Have students share out a few observations from their hands-on experience. Add to the list of observations. Focus on what students heard and felt. If students need to show the class, have one "drum" available as a demonstration.

Part 2: Individual Student Models



Learning Target

Mini-Lesson

4) Frame: Recap observations and review *What is a model?*

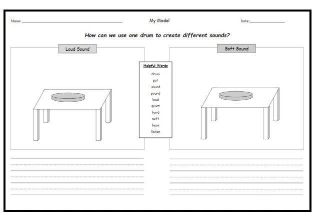
Take a moment to recap the observations from the kitchen drum video and the list created in part 1. Introduce purpose for next task.

Then, tell students that they will make a model of the drum to show how and why a drum can make different sounds, specifically thinking about loud sounds and quiet sounds.

Remind students about models so they are learn more about this science and engineering practice (NGSS) and are prepared for what you expect them to include in the next task.

It could sound like this:
Scientists draw models to explain something puzzling and why they think it happened. Today you're scientists and are trying to explain how the same drum can make loud and soft sounds. Scientists put their observations on their model. What happened? What did they notice? Then they add on how or why they think that happened. They use symbols and arrows and colors to show their ideas. The challenge today is how to draw sound since sound is something we hear but can't see. What are all the different ways we could draw sound? We will share later how each of you chose to draw sound.

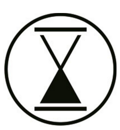
5) Explore: Students create models



Develop a Model

Students create initial models. Circulate and ask about the arrows, colors, sizes of objects, and other symbols. Jot down what you hear students say on a sticky note and place it on the back of their model (Students often say more than they write or draw)

Back-pocket question/prompts::
- ➢ *Tell me about what's going on.*
- ➢ *How did you decide to show sound in a picture? What does that show us about the sound?*
- ➢ *How can we tell by looking that this sound is loud and this sound is soft?*



Lesson Closing

6) Summarize: Share different ways of drawing sound
Have a few students share and compare ways they drew sound. Start a chart with the different ways students chose to represent sound.
Preview next lesson: *Next class, we will have time to share our ideas, our models, and make a class model and list of our ideas and questions. This will help us figure out how drums can make so many different sounds!*

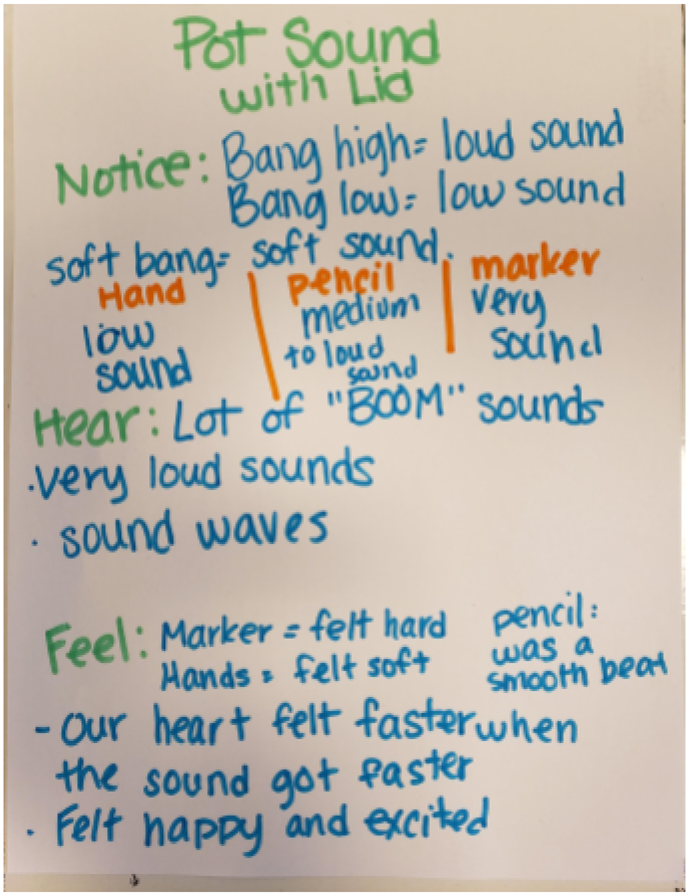
Post-Lesson: Analyze Student Work

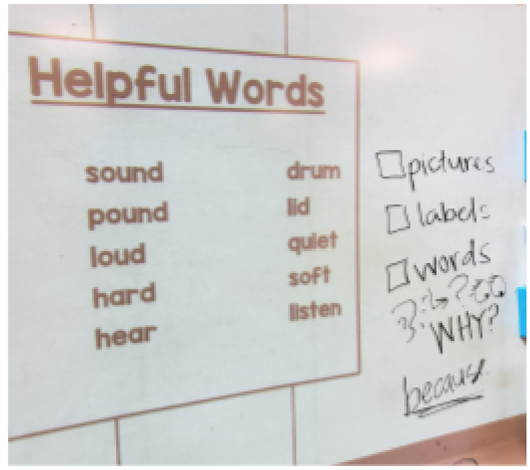
Sort by <u>amount on-the-page</u>: Who really got a lot down in pictures or words? Who didn't? Why and why not? What additional scaffolds do students need? What scaffolds worked well?

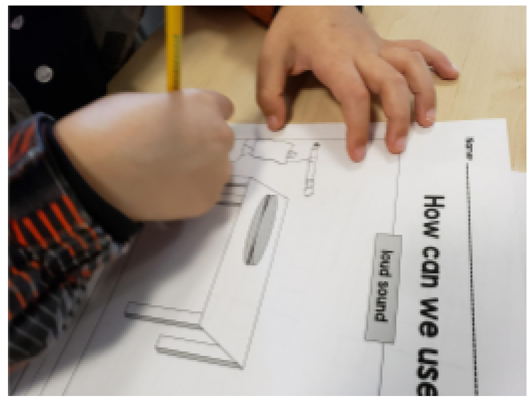
Sort by <u>depth of explanation</u>: Use the what-how-why levels to sort models into 3 piles. Track students' initial level of understanding for key unit ideas on a class chart.

Make a tally list of popular ideas: How many students included sound traveling in all directions? Vibrations causing sounds? Relationship between force and volume? This will help you plan how to structure your idea-sharing in Lesson 2.

Photos from Lesson 1







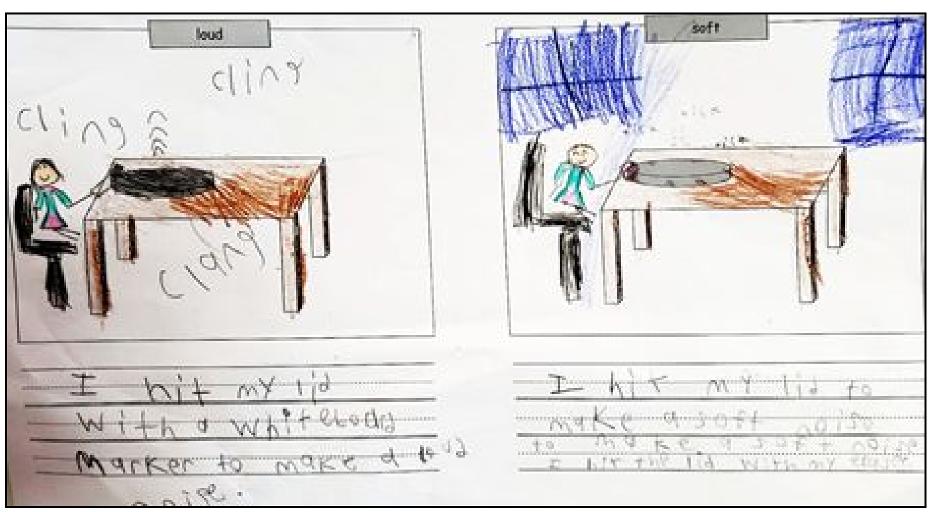
Left: Recording student observations after exploring drumming on the lids. This is optional but can be a useful reference for students. **Right, top**: Projecting helpful words and jotting an impromptu checklist to reminder students what to include in their models. **Right, bottom**: 1st grader working on her model.

Student Work Examples

Example 1:

"I hit my lid with a whiteboard marker to make a loud noise." Cling, Cling, Clang. "I hit my lit to make a soft noise to make a soft noise I hit the lid with my eraser." Tick, tick, tick.

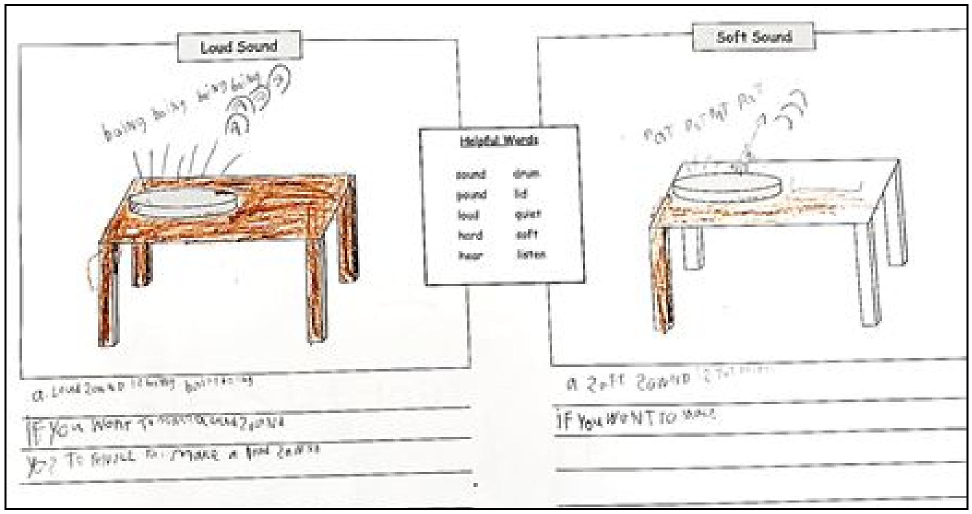
Sound representation: Half circles which are darker and bigger for loud sounds and lighter and smaller to show softer sounds.



Example 2:

"A loud sound is boiwg baing baing if you wont (want) to make a loud sound yos (use) to (two) penzlz (pencils) tu (to) make a loud sawnd (sound)." Baing, baing, baing, baing. "A saft (soft) sownd (sound) is pat pat pat if you want to make…" Pat, pat, pat.

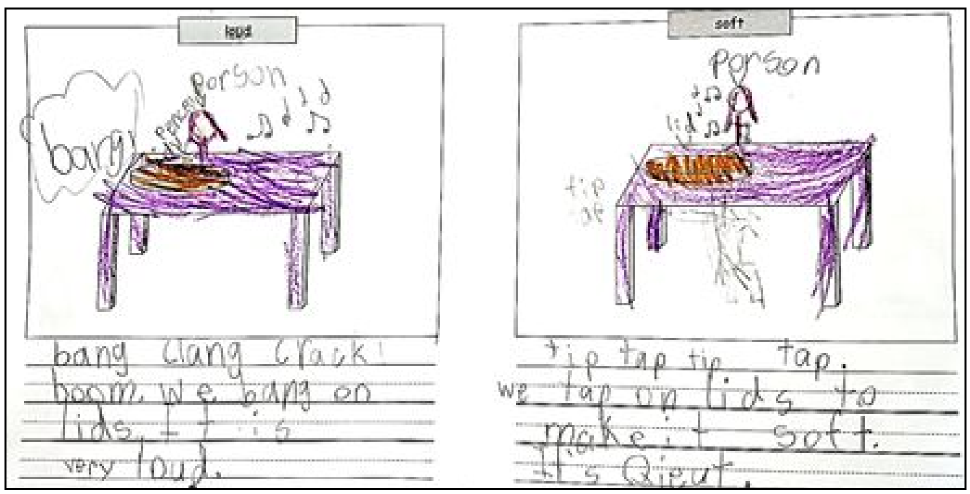
Sound representation: This student also used the half circles but doubled them up to show louder volumes. Also, this student added longer, darker lines coming up from the pan making the loud sound compared to shorter, light lines from the pan with the quieter sound.



Example 3:

"bang clang crack! boom. we bang on lids. It is very loud." "tip tap tip tap. we tap on lids to make it soft. It's qieut (quiet)."

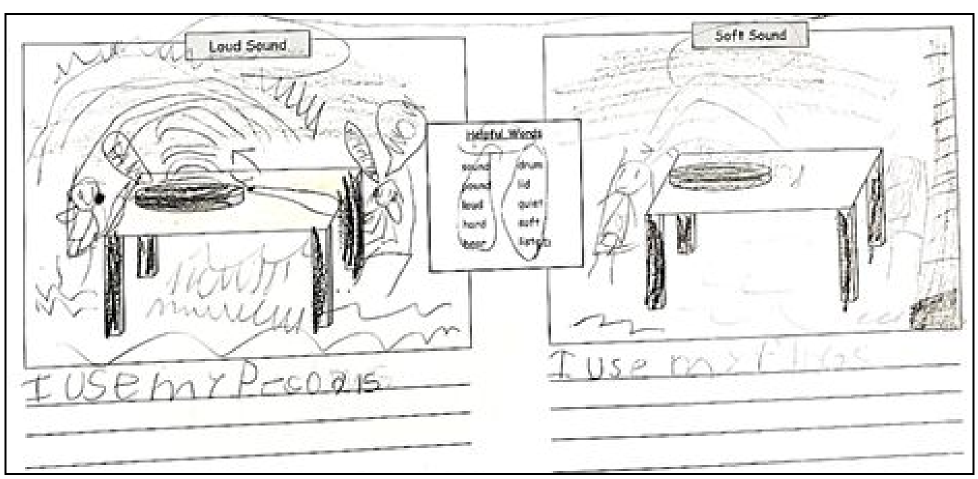
Sound representation: Music notes with words (bang and tip tap). The music notes for the louder sound are farther away from the person and there are more of them. The music notes for the softer sound are closer to the person and smaller.



Example 4:

"I use my pesoals (pencils) I use my fings (fingers)."

Sound representation: Sound arcs growing in size away from pan. There are more, darker arcs on the louder sound than the quiet sound. For loud, the student also includes words in bubbles (Bang).

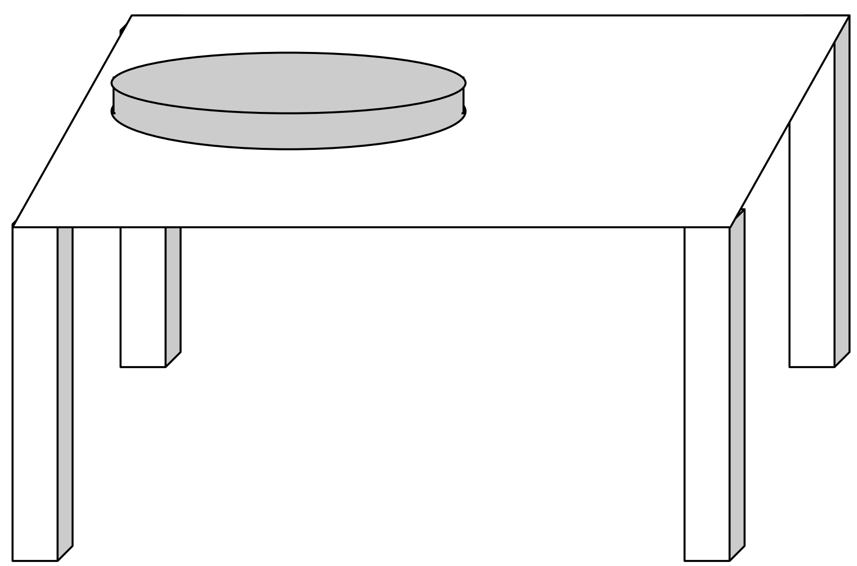


[This page intentionally left blank.]

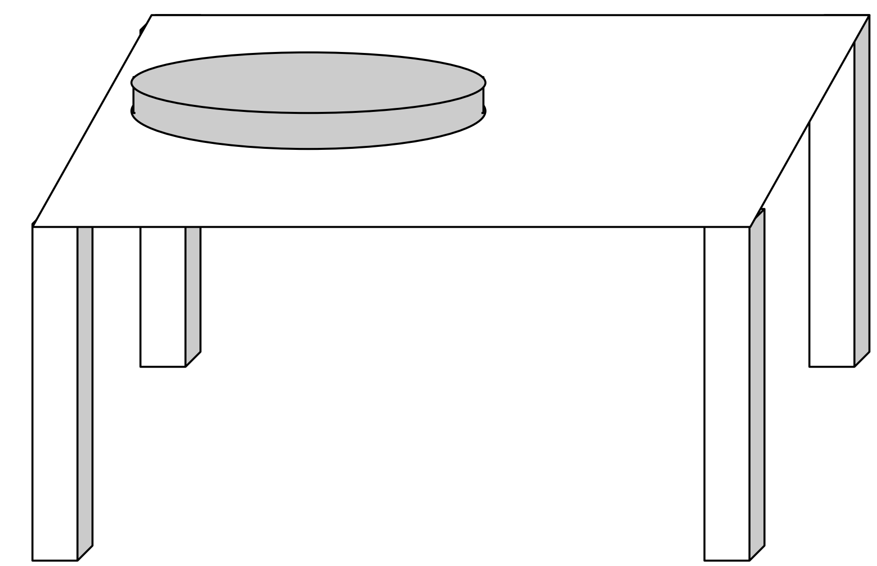
Name: ______________________________ My Model Date:______________

How can we use one lid to create different sounds?

loud



soft



____

____

____

____

____

____

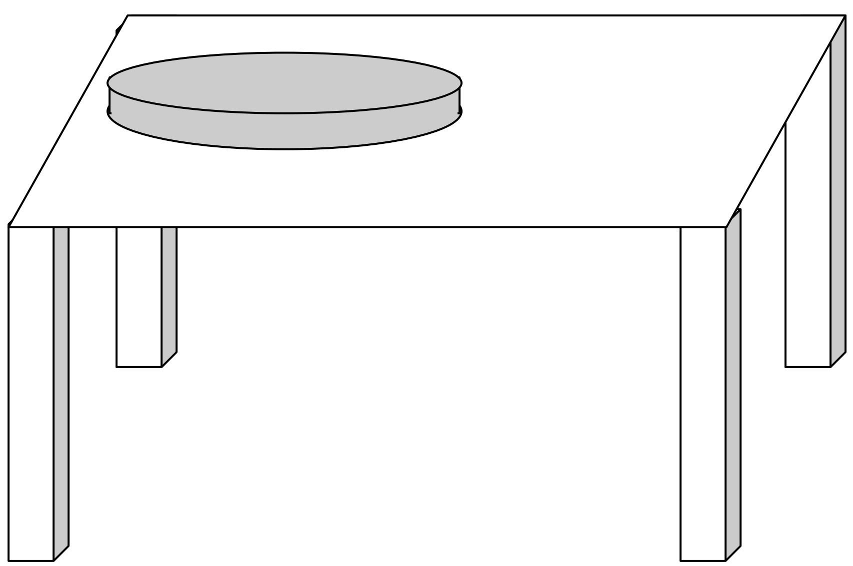
Name: ____ Date:_______________

My Sound Model of ___________________________

Name: ____ My Model Date:______________

How can we use one lid to create different sounds?

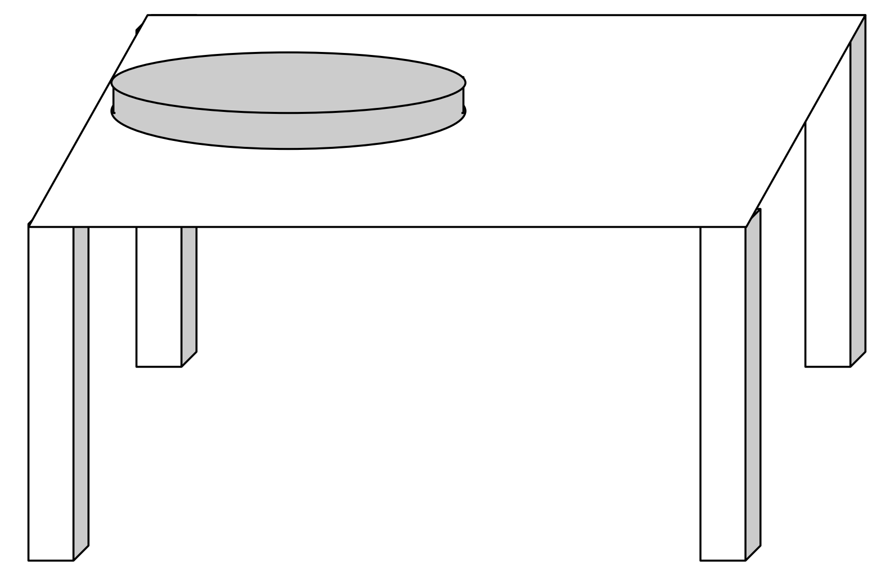
Loud Sound



Helpful Words

sound	drum
pound	lid
loud	quiet
hard	soft
hear	listen

Soft Sound



____

____

____

____

____

____

____

____

____

____

Name: ________________________________ My Model Date:____________

How can we use one lid to create different sounds?

Loud Sound

Soft Sound

Helpful Words

sound	drum
pound	lid
loud	quiet
hard	soft
hear	listen

____

____

____

____

____

Lesson 2 - Representing Sound

Purpose

In this lesson, students describe and compare how to represent loud and soft sounds, asks questions about sounds, and identifies problems caused by sound in their daily lives.

Responsibilities

Teacher's primary responsibilities:

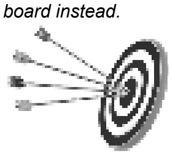
- Create chart of variety of sound representations
- Facilitating class discussion and creation of class model that presses student thinking about drum sounds

Students' primary responsibilities:

- Look- and listen-to-understand their peers' ideas
- Contribute to discussion by asking clarifying questions and sharing representations
- Ask questions

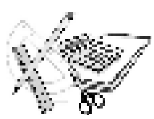
Learning Target

You do not need to post a target. But could pose a question on the board instead.



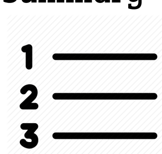
I can **understand** fellow scientists' **ideas** about what causes **sounds** to **change** and how to **model** sound.

Materials



- Chart paper & markers
- Student work: Students' models from lesson 1 (11x17)
- Chart: Observation list from lesson 1

Lesson Steps Summary

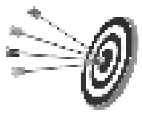


1) **Framing:** Mini-lesson about the purpose of symbols in modeling

2) **Explore:** Representing Sound - partner talk, whole group list. How did you show sound? What made you think to use that way? How many different ways did we show sound in pictures? What do these symbols help communicate about the sound?

3) **Summarize:** Asking Questions, Identifying Problems - Create a list of student questions and issues or problems related to sound that affects them.

Lesson Steps



Learning Target

1) Frame: Purpose of symbols in modeling

a) Introduce learning target. Recap kitchen drum phenomenon and hold up students models from lesson 1. Tell students that today, they will work to understand each other's ideas, specifically about how they chose to represent sound in your model. Introduce lesson target: *I can understand fellow scientists' ideas about what causes the sounds to change and how to show sound in a model.*

Mini-Lesson

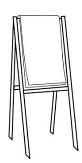
b) Mini-lesson: Purpose of symbols in modeling. Tell students about the purpose of symbols in science models. It might sound like this: *Symbols represent things that we can't see. Symbols help us communicate our ideas to others through pictures. We get to choose the symbols we want to use to express our ideas. One thing I noticed that many of you did was __(insert example: such as, draw loud sounds bigger/longer/more lines and softer sounds lighter/shorter/fewer lines)__. This is something we can all do to our symbols. We can draw them bigger, bolder, in different colors, or more of them or smaller, lighter, fewer of them to communicate something about the sound.*

2) Explore: Representing Sound

Turn-and-Talk

a) When students return to their desks in just a moment, have students look at their models. ***How did you choose to show sound? Why did you show sound that way? Did you do something special to your symbol to show a difference between loud and soft sounds?***

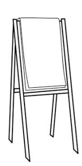
b) Take a moment to add or change something on your model if you wish. Then, turn-and-talk to your partner, triad, or table group to show and compare how you drew sound in your model. Circulate and look for a few pairs who you choose to share back whole group.



List of Representations

c) Return to the gathering area on the carpet. Have a chart, if you started one in lesson 1, or blank paper ready to capture all the ways students represented sound in their models. Have a few pairs put their models under the document camera to share and compare the ways they showed sound. ***How did they show it? How can a reader tell if it's a loud sound? A quiet sound?*** As students share, add to a chart of sound representations.

3) Summarize: Asking questions



Question List

a) Wrap-up this opening set of lessons by having students brainstorm questions they have about sound. Give students some silent think time about this question: *What questions do you have about the kitchen drums? Or about sound more generally?*

b) Decide if you want students to write questions on sticky notes and bring them up, or if you will scribe questions for them. Students may also bring up problems related to sound levels that are worth noting here.

Lesson Closing

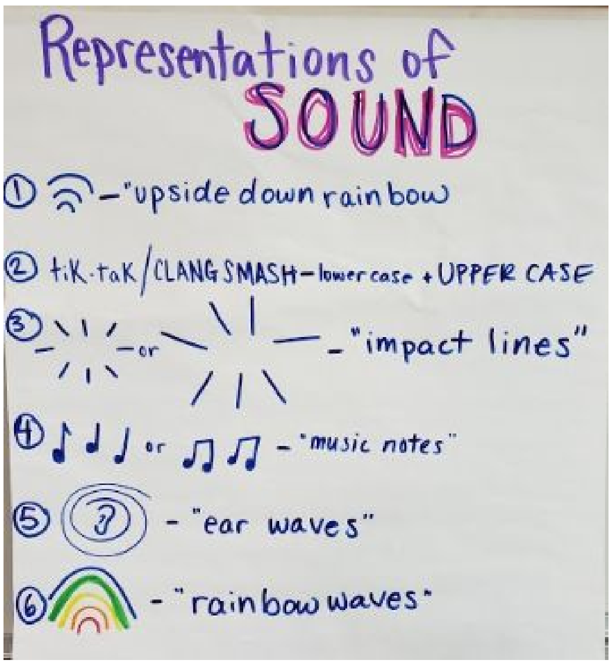
Have students return their models to you to keep for end-of-unit revision and assessment purposes. Gather any remaining questions students have.

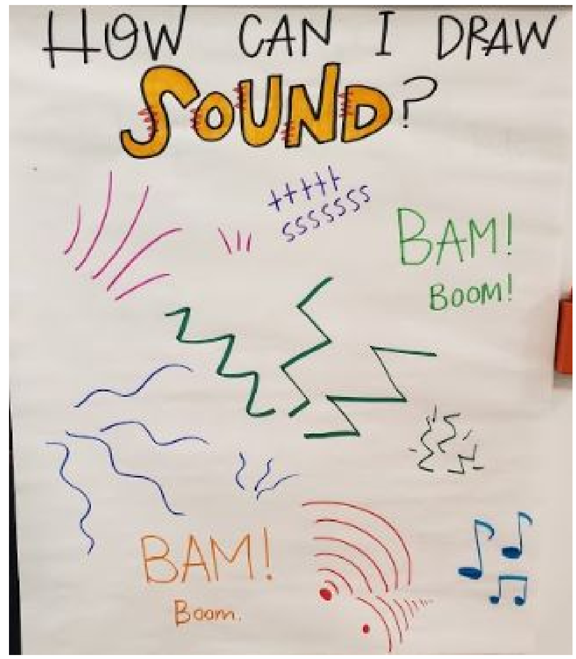
Post-Lesson: Share Class Models & Hypotheses

Take 5 minutes to reflect about your students' ideas from L1 & L2. Here are some prompts to get started:

- What were your students top 2-3 most popular ideas, representations, or questions?
- What might you do in an upcoming lesson to better support students' learning around their ideas and question?
- What are you now wondering about how to support students' science learning?

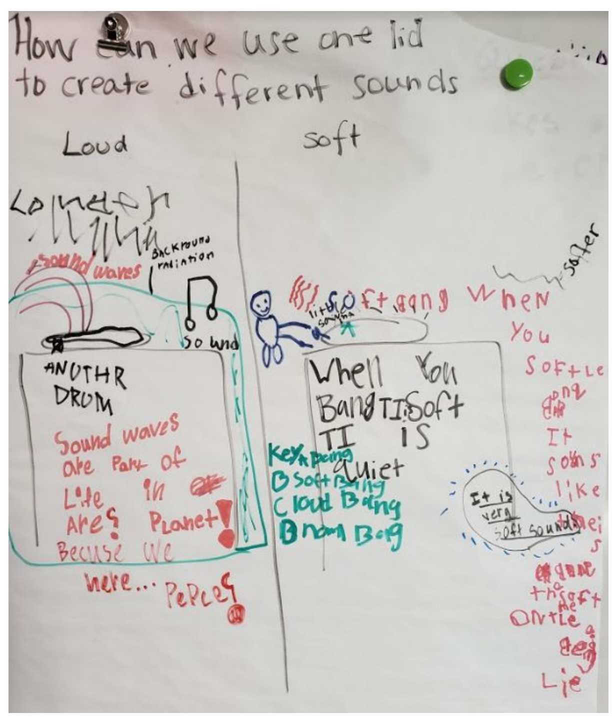
Lesson Photos





Above, these are charts of student-generated symbols came from two different classes. These are different ways students drew sound on their models. Numbering or labeling the representations can be helpful for future discussions.As you read books or look at other models of sound with students (diagrams, videos) see if those authors use any similar representations or if they had their own way of showing sound. Why might you choose one representation over another? Refer back to and use this chart in upcoming lessons to help students model the sounds they make in each activity based on what they observe (hear, see, feel).

At right, is a whole-class model where students worked together to develop a model that represented ideas or questions that students agreed were important.



[This page intentionally left blank.]

Lesson 3 - Loud and Soft Sounds

Purpose

In this lesson, students will learn about the concept of volume as it relates to sound energy and begin to see patterns in the relationship between force and volume.

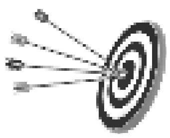
Responsibilities

Teacher's primary responsibilities:
- Introduce science concept
- Ask questions about what students observe and about their models
- Update public record with student input to summarize learning

Students' primary responsibilities:
- Look- and listen-to-understand new science terms
- Make observations. Collect data
- Find patterns in the data about force and volume
- Model volume using pictures and words

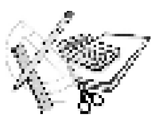
Learning Target

You do not need to post a target. But could pose a question on the board instead.



I can **collect data** and **find patterns** about the amount of **force** and **volume** of **sounds**.

Materials

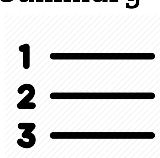


- ➢ Student task sheet (link)
- ➢ Related Brain Break GoNoodle Make Some Noise (3:19)

Optional/Extension: Learn about measuring volume in decibels: How much louder is it? Reasoning with numbers more exact for students than the comparative descriptive words of louder than and quieter than.

- ➢ *Book: Sounds All Around by Wendy Pfeffer p.28-32*
- ➢ *Reading: Measuring Sound (PDF)*
- ➢ *Classroom noise meter or app* (i.e. https://youlean.co/online-loudness-meter/)

Lesson Steps Summary



1) **Frame:** Purpose of today's lesson, building on student idea and/or answering question related to volume (loud/soft). Introduce the concept of volume through selected pages of a text and video with turn-and-talk.

2) **Explore:** Stomp, Clap, and Knock Observations. Look for patterns in the data. How does the force relate to the volume of the sound? Is this always true? Model-to-explain your results.

3) **Summarize:** Create a short summary chart about what students did, what they figured out from the exploration. *Wrap-up with GoNoodle Brain Break Make Some Noise (3:19)*

***Optional** Math Connection/Extension about measuring volume.*

Lesson Steps

1) Frame: Introducing the terms volume and force

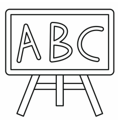
Turn-and-Talk

Students likely already know the term volume *but now is a time to introduce it to the class together and add it to the science word wall. What is likely new for students is thinking about the relationship between the amount of* force *to make the sound and the volume of that sound.*

a) **Activate prior knowledge**: Remind students of their listening walk and hearing a variety of sounds, some sounds were loud, others were quiet. Think to yourself silently: Where have you seen or heard the word volume before? Give think time. Turn-and-talk.

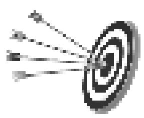
Mini-Lesson

b) **Introduce concept of volume** *(direct instruction)***:** Use the short video clip (less than 1 minute) to introduce the term volume. Add this to the word wall with the simple definition -- *Volume is how loud or soft a sound is. Loud sounds have more energy than soft sounds*.



Science Word

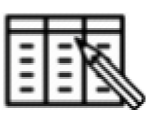
c) **Pose learning target or today's question.** Tell students that today, they will explore loud and soft sounds using knocking, stomping, and clapping to figure out how the amount of force affects the volume. *How does the amount of force change volume?*



Learning Target

Clarify the term *force*. Say something quick like: *Force means how hard or soft you push or pull on something. A gentle tap as less force than a hard hit.* Have students practice with more/less force by tapping the floor or clapping their hands and saying "less force" (light clap) "more force" (hard clap). They will need to know the idea of more and less force for their exploration.

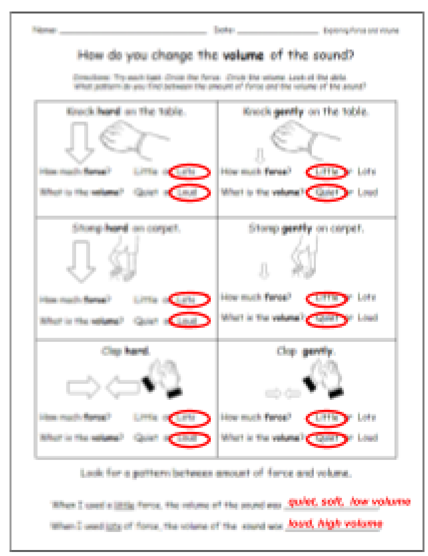
2) Explore: Force and volume



Collect data

Depending on your students' reading ability, students could self-guide through the student exploration task. Ideally students would work on this without much teacher guidance. But it can also be a guided whole-class task. After students observed using more or less force in knocking, stomping, and clapping and recorded their data, ask them to look for patterns. *What patterns do you see between how much force you used and the volume of the sound?*

Turn-and-Talk



How do you change the volume of the sound?

Knock hard on the table.
Knock gently on the table.
Stomp hard on carpet.
Stomp gently on carpet.
Clap hard.
Clap gently.
Look for a pattern between amount of force and volume.
quiet, soft, low volume
loud, high volume

Modeling Task

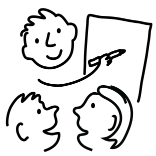
On the back of the sheet or in their notebooks, students make decisions about how they want to draw a model showing volumes from a clap, stomp, and knocks made with less or more force using one of the representations of sound (see chart from lesson 2). Let students figure out how to show louder volume or softer volume using that symbol.

Possible ways students use symbols to show volume:

- size *(bigger=louder, smaller= quieter)*
- quantity *(more of a symbol = louder)*
- color *(red = louder, blue = quieter)*
- numerals *(high number = high volume)*

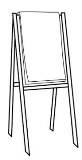
Students come up with their own ways. Ask them to explain or show how they put volume in their model.

3) Summarize: Model Share and Summarize Learning



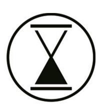
Share and Compare

a) *Modeling moment:* Have students share models with each other. This could be in partners or having a few students share with the whole group. Keep asking students: *How did you choose to draw sound? What did you do to show volume? How can we tell it's a loud sound or quiet sound from your model?* There are many possible solutions to modeling this. Press students to explain how they show volume.



Summary Chart

b) *Summarize learning*: Do a quick chart with student input to wrap up the lesson. *(If time is short, this is something you can create partially, show students tomorrow and ask them to add or revise it).*
   - Activity: What did we do today? Sketch with a note
   - Learning: What did we figure out? A few phrases, maybe a sketch or model; What new words? Volume means how loud or soft a sound is
   - Connection: How does this help us explain the kitchen drummer?



Lesson Closing

Have students turn in student sheets or notebooks if you did not have a chance to circulate and observe how students are thinking about and modeling volume. Review the definition of volume from today's lesson and then take a brain break with Go Noodle [Make Some Noise](#) *(3:19)*

Post-Lesson: Analyze Student Work

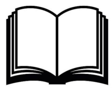
Take 5 minutes to reflect about your students' models about volume and how they talked about force and volume today. Here are some prompts to get started:

- Which students expressed their understanding of the pattern between force and volume? Verbally? In their model? Both? *(Analyzing data, Communicating ideas)*

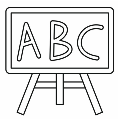
- How did students show different volumes in their model? *(Developing and using models)*

- Which students shared their models today? Who might you prepare to share in the next lesson? What scaffolds or supports do students need to be successful with modeling and sharing publicly? *(Developing and using models; Equitable participation; Student voice)*

Optional: Math Connection & Extension -- How do we measure volume?



Read for information



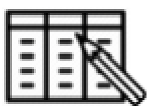
Science Word

1) Frame: Introduce decibels

a) Connect back to the definition of volume from lesson A1. Tell students that just like we can measure things like height, weight, distance, and time, we can also measure the volume of sound.

b) Read selected pages to introduce the concept of decibels to students. *Book: Sounds All Around by Wendy Pfeffer p.28-32*

Watch Video



Collect or Analyze data

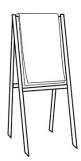
2) Explore: What does ____ decibels sound like?

- Watch this video with different examples of decibel levels (4:25)
- Try whisper, hum, talk, and yell with the Noise O'Meter on Scratch to see how many decibels the sounds students can make as a class. Make a chart.
- *Partner classroom option*: Work with an older grade. Measure sounds around the building with a decibel meter. Record and graph sounds. What are the quietest spaces? Loudest spaces? Did students find any problem areas with noise they could problem-solve to engineer solutions?

Questions to ask:

- *Which sounds are loudest? Quietest?*
- *How many decibels louder is X than Y?*
- *How much quieter is Y than X?*
- *What are you wondering about measuring sound?*

Students might notice that the distance from the source of the sound matters in measuring it. This relationship between volume, amount of energy, and distance is a key relationship explored in upper grades.

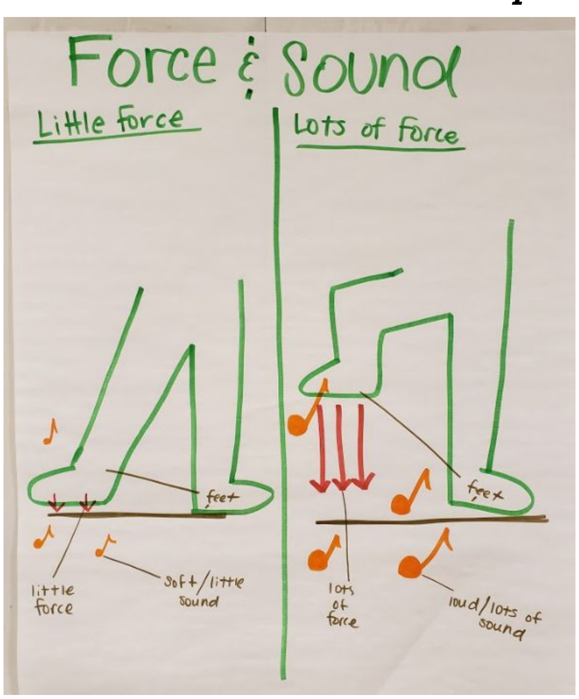


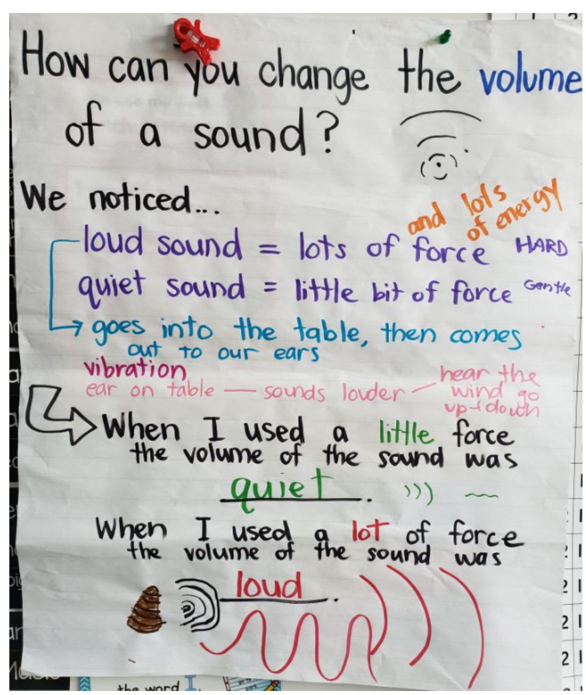
Summary Chart

3) Summarize: Add to the summary chart

Ask students to share some new learning from this extension and add it to a summary chart about understanding volume started in the first part of this lesson.

Class chart examples created from Lesson 3



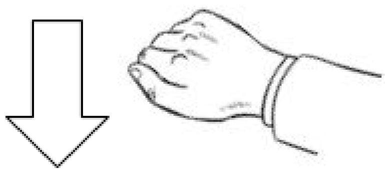


Name: ______________________________ Date: ________________ Exploring Force and Volume

How do you change the **volume** of the sound?

Directions: Try each task. Circle the force. Circle the volume. Look at the data.
What pattern do you find between the amount of force and the volume of the sound?

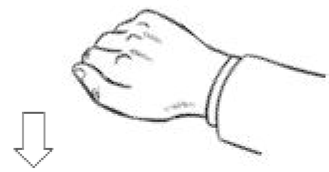
Knock **hard** on the table.



How much **force**? Little or Lots

What is the **volume**? Quiet or Loud

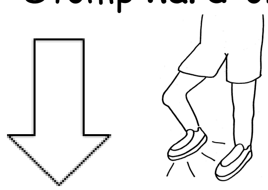
Knock **gently** on the table.



How much **force**? Little or Lots

What is the **volume**? Quiet or Loud

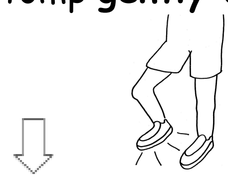
Stomp **hard** on carpet.



How much **force**? Little or Lots

What is the **volume**? Quiet or Loud

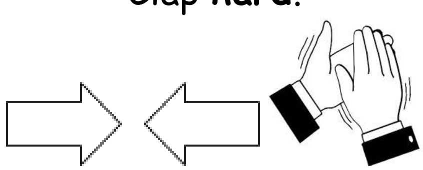
Stomp **gently** on carpet.



How much **force**? Little or Lots

What is the **volume**? Quiet or Loud

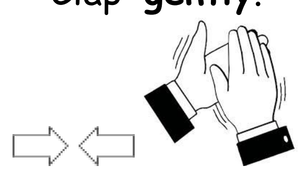
Clap **hard**.



How much **force**? Little or Lots

What is the **volume**? Quiet or Loud

Clap **gently**.



How much **force**? Little or Lots

What is the **volume**? Quiet or Loud

Look for a pattern between amount of force and volume.

When I used a <u>little</u> force, the volume of the sound was __________________.

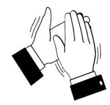
When I used <u>lots</u> of force, the volume of the sound was __________________.

Model your science thinking about **volume** and **force**.

Which will you explain? Circle one.

knock

stomp



clap

1. Draw the knock, stomp, or clap.
2. How will you draw sound?
3. How will you show in your picture if the sound is loud or quiet?

Lots of force	***Little force***

Lesson 4 - Feeling Vibrations

Purpose

In this lesson, students will learn about vibrations and how vibrations relate to volume. This extends lesson A1 where students observed a relationship between force and volume. Here students will notice that more force makes stronger vibrations which makes a louder sound.

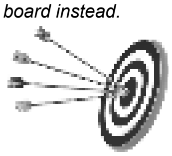
Responsibilities

Teacher's primary responsibilities:
- Introduce science concept
- Ask questions about what students observe and about their models
- Update public record with student input to summarize learning

Students' primary responsibilities:
- Look- and listen-to-understand new science terms
- Make observations. Collect data
- Find patterns in the data about vibrations and volume
- Share ideas about vibrations using pictures and words

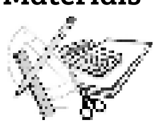
Learning Target

You do not need to post a target. But could pose a question on the board instead.



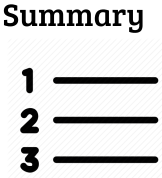
I can **make observations** and **find patterns** about **vibrations** and **volume** of **sounds**.

Materials



- ➢ Reading that features information vibrations, such as:
  - [How Does Sound Change?](#) by Robin Johnson pp 4-7
  - Rookie Read About Science All About Sound by Lisa Trumbauer pp 3-21
- ➢ Student sheet ([link](#))
- ➢ Per group of 3 students:
  - 1 flexible shatterproof ruler
  - 1 tuning fork
- ➢ Related Dance Move Body Awareness [Learn to Vibrate](#) (2:06)

Lesson Steps Summary



1) **Frame:** Purpose of today's lesson, building on student idea and/or answering question related to vibrations. Introduce the concept of vibrations through selected pages of a text with turn-and-talk and ruler twang demonstration.

2) **Explore:** Vibration Observations. Look for patterns in the data. How does the force relate to the vibrations and the volume of the sound? Is this always true? Model-to-explain your results.

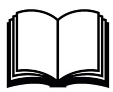
3) **Summarize:** Create a short summary chart about what students did, what they figured out from the exploration. *Wrap-up with vibration dance move tutorial* [Learn to Vibrate](#) (2:06)

Lesson Steps

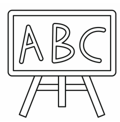
1) Frame: Introduce the concept of vibration

Turn-and-Talk

a) **Activate prior knowledge**: Do a demonstration. Place 1 flexible shatterproof ruler on the edge of a desk. Hold one end down on the desk and use your other hand to “twang” the ruler. Students can see and hear it. Repeat. Have students observe and then turn-and-talk about what they see and hear. Note student language (wiggle, flexing, back-and-forth, moving up-and-down) and build from their language in the next part to introduce the science word.

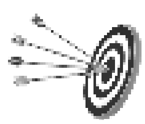


Read for information



Science Word

b) **Introduce concept of vibration** *(direct instruction)***:** Introduce new science term *vibration* building on student language in turn-and-talks you heard. Then, read a few pages of a selected text that teaches about vibration (but does not go into how sound travels, yet, that is in a future lesson). *For example, pages 4-7 of How Does Sound Change? By Robin Johnson.* Add this to the word wall with the simple definition, such as -- *Vibration is when something moves back and forth. Vibrations can make sounds.*



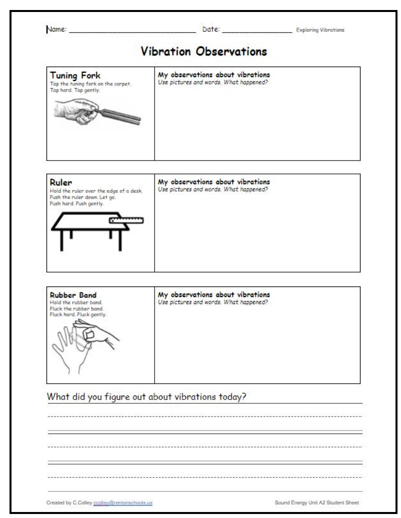
Learning Target

c) **Pose learning target or today’s question.** Tell students that today, they will observe vibrations with their eyes, ears, and hands. Remind them to continue thinking about force and volume from the prior lesson because vibrations, forces, and volume all work together to help us understand how sounds happen. ***How does the amount of force change the vibration? How does the amount of force change the volume of a sound?***

2) Explore: Vibrations and volume

Record Observations

Each group of students shares 1 tuning fork, 1 flexible shatterproof ruler, and 1 rubber band. Students take turns with materials and tap, pluck, and twang these objects and write about and/or draw observations on the student sheet (or make 3 row table in notebook).
Note: Tuning fork works best when: Hold bottom gently, turn on its side, tap one prong on the carpet, listen/feel.



Name: ______ Date: ______ Exploring Vibrations

Vibration Observations

Tuning Fork Tap the tuning fork on the carpet. Tap hard. Tap gently.	**My observations about vibrations** *Use pictures and words. What happened?*
Ruler Hold the ruler over the edge of a desk. Push the ruler down. Let go. Push hard. Push gently.	**My observations about vibrations** *Use pictures and words. What happened?*
Rubber Band Hold the rubber band. Pluck the rubber band. Pluck hard. Pluck gently.	**My observations about vibrations** *Use pictures and words. What happened?*

What did you figure out about vibrations today?

Created by C.Colley ccolley@rentonschools.us Sound Energy Unit A2 Student Sheet

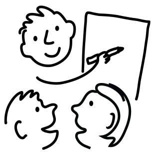
In the drawing space, encourage students to use representations of sound and other symbols to show vibrations and how they are different if they tap, pluck, or twang with more force (hard) or less force (gently).

How does that affect the amount of vibration?

How does that affect the volume of the sound?

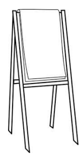
Students write at least one sentence (can also use back of page) about their observations.

3) Summarize: Summarize Learning



Share and Compare

a) *Partner Share:* Have students share observations with each other using what they wrote/drew in the recording sheet (or their notebooks). This could be in partners or having a few students share with the whole group. Keep asking students: *How does the amount of force change the vibration? How does the amount of force change the volume of a sound?*



Summary Chart

b) *Summarize learning*: Do a quick chart with student input to wrap up the lesson. *(If time is short, this is something you can create partially, show students tomorrow and ask them to add or revise it).*
   - Activity: What did we do today? Sketch with a note
   - Learning: What did we figure out? A few phrases, maybe a sketch or model; What new words? Vibration means something moves back and forth. Vibrations can make sounds.
   - Connection: How does this help us explain the kitchen drummer?

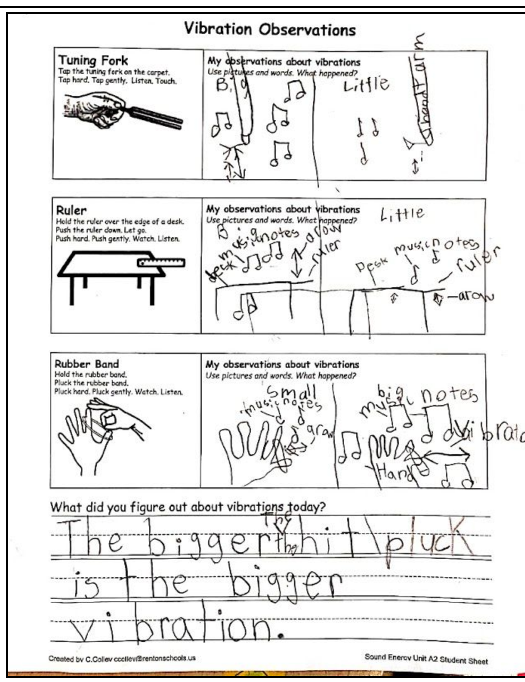
Lesson Closing

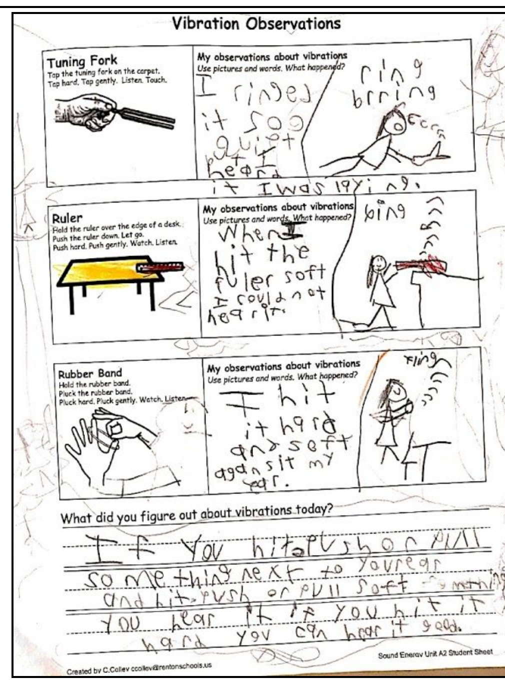
Have students turn in student sheets or notebooks if you did not have a chance to circulate and observe how students are thinking about and modeling volume. Review the definition of vibration from today's lesson and then take a brain break with vibration dance move tutorial [Learn to Vibrate](#) (2:06)

Post-Lesson: Analyze Student Work

Take 5 minutes to reflect about your students' observations and conclusions about force, vibrations, and volume from today. Here are some prompts to get started:

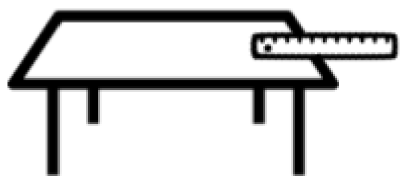
- Which students expressed their understanding of any patterns between force, vibrations, and volume? Verbally? In their model? Both? *(Analyzing data, Communicating ideas)*
- How did students show different vibrations in their drawing? *(Developing and using models)*
- Which students shared today? Who might you prepare to share in the next lesson? What scaffolds or supports do students need to be successful with modeling and sharing publicly? *(Equitable participation; Student voice)*

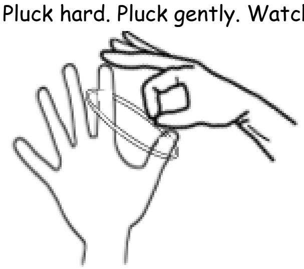




Vibration Observations

Tuning Fork Tap the tuning fork on the carpet. Tap hard. Tap gently. Listen. Touch. 	**My observations about vibrations** *Use pictures and words. What happened?*

Ruler Hold the ruler over the edge of a desk. Push the ruler down. Let go. Push hard. Push gently. Watch. Listen. 	**My observations about vibrations** *Use pictures and words. What happened?*

Rubber Band Hold the rubber band. Pluck the rubber band. Pluck hard. Pluck gently. Watch. Listen. 	**My observations about vibrations** *Use pictures and words. What happened?*

What did you figure out about vibrations today?

Lesson 4 Create - Balloon Bongos

Purpose

In this lesson, students will create and decorate their very own balloon bongo then play it and describe the sounds using ideas about force, volume, and vibrations from lessons A1 and A2. *(Music & Art integration)*

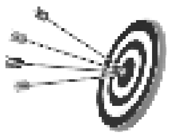
Responsibilities

Teacher's primary responsibilities:
- Provide materials and steps for how-to construct bongo drum
- Prompt and press to hear students' ideas about force, vibration, and volume

Students' primary responsibilities:
- Create own balloon bongo drum
- Play their bongo. Write algorithm.
- Describe how bongo works using force, vibration and volume concepts

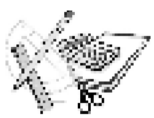
Learning Target

You do not need to post a target. But could pose a question on the board instead.



I can **explain** how my **drum** makes **sound** using what I know about **force**, **vibration**, and **volume**.

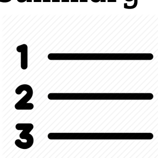
Materials



- ➢ Video: Do it yourself balloon bongo drum video (5:34)
- ➢ Materials for a drum per student:
  - scissors, glue, markers
  - 1 tin can or round empty container
  - 1 rubber band
  - 1 handful dried beans
  - 1 balloon
  - construction paper and/or colored tape

Make a bongo for yourself ahead of time to see places your students may have trouble. Some materials may need prep ahead of time and/or partner power! Consider this art/science project for class buddies to do together! (older/younger)

Lesson Steps Summary



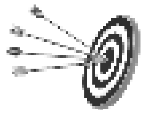
1) **Frame:** Purpose of today's lesson is putting together our knowledge about force, vibrations, and volume by making our own drum. Show students the do-it-yourself video directions.

2) **Explore:** Make and decorate bongos. Play them. Make up rhythms at different tempos. Write an algorithm (song) using symbols for shake and tap to tell someone how to play it.

3) **Summarize:** Ask students to explain how their drums make sound. How do they make loud sounds? Soft sounds? Remind students to use what they have learned about force, vibration, and volume in their explanations. *(Choose explanation format: Partner share, Seesaw recording, and/or sketch/explain in notebooks)*

Lesson Steps

Turn-and-Talk



Learning Target

1) Frame: Pulling together our learning so far to play our own drum!

a) **Activate prior knowledge**: Remind students of prior concepts using the word wall and/or summary chart from prior activities. Have students turn-and-talk about something they remember about force, vibrations, or volume. *What did they do? What do those words mean?*

b) **Pose learning target or today's question.** Tell students that today, they will make their own drum, play it, and explain how it works using what they have been learning about force, vibration, and volume.

Create

Partner Perform

2) Explore: Make and decorate bongo

a) Use the video to show students how to make the drum. Pause video at 3:00 after directions. Have students use the materials, work together, and create their balloon bongos.

b) Algo"rhythm": Students can write their own algorithm of a rhythm. Provide easy-to-draw symbols, such as a letter "S" for shake, "T" for tap, "P" for pluck (pluck by gently pinching the balloon in the middle pulling up a little and releasing). Trade your algorithms and perform for partners, checking and "debugging" the algorithm performance.
For example: **S S T P P** *means 2 shakes, 1 tap, 2 plucks.*
Use a loop for efficiency: Instead of S S S S S S S S T T P what could we write to show we want 8 shakes instead of writing S 8 times?

Turn-and-Talk

3) Summarize: Explain how the drum works

a) *Partner Share:* Have students explain to each other how their drum works. Remind students to use what the know about force, vibration, and volume.
- *How can the drum make loud sounds? Quieter sounds?*
- *Are all our bongos the same size? Do different size bongos make different sounds? Is there a pattern between the size of the bongo and its sound?*

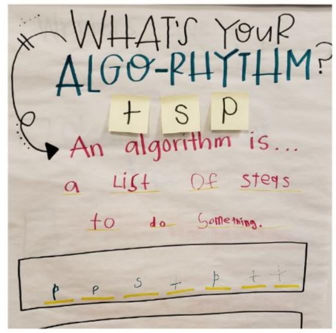
Optional: Modeling Task & Explanation

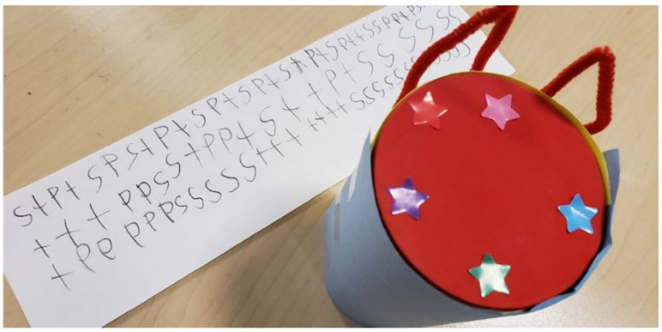
b) Optional assessment: Students can publicly share their explanations in various ways like a Seesaw video, a partner interview, or a written/drawn model in their notebooks. Encourage students to talk about forces, vibrations, and volumes or how they wrote their rhythm algorithm. Not just using the words but explaining and showing patterns.

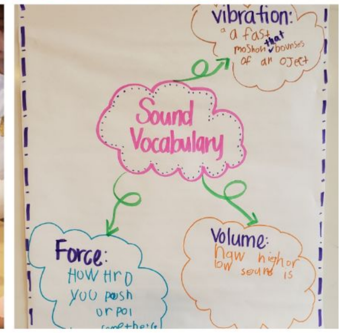
Lesson Closing

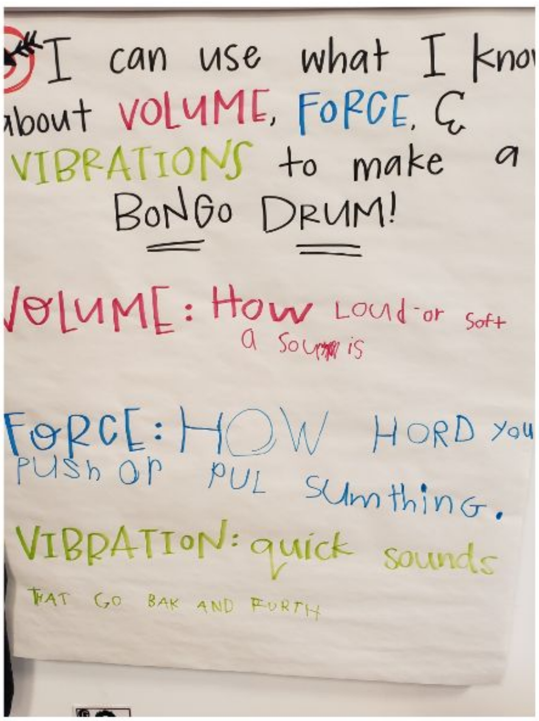
Wrap up today with a drum circle. Have students sit at the carpet at their spots or in a circle. Share their algorithm strips under the document camera for everyone to read and play together! Or it can be a call-and-respond rhythm that goes around the circle. The author of the algorithm sets the tempo and everyone else must follow with that student. Rotate students.

Lesson Photos









[This page intentionally left blank.]

Lesson 5 - Vibrations Travel

Purpose

Students learn how vibrations travel through air. Then, students use what they have learned so far about the amount of force and strength of vibration that would explain how far the sound travels.

Responsibilities

Teacher's primary responsibilities:

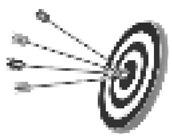
- Introduce science concept that matter is made of particles
- Ask questions about what students observe
- Update public record with student input to summarize learning

Students' primary responsibilities:

- Look- and listen-to-understand new science terms
- Make observations. Collect data
- Find patterns in the data about the volume of the sound
- Share ideas about vibrations using pictures and words

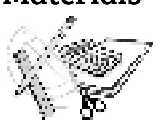
Learning Target

You do not need to post a target. But could pose a question on the board instead.



I can **make observations** and **find patterns** about **wood** and **air** and the **volume** of **sounds**.

Materials



- ➢ Student recording sheet (link) or notebook
- ➢ Room with a door that opens and closes
- ➢ Video: SciShow What is sound? (3:57)
- ➢ Variety of objects per group: marbles, dominoes, pom-poms, other materials to physically model sound wave through air

Lesson Steps Summary

1) **Frame:** Purpose of today's lesson, building on student idea and/or answering question related to hearing sound through walls/doors/floors (how noise travels). Introduce idea that matter, specifically air, is made of particles using SciShow video.

2) **Explore:** Sound observations through the air and through the solid (open/closed door demo). Why is it easier to hear when the door is open not closed? Use the idea the matter is made of particles to model-to-explain observations about sound through open/closed doors. Students create physical and drawn models.

3) **Summarize:** Create a short summary chart about what students did, what they figured out from the demonstration and the video about how sound travels through air and any critiques about model features for showing this natural phenomenon.

***Optional Extension**:* Tour the school building. Look for places that are typically loud (i.e. cafeteria, covered basketball court) and places that are typically quiet (i.e. library). What substances are in the room that help block (quiet) or move (loud) the sound? Brainstorm a list of problems and sketch out solutions to sound-related problems in the school building.

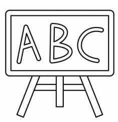
Lesson Steps

1) Frame: Extend students' understanding of how vibrations travel by introducing the idea that matter is made of particles

a) *Connect to student idea or question:* Identify and recall a student idea and/or question related to hearing sound through walls/doors/floors (how noise travels). Tell students that today will learn more about how vibrations travel and we can hear sound.


Video


Turn-and-Talk

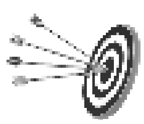

Science Word

b) *Introduce concept that air is made of particles (direct instruction)*: Introduce idea that matter is made of particles using the SciShow video (3:57).

i) Before watching: Tell students the video reviews the idea of vibration, teaches us about how sound travels through air since we can't see it, and shows a little bit about how ears hear sounds. Then, say something like: "*Let's review a little bit about particles. Take a deep breath in and hold it. You just breathed air particles like oxygen and nitrogen. Now, breathe out. You just breathed out air particles, like carbon dioxide.The video talks about particles in the air so watch and listen to how air helps move sound.*"

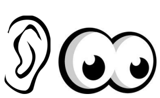
ii) During watching: Pause 1-2 times and have students turn-and-talk: *What has the video told us so far about sound?*

iii) After watching: Re-watch portions and use input from students to define new science word(s) such as air *(invisible gas made mostly of oxygen and nitrogen particles)* and sound wave *(vibration of particles moving in a pattern).*


Learning Target

c) *Pose learning target or today's question.* Tell students that today, they will listen to how sound travels through a few different things and use what they know about particles to explain how it travels. *How does sound travel through air?*

2) Explore: Hallway Clapping


Observe

a) Observe clapping

Have one student clap in front of the class. Then go to the hallway, leave the door open, and clap again. Repeat with the door closed. Ask questions (at right) to make observations.


Turn-and-Talk

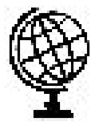
Remind students to use ideas from the video about particles in the air and how sound travels through the air by bumping or moving particles.

Door OPEN, loud clap:

- Can we hear the clap? *Yes.*
- Does it sound as loud as the clap next to us? *Kinda. No. Not really. A little quieter.*
- How come we can hear the clap from the hallway when we are all the way here? Turn-and-talk.

Door CLOSED, loud clap:

- Now, can we still hear the clap? *Kinda, much quieter.*
- How come we can hear the clap even through the door is closed? Turn-and-talk.



Develop & Compare physical models

b) Physical model using objects

Remind students that we can't see sound traveling through the air but we know it's there because we can hear it. Have students work in partners or triads to use a collection of objects to show how the sound of the clap from the student moves through the air. (*Optional: Replay the portion of the SciShow video that used marbles and dominoes to show how sound interacts with particles.)*

Circulate and ask:

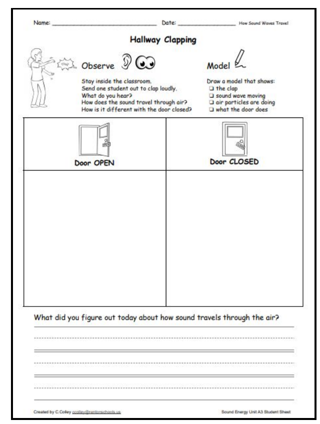
- How does your model show air particles?
- How does your model show how sound wave of the clap moving?
- How is your model the same or different than one you saw in the video.

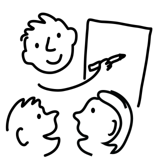
Some students may replicate models from the video putting it into their own words, while others may make different models. Have groups pair up and tell each other about their models. How did they show sound? How did they show air?

Draw a Model

c) Drawn Model

In the [drawing space](), encourage students to use representations of sound and other symbols (arrows, colors) to show air particles, sound wave, and how the door changes the sound. Students write at least one sentence (also use back).

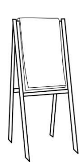




Share and Compare

3) Summarize: Summarize Learning

a) *Partner Share:* Have students come to the carpet and partner what they wrote/drew in the recording sheet (or their notebooks) about modeling the sound wave of the clap traveling through the air.



Summary Chart

b) *Summarize learning*: Do a quick chart with student input to wrap up the lesson. *(If time is short, this is something you can create partially, show students tomorrow and ask them to add or revise it).*
   - Activity: What did we do today? Sketch with a note
   - Learning: What did we figure out? A few phrases, maybe a sketch or model; What new words? Particles are too small to see but they are in the air, tables, doors, all around us and make up the stuff around us..
   - Connection: How does this help us explain the kitchen drummer?

Lesson Closing

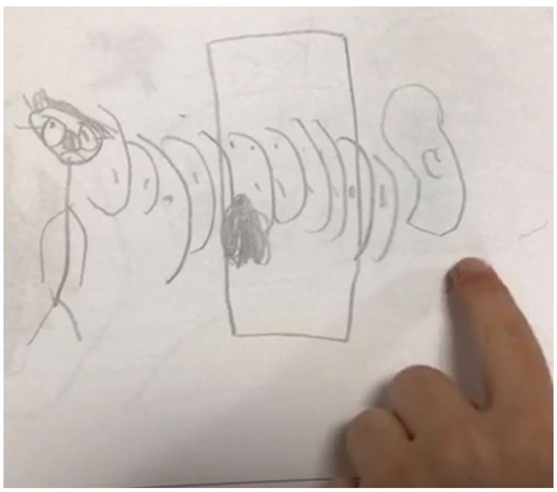
Review the definition of air and/or sound wave from today.
Have students turn in student sheets or notebooks if you did not have a chance to circulate to check on how students are thinking about and modeling sound waves.

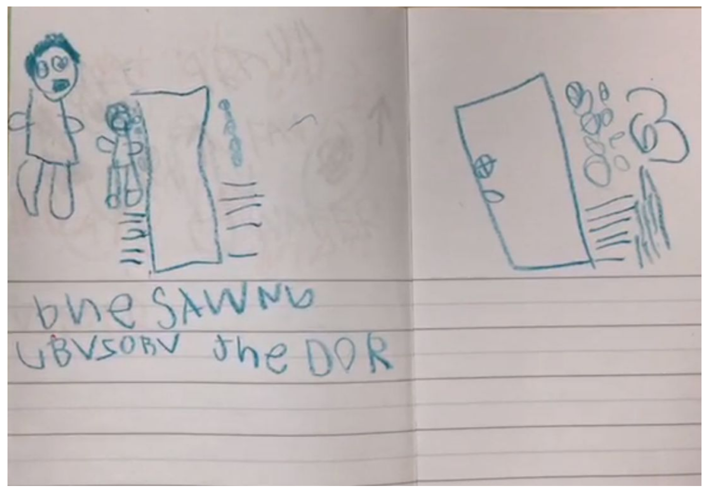
Post-Lesson: Analyze Student Work

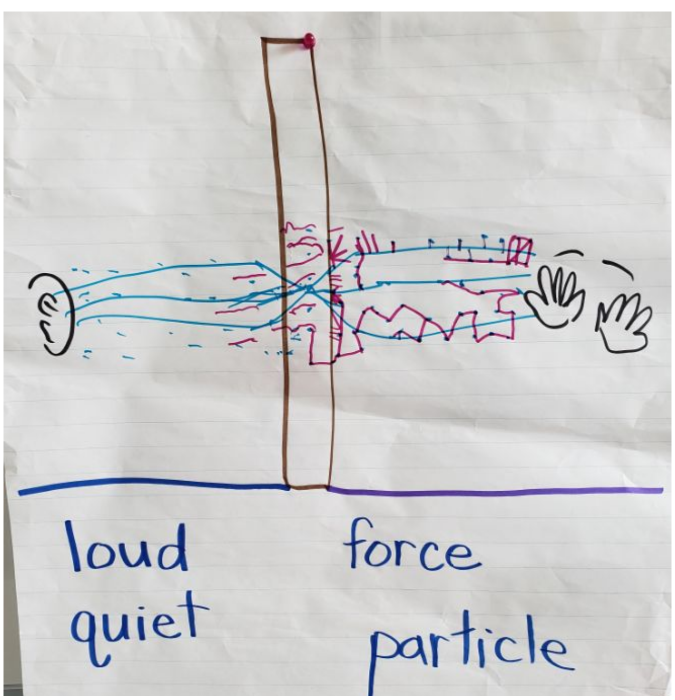
Take 5 minutes to reflect about your students' observations and conclusions about air particles, sound waves, and how students modeled their understanding. Keep in mind that at this grade level, students just need to know *that* sound travels from one place to another through vibrations. Students who applied knowledge of the particulate nature of matter are demonstrating understanding beyond grade level so don't worry too much if not every student finds this knowledge useful in their thinking just yet.

- Which students expressed their understanding that air is made of particles that move differently when there is sound? (*Communicating ideas)*
- How did students show different motions of particles in their drawing? *(Developing and using models)*
- Which students shared today? Who might you prepare to share in the next lesson? What scaffolds or supports do students need to be successful with modeling and sharing publicly? *(Equitable participation; Student voice)*

Photos from Lesson 5







TOP: One class had students draw individually about what they heard and how they thought it worked. This student drew observations with the door open and closed and if they could hear the sounds.

LEFT: In another class students worked on a class model to explain what they heard. They drew the ear to represent the listeners and the hands to show the clapper. The large brown rectangle is the door. They started with the blue lines to show sound going through the door and coming out the other side. Then added in particles. The sound helps connect the particles to bump into each other, shown by the blue and pink lines.

Hallway Clapping

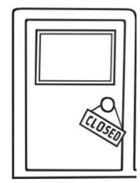
Observe

Stay inside the classroom.
Send one student out to clap loudly.
What do you hear?
How does the sound travel through air?
How is it different with the door closed?

Model

Draw a model that shows:

- ❏ the clap
- ❏ sound wave moving
- ❏ air particles are doing
- ❏ what the door does

 **Door OPEN**	 **Door CLOSED**

What did you figure out today about how sound travels through the air?

____

____

____

[This page intentionally left blank.]

Lesson 5 Create - Make a String Thing

Purpose

In this lesson, students will create string phones or a laughing cup to observe more about how vibrations create sounds and how sounds travel. *(Music & Art integration).*

Responsibilities

Teacher's primary responsibilities:

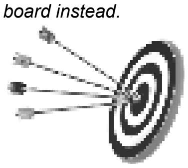
- Provide materials and steps for how-to construct the string phone and/or laughing cup
- Prompt and press to hear students' ideas about force, vibration, volume, and how sound travels in the device (phone/cup) students make.

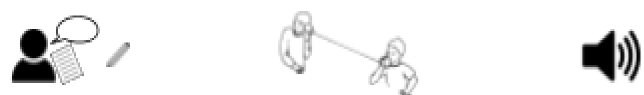
Students' primary responsibilities:

- Create own string phone and/or laughing cup.
- Make observations about how their string phone and/or laughing cup works.
- Describe how phone and/or cup cup using ideas about force, vibration, particles, and sound waves.

Learning Target

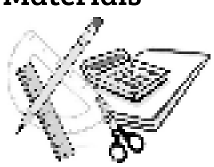
You do not need to post a target. But could pose a question on the board instead.





I can **explain** how my **device** makes **sound** using what I know about **vibrations**, **particles**, and **how sound travels**.

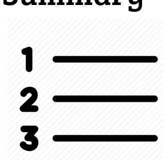
Materials



Decide if students will make a string phone, laughing cup, or spend two lessons and make both!

- Materials for laughing cup:
  - Video: [Laughing Cup]
  - 1 cup
  - 1 paper clip
  - String or yarn
  - Scissors
  - markers/crayons to decorate
- 1 awl or ice pick for pre-punching holes in cups (adult-use only)
- Materials per each string phone:
  - Video: [Make a string phone]
  - 2 cups
  - Length of yarn, pre-cut
  - *Optional: 2 paper clips for holding the knots better*

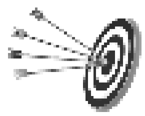
Lesson Steps Summary



1) **Frame:** Purpose of today's lesson is to create a device that uses what we've learned about vibrations, volume, force, and how sound travels in waves.
2) **Explore:** Make and decorate device (string phone or laughing up). Explore how it works. What works well? What doesn't work? Discuss some "What if…?" questions about the design.
3) **Summarize:** Ask students to explain how their devices work. Remind students to use what they have learned about force, vibration, volume, and how matter is made of particles in their explanations. *(Choose explanation format: Partner share, Seesaw recording, and/or sketch/explain in notebooks)*

Lesson Steps

Turn-and-Talk



Learning Target

1) Frame: Pulling together our learning so far...

Activate prior knowledge: Remind students of prior concepts using the word wall and/or summary chart from prior activities. Have students turn-and-talk about something they remember about force, vibrations, volume, air particles, and/or sound waves. *What activities have they do so far? What do those words mean?* Use summary charts to remind students of all they have done so far.

Pose learning target or today's question**.** Tell students that today, they will make their own device, play it, and explain how it works using what they have been learning about how sound is made and how it travels.

Create

2) Explore: Make and decorate laughing cup and/or string phone.

Use the video to show students how to make the device. Have students use the materials, work together, and create their device.

If students made a laughing cup:

Have students try them out and share what they notice about when/how it works and how they can make different sounds.

- What happens if someone else holds the string when you're trying to use it?
- What happens if the string gets dry?
- What might happen if we used a different kind of yarn or string?
- What might happen if we used a bigger cup?

If students made phones:

Have students try them out.

- What happens if you keep the string tight/taut? Loose?
- What might happen if we used different sized cups?
- What might happen if we used a longer string? Shorter string?

Turn-and-Talk

Lesson Closing

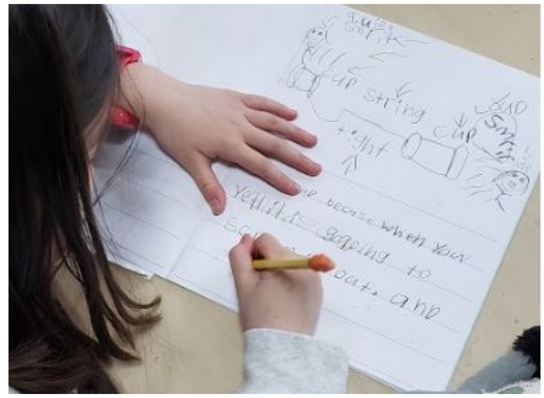
3) Summarize: Explain how the device works

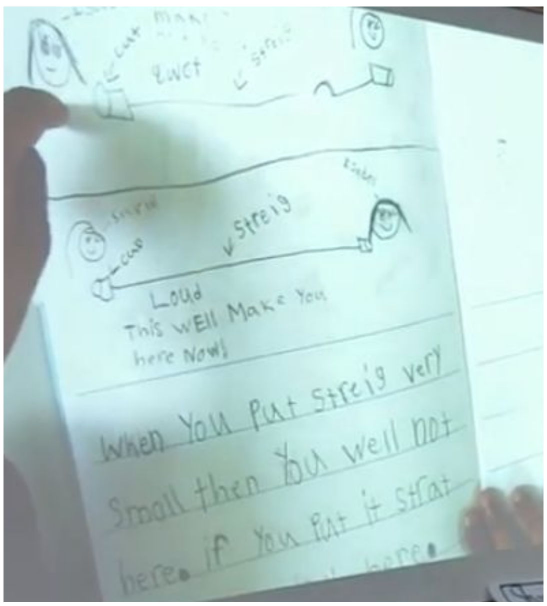
Partner Share: Have students explain to each other how their device works. Remind students to use what the know about force, vibration, volume, particles, and how sound travels.

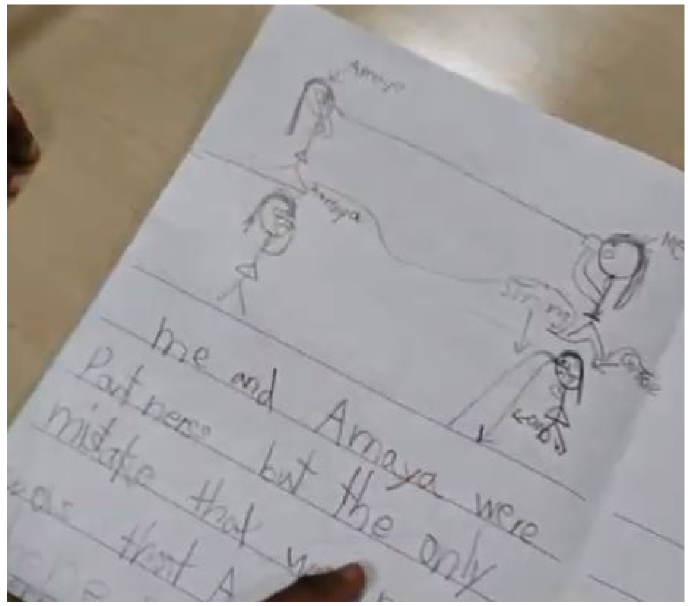
Have students think and share one thing: a comment, compliment, question, something they might want to try next or wondering. Quick share in a big circle.

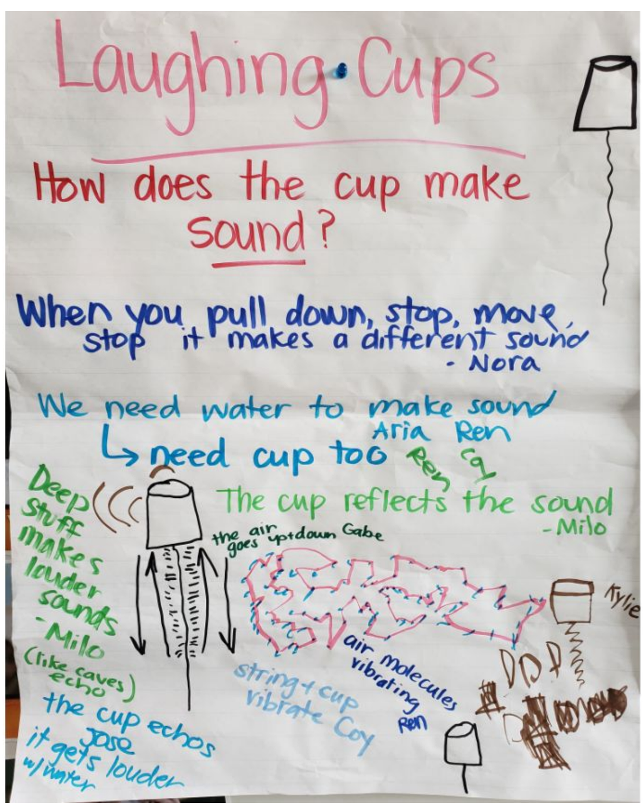
Optional extension*: If students suggest plausible things to try, this could lead into an extension of this lesson to test-and-observe*.

Lesson Photos of string phones and/or laughing cups









[This page intentionally left blank.]

Lesson 6 - Size and Pitch

Purpose

Students observe patterns between the size of the object and the pitch of the sound to notice that knowing the size of the object can be used to predict what sound it makes when vibrated.

Responsibilities

Teacher's primary responsibilities:

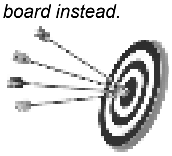
- Introduce science term pitch and provide examples
- Ask questions about what students observe and what patterns they find
- Update public record with student input to summarize learning

Students' primary responsibilities:

- Look- and listen-to-understand new science term
- Make observations. Collect data
- Find patterns in the data about the size of the vibrating part of an object and pitch
- Share ideas about vibrations using pictures and words

Learning Target

You do not need to post a target. But could pose a question on the board instead.

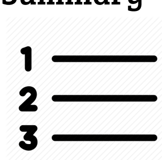


I can **make observations** and **find patterns** about **size** of the object and **pitch** of a **sound**.

Materials

- ➢ Student recording sheet (link) or notebook
- ➢ Reading: pgs 12-13 of How Does Sound Change? By Robin Johnson (Project these pages link or print reading strips for each student)
- ➢ Video: What is pitch? (5:16)
- ➢ Per group:
  - 2 Tuning forks (different sizes)
  - 1 shatterproof plastic rulers
  - 1 rubber band
- ➢ *Optional: Brain Break GoNoodle Weird Sounds (2:24)*

Lesson Steps Summary



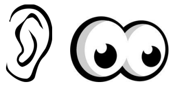
1) **Frame:** Purpose of today's lesson, building on student idea and/or answering question related to different notes or pitches of sounds. Introduce the science term pitch using the reading and/or video.

2) **Explore:** Size and Pitch Observations. Look for patterns in the data using rulers, tuning forks, and rubber bands. How does the size of the vibrating portion of the object relate to the pitch of the sound? Is this always true? Draw a model of the sound wave and how it the picture changes to communicate low pitch compared the high pitch. Could a reader mis-interpret the drawing as showing volume not pitch? How can we show that difference, too?

3) **Summarize:** Create a short summary chart about what students did, what they figured out from their observations and the video about how size of the object vibrating relates to pitch.

Lesson Steps

1) Frame: Introduce the concept of pitch

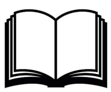


Observe

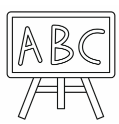
a) Activate prior knowledge**:** Do a demonstration. Place 1 flexible shatterproof ruler on the edge of a desk. Hold one end down on the desk and use your other hand to “twang” the ruler. Students can see and hear it. Repeat but move the ruler so there is more or less hanging over (size of vibrating part changes). Have students observe and then turn-and-talk about what they see and hear. Note student language (wiggle, flexing, back-and-forth, moving up-and-down) and build from their language in the next part to introduce the science word pitch.

Turn-and-Talk

b) Introduce concept of pitch *(direct instruction)***:** Introduce new science term *pitch* building on student language in turn-and-talks you heard from the ruler demonstration. Then, read a few pages of a selected text that teaches about vibration (but does not go into how sound travels, yet, that is in a future lesson). *For example, pages 12-13 of How Does Sound Change? By Robin Johnson or reading strip for each student to partner read or follow-along.* Add this to the word wall with the simple definition, such as -- *Pitch is how high or low a note sounds.* Also, you can use this video that more slowly goes through the idea of pitch as high and low notes.

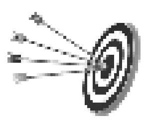


Read for information



Science Word

c) Pose learning target or today’s question. Tell students that today, they will observe the relationship between the speed of vibrations and the pitch of the sound. ***How does the speed of the vibration relate to the size of the object and the pitch of the sound?***

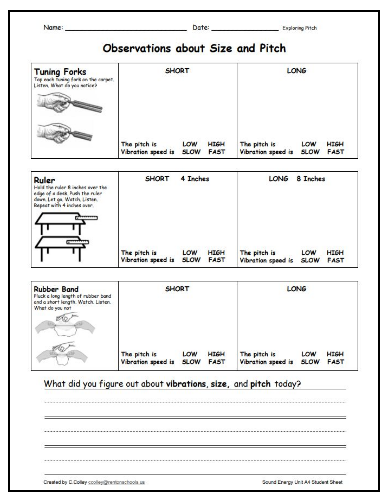


Learning Target

2) Explore: Size and Pitch

Record Observations

Each group of students shares 2 tuning forks (2 sizes), 1 flexible shatterproof ruler, and 1 rubber band. Students take turns with materials and tap, pluck, and twang these objects and write about and/or draw observations on the student sheet (or make 3 row table in notebook). *Note: Tuning fork works best when: Hold bottom gently, turn on its side, tap one prong on the carpet, listen/feel.*


Name: ____________ Date: ________ Exploring Pitch

Observations about Size and Pitch

Tuning Forks Tap each tuning fork on the carpet. Listen. What do you notice?	SHORT The pitch is LOW HIGH Vibration speed is SLOW FAST	LONG The pitch is LOW HIGH Vibration speed is SLOW FAST
Ruler Hold the ruler 8 inches over the edge of a desk. Push the ruler down. Let go. Watch. Listen. Repeat with 4 inches over.	SHORT 4 Inches The pitch is LOW HIGH Vibration speed is SLOW FAST	LONG 8 Inches The pitch is LOW HIGH Vibration speed is SLOW FAST
Rubber Band Pluck a long length of rubber band and a short length. Watch. Listen. What do you not	SHORT The pitch is LOW HIGH Vibration speed is SLOW FAST	LONG The pitch is LOW HIGH Vibration speed is SLOW FAST

What did you figure out about **vibrations**, **size**, and **pitch** today?

Created by C.Colley ccolley@rentonschools.us Sound Energy Unit A4 Student Sheet

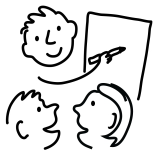
In the drawing space, encourage students to use representations of sound and other symbols to show pitch.

Students write at least one sentence (can also use back of page) about their observations.

How does the size of the object change the pitch?

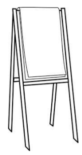
How can you draw sound to communicate low or high pitch rather than volume?

3) Summarize: Summarize Learning



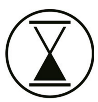
Share and Compare

a) *Partner Share:* Have students share observations with each other using what they wrote/drew in the recording sheet (or their notebooks). This could be in partners or having a few students share with the whole group. Keep asking students: *How does the size of the vibrating object relate to the pitch of the sound?*



Summary Chart

b) *Summarize learning*: Do a quick chart with student input to wrap up the lesson. *(If time is short, this is something you can create partially, show students tomorrow and ask them to add or revise it).*
  - Activity: What did we do today? Sketch with a note
  - Learning: What did we figure out? A few phrases, maybe a sketch or model; What new words? *Pitch means how high or low a note or sound is. The size of the object relates to pitch because the smaller objects made higher notes and bigger/longer objects had lower pitches.*
  - Connection: How does this help us explain the kitchen drummer?



Lesson Closing

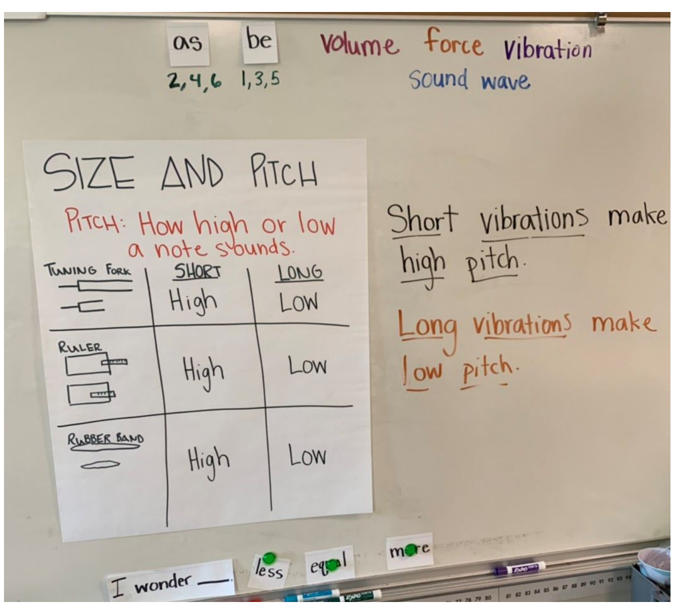
Have students turn in student sheets or notebooks if you did not have a chance to circulate and observe how students are thinking about and modeling volume. Review the definition of pitch from today's lesson and then take a brain break GoNoodle Weird Sounds (2:24).

Post-Lesson: Analyze Student Work

Reflect about your students' observations and conclusions about vibrations, size of the part of the object that is vibrating, and the pitch of the sound. Here are some prompts to get started:

- Which students expressed their understanding of any patterns between size and pitch? Verbally? In their model? Both? *(Analyzing data, Communicating ideas)*
- How did students show different pitches in their drawing of sounds?
- Which students shared today? Who might you prepare to share in the next lesson? What scaffolds or supports do students need to be successful with modeling and sharing publicly? *(Equitable participation; Student voice)*

Photos from Lesson



Pitch Perfect

Different sounds also have different pitches. Pitch is how high or low a sound is. Whistles, sirens, and screams are high sounds. Rolling thunder, hooting owls, and horns on big ships are all low sounds.

Coaches use whistles to communicate with their players. Whistles make a high sound which is hard not to hear!

Musical instruments make notes. A note is a musical sound with a certain pitch. When you strum a thin, light string on a guitar, it vibrates quickly and makes a high pitched note. When you strum a thick, heavy string, it vibrates slowly and makes a low pitched note.

Pitch changes when the motion of vibrations in sound waves speed up or slow down. When vibrations move back and forth very fast, sounds have a high pitch. When vibrations move more slowly, sounds have a low pitch.

Excerpt from pages 12-13 from How Does Sound Change? By Robin Johnson

Pitch Perfect

Different sounds also have different pitches. Pitch is how high or low a sound is. Whistles, sirens, and screams are high sounds. Rolling thunder, hooting owls, and horns on big ships are all low sounds.

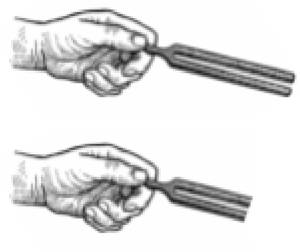
Coaches use whistles to communicate with their players. Whistles make a high sound which is hard not to hear!

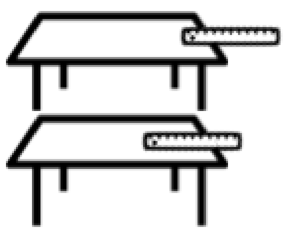
Musical instruments make notes. A note is a musical sound with a certain pitch. When you strum a thin, light string on a guitar, it vibrates quickly and makes a high pitched note. When you strum a thick, heavy string, it vibrates slowly and makes a low pitched note.

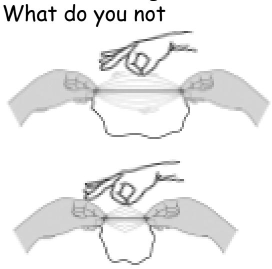
Pitch changes when the motion of vibrations in sound waves speed up or slow down. When vibrations move back and forth very fast, sounds have a high pitch. When vibrations move more slowly, sounds have a low pitch.

Excerpt from pages 12-13 from How Does Sound Change? By Robin Johnson

Observations about Size and Pitch

	SHORT	LONG
Tuning Forks Tap each tuning fork on the carpet. Listen. What do you notice? 	The pitch is LOW HIGH Vibration speed is SLOW FAST	The pitch is LOW HIGH Vibration speed is SLOW FAST

	SHORT 4 Inches	LONG 8 Inches
Ruler Hold the ruler 8 inches over the edge of a desk. Push the ruler down. Let go. Watch. Listen. Repeat with 4 inches over. 	The pitch is LOW HIGH Vibration speed is SLOW FAST	The pitch is LOW HIGH Vibration speed is SLOW FAST

	SHORT	LONG
Rubber Band Pluck a long length of rubber band and a short length. Watch. Listen. What do you not 	The pitch is LOW HIGH Vibration speed is SLOW FAST	The pitch is LOW HIGH Vibration speed is SLOW FAST

What did you figure out about **vibrations**, **size**, and **pitch** today?

[This page intentionally left blank.]

Lesson 6 Create - Straw Flute

Purpose

In this lesson, students will create straw flutes to observe more about how the size or amount of the object vibrating creates different sounds. *(Music & Science integration).*

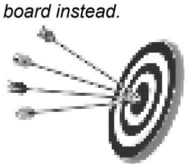
Responsibilities

Teacher's primary responsibilities:
- Provide materials and steps for how-to construct a straw flute
- Prompt and press to hear students' ideas about force, vibration, volume, pitch and how sound travels

Students' primary responsibilities:
- Create a straw flute
- Make observations about the sounds they make using their straw flute
- Describe how the straw flute works and how it makes different pitches

Learning Target

You do not need to post a target. But could pose a question on the board instead.

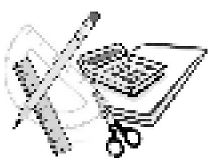



I can **describe** the different **sounds**

I make with my **flute**.

This lesson has students making straw flutes.
If time permits also make and explore bottle xylophones!

Materials

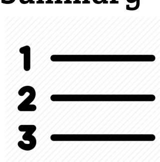


Make straw flutes:
- Straw Flute directions (video)
- 8 straws per student (can do it with 2 or 4 instead)
- scissors
- tape (video shows glue)

Make bottle xylophone:
- Xylophone directions (video)
- glass bottles or drinking glasses
- water
- large mixing spoon or pencil
- Optional: measuring cup

Note: The pitch is opposite when you tap compared to if you blow across the top of the bottle. Why?

Lesson Steps Summary



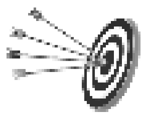
1) **Frame:** Purpose of today's lesson is to create a device that uses what we've learned about size, pitch, and how sound travels.

2) **Explore:** Make and play your straw flute (and/or bottle xylophone). Explore how it works. What works well? What doesn't work? Discuss some "What if…?" questions about the design. *Optional extension: Follow up of these design questions and test things like straw diameter (coffee stirrer vs Boba straw) or straw material (paper straw vs plastic vs metal).*

3) **Summarize:** Ask students to explain how their devices work. Remind students to use what they have learned about size of the object vibrating, pitch, and how sound travels. *(Choose explanation format: Partner share, Seesaw recording, and/or sketch/explain in notebooks)*

Lesson Steps

Turn-and-Talk



Learning Target

1) Frame: Pulling together our learning so far...

Activate prior knowledge: Remind students of prior concepts using the word wall and/or summary chart from prior activities. Have students turn-and-talk about something they remember about vibrations, pitch, size, and how sound travels. *What activities have they do so far? What do those words mean?* Use summary charts to remind students of all they have done so far.

Pose learning target or today's question**.** Tell students that today, they will make their own device, play it, and explain how it works using what they have been learning about pitch.

Create

2) Explore: Make the straw flute (and/or bottle xylophone).

Use the video to show students how to make the device. Have students use the materials, work together, and create their device.

If students made a straw flute:
Have students try them out and share what they notice about when/how it works and how they can make different sounds.

- What do you notice about the length of straw and the sound?
- If you could make another flute, what would you change? How do you think that would affect the sound?

If students made xylophone:
Have students try them out.

- What do you notice about the amount of water and the pitch when you tap it?
- What do you notice about the amount of water and the pitch when you blow across the bottle opening?

Turn-and-Talk

Lesson Closing

3) Summarize: Explain how the device works

Partner Share: Have students explain to each other how their device works. Remind students to use what the know about pitch, vibration, size, particles, and how sound travels.

Have students think and share one thing: a comment, compliment, question, something they might want to try next or wondering. Quick share in a big circle.

Optional extension:* I*f students suggest plausible things to try, this could lead into an extension of this lesson to test-and-observe.

Lesson 7: Update & Revise Models Using Evidence

Purpose

Students use what they have learned from experiments, text, and video so far to take stock of their current understanding, see how their thinking has changed, and use evidence to support claims.

Responsibilities

Teacher's responsibilities:

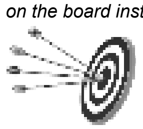
- Share what it means to revise ideas (looks like/sounds like)
- Help students review evidence and unit experiences so far
- Asking students to explain their models and why they made any changes they did

Students' responsibilities:

- Recall and describe what they have learned or done so far using summary charts and reviewing their notebooks.
- Apply experiences and learnings to make a more complete and clear model

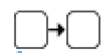
Learning Target

You do not need to post a target, but you can if that is part of your routine. You could pose a question on the board instead.



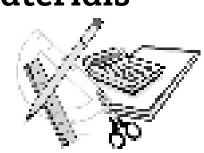


I can **share** my **ideas** by making a **model** to explain

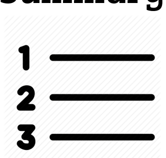
what causes the **sound** to **change**.

Materials



- Summary charts from prior lessons/activities posted on the board, wall, or cabinet doors so students can see them all
- Representations of Sound chart created in lesson 2.
- Blank model scaffold, one per student (choose a version or use blank paper and let students plan their own science story)
- Stack of students' initial models from lesson 1
- Sticky notes
- Chart paper & markers

Lesson Steps Summary



Part 1: What do we know now? (15-20 mins)

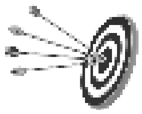
1. Launch: Purpose to review what evidence we have collected
2. Review: Gallery walk of summary charts from prior lessons
3. Summarize: Create an explanation checklist

Part 2: How has our thinking changed? (45 mins)

1. Launch: Review checklist and modeling syntax (arrows, symbols color for a purpose of communicating observations or ideas)
2. Mini-Lesson: Showing amounts, relationships, and patterns.
3. Update models: On new sheet, update models. Then compare to initial model. Similarities in my thinking? Differences?
4. Summarize: Compare models.

Extend (optional): Explain model on Seesaw and/or write/speak a multi-sentence explanation as a video to share with families. This also helps with assessment where students will say more than they write/draw about their understanding.

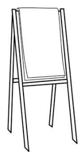
Lesson: Part 1 What do we know now?



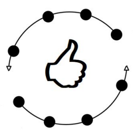
Launch

1) Launch: Introduce lesson
Frame the lesson. Indicate that today, you will be pulling together all the work you have done as scientists to identify the important parts and ideas in our science story about how we can make different kinds of sounds.

It could sound something like:
Today, scientists, we will take a moment to remember all the learning and experiments we've done. Scientists not only share their ideas but they also need to be able to say how they know it. Scientists need evidence. And we have done several investigations and readings together that have shown us this evidence.



Summary Charts



Gallery Walk

Turn-and-Talk

2) Review: What have we done and learned so far? Looking at evidence.

Post charts from the unit activities on cabinet doors, or around the room or in one area students can easily see (There are likely 3-4 charts, including the class model and/or chart of sound representations)

Point to the summary charts from prior activities. Tell students their job right now is to use quiet feet, safe bodies, and observing eyes to go walk around and look at each poster to remember things they have done. Keep at least one thing that we did or learned in your brain and then come back to the carpet. Have students go silently gallery walk around to each poster.

After a few silent minutes of looking and taking a gallery walk, students return to the carpet. Have students turn-and-talk and share about something they remember from the unit, their favorite activity and why they liked it, and/or something they learned.

3) Summarize: Build an explanation checklist together

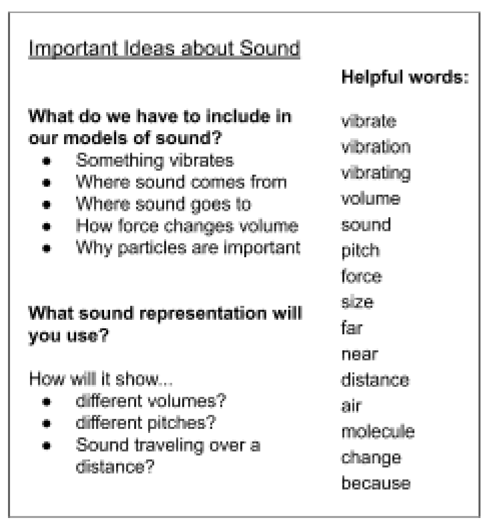
Collaborate on a checklist

Turn-and-Talk

Ask students: *If we want to fully explain how we can make different kinds of sounds, what are the important ideas we must include?*

Create an explanation checklist students will use to update their models. Two-columns are helpful with ideas on one side and helpful words on the other.

Tell students they will use this list the next science class to create new, updated, and detailed models of where the puddle came from and where it went using evidence from this unit.



Important Ideas about Sound

What do we have to include in our models of sound?
- Something vibrates
- Where sound comes from
- Where sound goes to
- How force changes volume
- Why particles are important

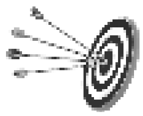
What sound representation will you use?

How will it show...
- different volumes?
- different pitches?
- Sound traveling over a distance?

Helpful words:
vibrate
vibration
vibrating
volume
sound
pitch
force
size
far
near
distance
air
molecule
change
because

Want more on explanation checklists? See this teacher video about how-to create a checklist with 4th graders.

Lesson: Part 2 How has our thinking changed?



Launch

1) Launch: Introduce lesson

Frame the lesson. Indicate that today, students will use their explanation checklist to make a new model about how we can make different kinds of sounds.

.

It could sound something like:

Today, scientists, we will use what we learned from our investigations and readings, and our explanation checklist to make new models about how we make different kinds of sounds. Your job today is not just to think about what you know, but to show it in your drawing using arrows, labels, and symbols.

2) Mini-Lesson: Representing amounts, relationships, and patterns

Mini-Lesson

Recap for students that scientists use arrows, symbols, and colors to mean different things in a model. *(This is a review as students hopefully have had opportunities throughout the unit to practice this.)*

Pose a challenge for today's model: How can we show amounts or patterns? What is an amount of something we could show? *(volume, distance)* What is a pattern we could show? *(how more force makes a louder volume, how pitch gets lower as object gets bigger)* Think about a way to show that in your model.

Close the mini-lesson: Remind students that models should use symbols, color, and arrows for a purpose or meaning so they will need to be able to talk about their choice. Models also need to show all of what they know right now about sound.

Possible responses or discussion points about using arrows on models:

- *pointer to label something;*
- *direction of movement;*
- *speed of movement;*
- *something happening over time,*
- *something changing from one thing/size to another…*

<u>Science Models</u>

Science models show our understanding.

Models have…

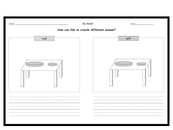
- Pictures
- Symbols
- Labels
- Captions
- Color

Models show…

- Patterns
- Observations
- How and why
- All of what we know right now!

Can other people understand your model?

3) Update models: New model scaffold

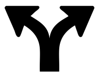


Develop a Model

Give each student a blank model scaffold or storyboard and a copy of the explanation checklist you built together in part 1 so students can use that to keep focused and be sure to include all of the important things in their puddle explanation.

As students work, circulate and make sure students know how to get started. Suggest picking a checklist item to start with.

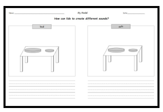
- *Which item do you want to start with?*
- *Tell me about that.*
- *How will you show in a drawing? Could you use arrows or color?*
- *Use some letters, words, or sentences to write about it, too!*



Teacher Decision

4) Summarizing similarities: Looking across student models

There are two different ways to do this comparison. Doing both is likely too much, so choose one to try now. The left option follows from the mini-lesson on color/arrows. The right option would work if you have been working on growth mindset and having students reflect on learning and their developing thinking.



Compare models

Turn-and-Talk

Discuss

Students compare today's model with a partner *(modeling focus, how we use arrows/color)*

Have students take today's model and partner up. Look for 3 things they both have in common. Share them with the class.

Did you have the same idea?

Did you show it in the exact same way using colors, labels, arrows? Did they show a pattern or amount?

The checklist has ____. I showed that by...

The neat thing about modeling is that we can have the same idea but show it in different ways to show our own understanding. Look at how they used arrows, symbols, and color to show amounts, relationships, and patterns.

Have a few pairs share out what they talked about in comparing their models.

Students compare their initial model to today's model *(individual metacognitive)*

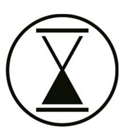
Have students clear off their desks. Pass back students' original models. The only things at their desks are their original model sheet and today's model.

Ask students what ideas or knowledge they kept, what they changed, and what new things they know now. Questions to have students think-pair-share about:

What is similar about your two models?

What is different or new about today's model that you added now that you didn't have before?

Have a few students share how their thinking has changed and/or what evidence they now have for ideas they started with.



Lesson Closing

5) Lesson closing options:

- Refer back to students' original hypotheses and questions from lesson 1. Are there any questions we can answer now? Are there others that we don't have information about yet?
- Self-Compliment: What is something you are proud of about your work today? *I am proud of how I _____ because….* After some think time to tell it to yourself in your head (silently), whisper it to yourself (whisper voice, all at once), now turn-and-tell it to a partner, say yours and listen.

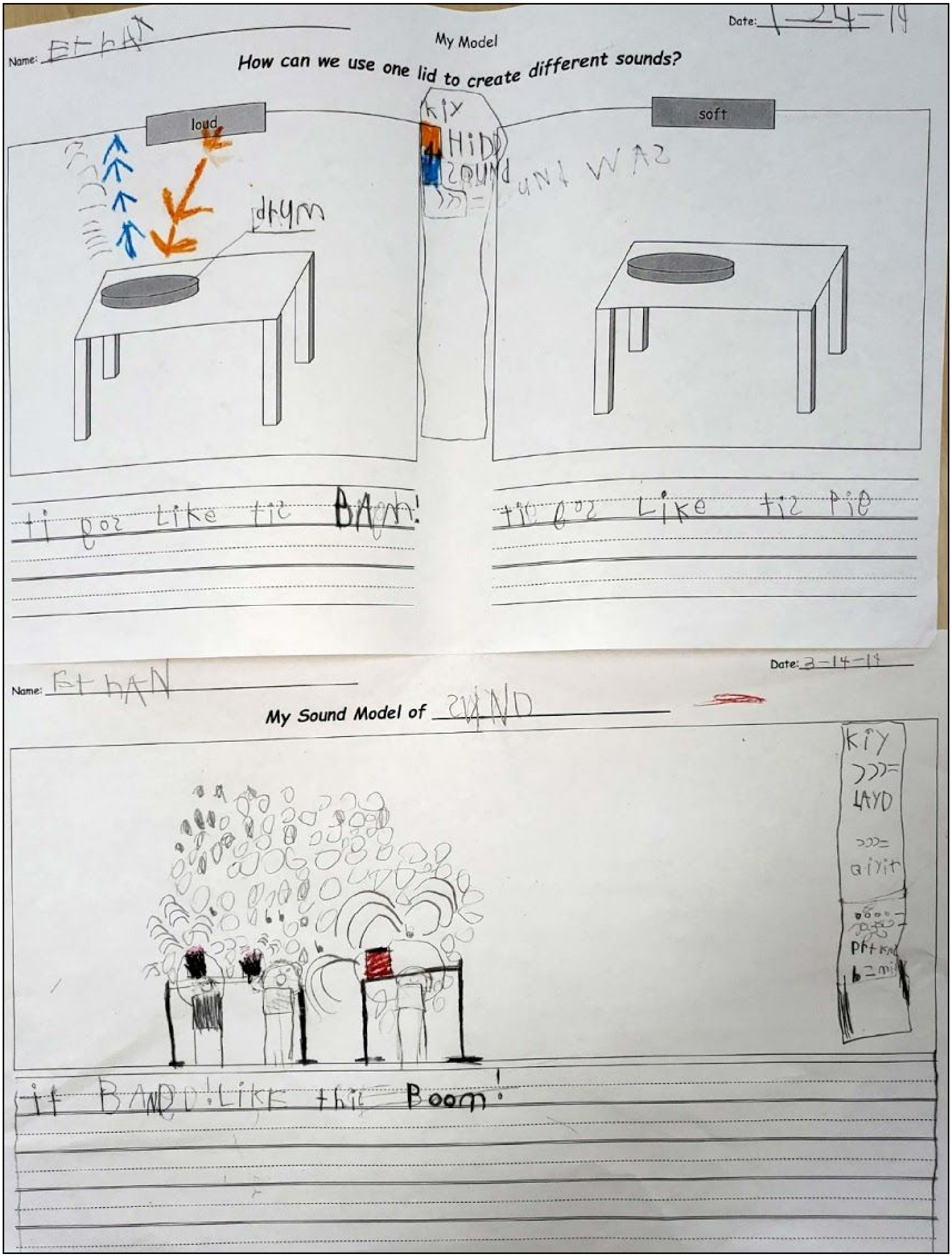
Lesson Reflection

This is a data point for assessing student understanding of key unit science concepts. Use this written document in combination with what you've heard students talk about to assess their depth of explanation. Compare to students' original thinking from Lesson 1. Use the matrix in the unit overview on pages 8-9 "Analyzing Student Understanding" to look at students depth of understanding of core science ideas as well as look at how they are progressing in modeling as a science practice.

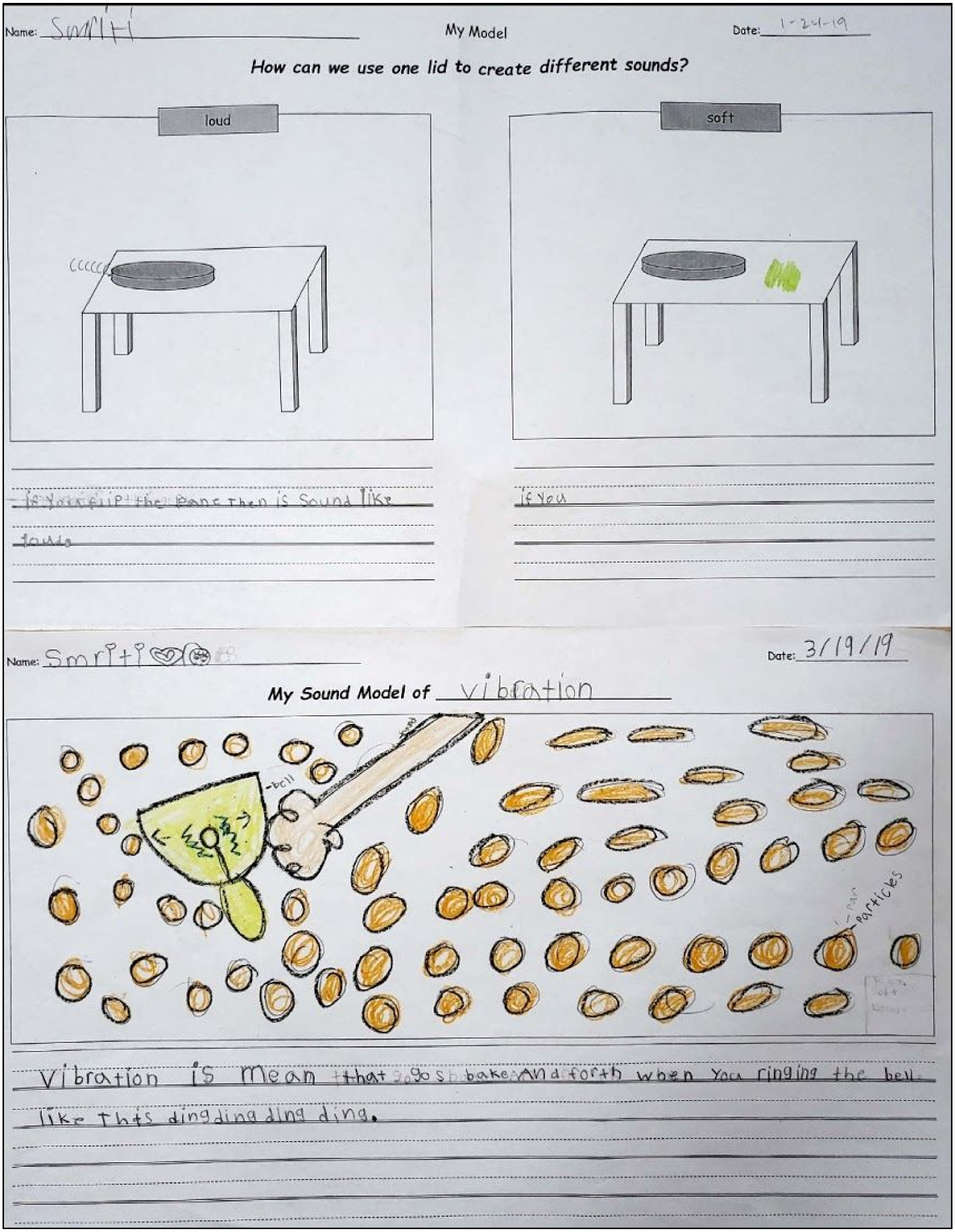
Student Work

Student's initial model is shown on top and their updated models is on the bottom of each image. Students selected different modeling paper and used a variety of symbols, words, and phrases in telling their sound story.

Student's initial model is shown on top and their updated models is on the bottom of each image. Students selected different modeling paper and used a variety of symbols, words, and phrases in telling their sound story.

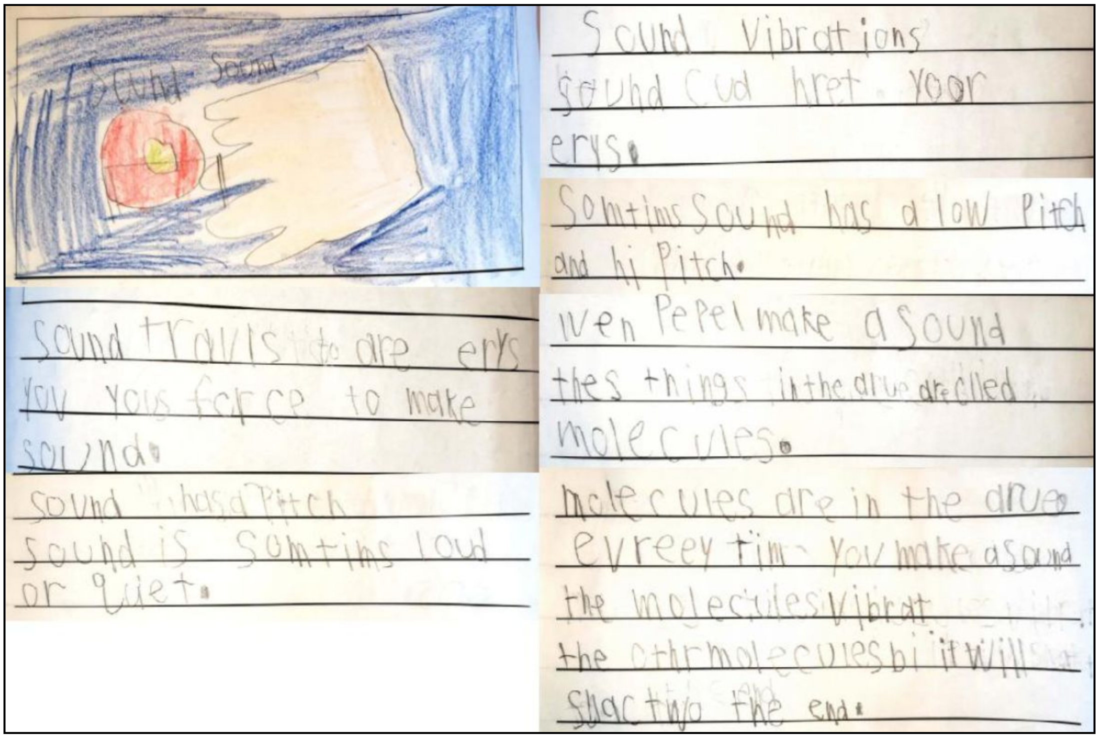


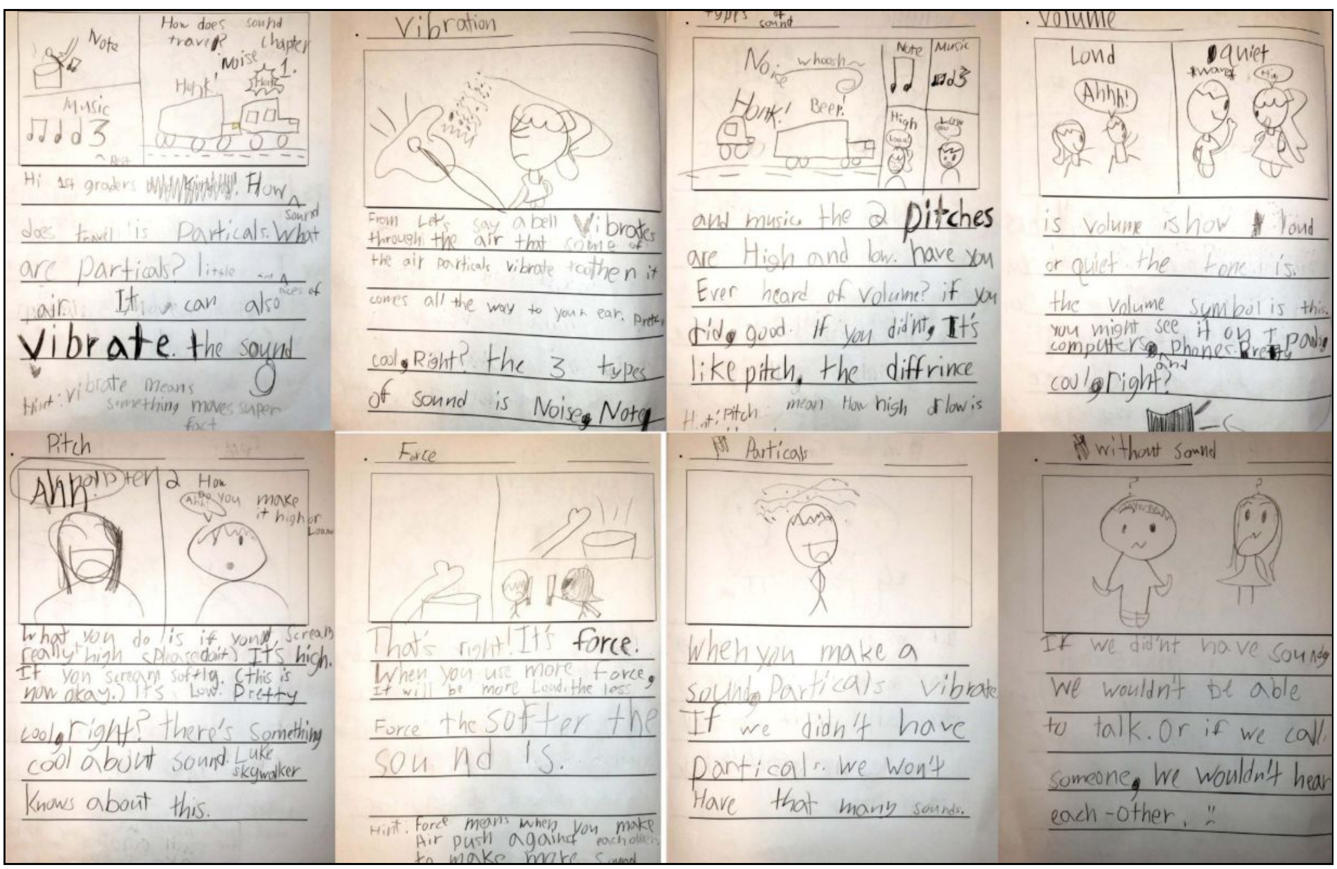
Student's initial model is shown on top and their updated models is on the bottom of each image. Students selected different modeling paper and used a variety of symbols, words, and phrases in telling their sound story.



Extension: All About Books

After completing their models to explain how kitchen drums or other device works to make sounds (teacher gave them that choice), some students wanted to write more and did an extension of writing an “All About Sound” book. Then they buddied up with another class to read each other their non-fiction texts. Images below are cropped to fit multiple pages together as students may not have drawn illustrations, diagrams, and/or models on each page.

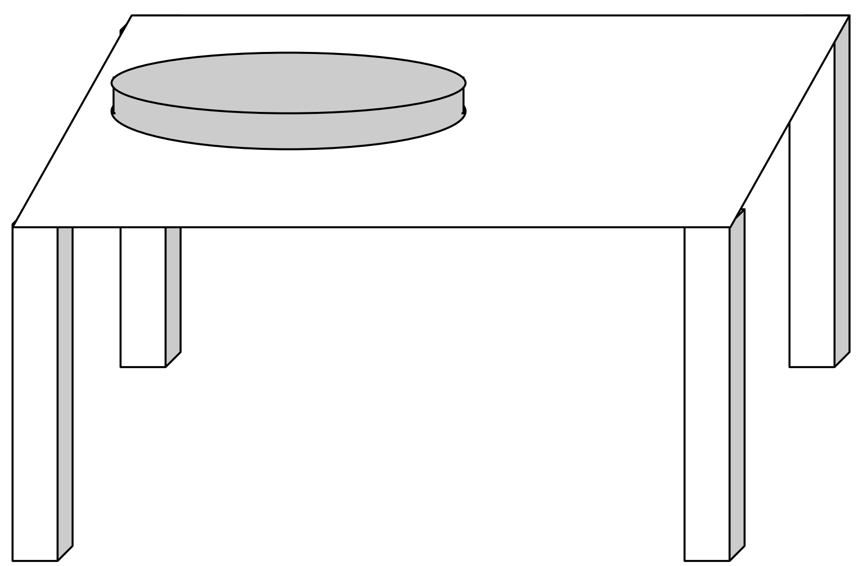




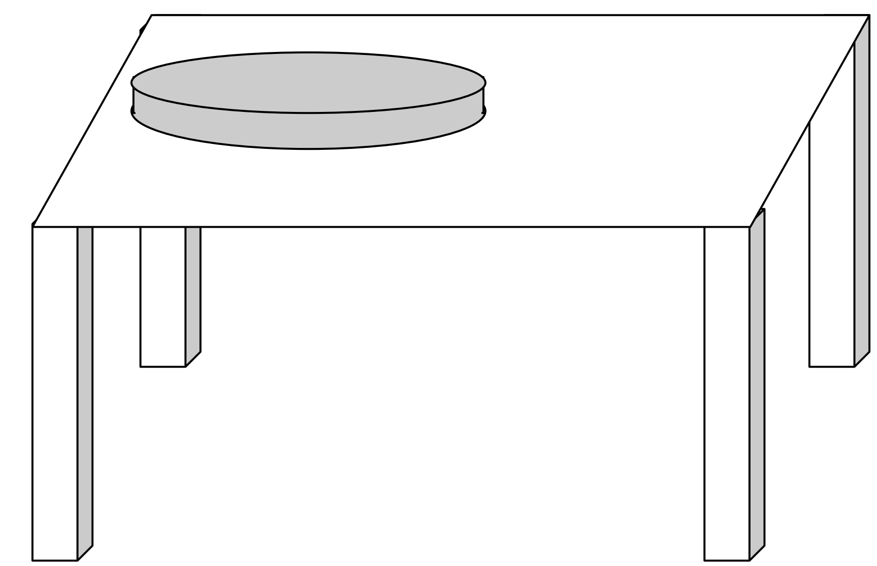
Name: ____ My Model Date:_______________

How can we use one lid to create different sounds?

loud



soft



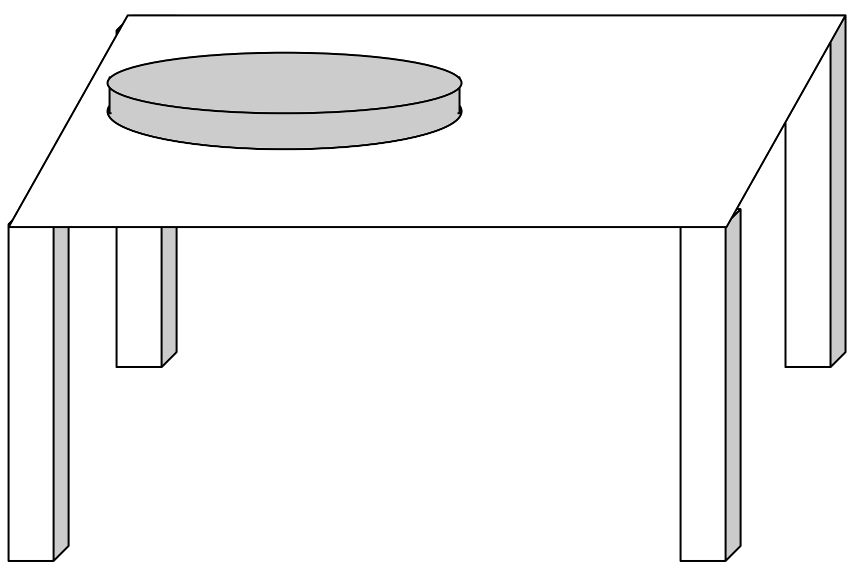
Name: ____ Date:______________

My Sound Model of ______________________

Name: ______________________________ My Model Date: ____________

How can we use one lid to create different sounds?

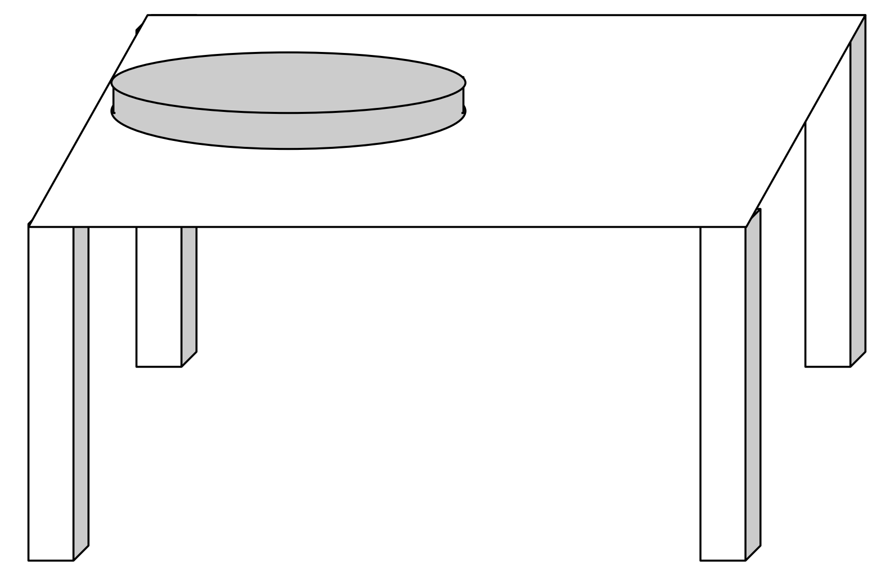
Loud Sound



Helpful Words

sound	drum
pound	lid
loud	quiet
hard	soft
hear	listen

Soft Sound



____

____

____

____

____

____

____

____

____

____

Name: ____ My Model Date:______________

How can we use one lid to create different sounds?

Loud Sound

Soft Sound

Helpful Words

sound	drum
pound	lid
loud	quiet
hard	soft
hear	listen

______________________________________ ______________________________________

______________________________________ ______________________________________

______________________________________ ______________________________________

______________________________________ ______________________________________

______________________________________ ______________________________________

Lesson 8 - Communicating with Sound

Purpose

Students use what they know about creating vibrations to transmit a message using sound over a distance

Responsibilities

Teacher's primary responsibilities:

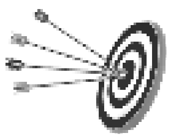
- Introduce examples of using sound to communicate using rhythms and patterns (e.g. Talking Drums, Morse code)
- Provide design criteria and materials
- Facilitate design comparison discussion using data

Students' primary responsibilities:

- Learn about and practice Morse code and drumming patterns
- Devise a simple device to communicate a message across a distance
- Test and compare devices.

Learning Target

You do not need to post a target. But could pose a question on the board instead.

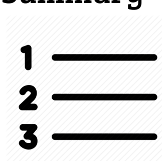


I can **communicate** a message with **sound** over a distance.

Materials

- ➢ 1 balloon bongo for demo (from L5)
- ➢ 1 copy of Talking Drums one-page for shared reading as a class (link)
- ➢ Video:Talking Drums (0:51)
- ➢ Video: Morse Code (1:15)
- ➢ Morse Code alphabet half sheet (link)
- ➢ Materials for creating a way to send a sound signal/message: balloons, cups, cans, string, paper clips, rubber bands, etc.

Lesson Steps Summary



Part 1:

1) **Frame -** Introduce purpose for today's lesson
2) **Mini-Lesson -** How do we use sound to communicate? How can we do this across distances? Use Talking Drums and Morse code as two examples. Briefly practice Morse code with a balloon. Remind students of the drum algorithms they made with Bongos.
3) **Explore -** Then give time for students to plan and test a way to transmit a short message using sound over a given distance.
4) **Summarize -** Self-assessment on progress. What's going well? Anyone stuck or need some help?

Part 2:

1) **Frame -** Recap shared criteria. Provide a few minutes for students to practice a message and prepare for today's testing.
2) **Explore -** Test devices and collect data on each criteria.
3) **Summarize -** Examine criteria and data as a class. Which design features seemed to work best for ___? Why?

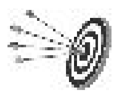
Part 1


Perform

1) Frame: Introduce the purpose of the lesson


Think

Activate prior knowledge**:** Remind students about the balloon bongo algorithms using tap, pluck, and shake from lesson 5. What if each sound had a meaning. For example, what if a tap meant stand up? Pluck was bend down? Shake meant jump? Let's try it! *(Have some or all students try this out as you use the balloon bongo to tap, pluck, and shake.)* Then, ask students to think: Think to yourself. How do we use sounds, that aren't words, to communicate messages or information? *Silent think time.* Then, pose learning target or today's question.


Learning Target

2) Mini-Lesson: How can we communicate over a distance?

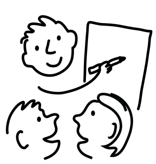

Read for information

Read about and watch the Talking Drums information (reading / video). The reading says that drummed messages can travel for up to 4 miles away! What are some advantages for using drumming to send a message? Any disadvantages?


Turn-and-Talk

Drumming is just one way that people have invented to communicate over a distance. Another way was through Morse code (video / handout). Have students practice Morse code with clapping some letters to spell words (clap = dot; rub/slide = dash) and translating the code on the half sheet. Have students think and then turn and talk about other ways they could use Morse code dots and dashes with sound besides claps.

3) Explore: Begin making a plan to communicate a message


Teamwork

Give directions for the task, including the criteria. Students can use Morse code, a drum algorithm, or other way to send a message but the message must travel over X distance (decide on a distance that works for your class, across the room? Down the length of a hallway?)

Each pair or trio of students will work together to figure out how to communicate a short message, possibly using Morse code, clearly and accurately over a distance. They need to decide on (1) what their message will be and (2) how they will get the message over that distance to another person.

Give students time to plan their device, build, test, and practice their message.

Design criteria:

- Accurate message, is clear to understand
- Travels a distance of___
- Can't be so loud as to disturb other classes
- Uses the materials we have available

Teamwork sounds like...

- What is your idea? Tell me more.
- Are you saying you want to try ____?
- I have a different idea. My idea is …
- How can we combine our ideas?


Think

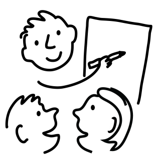

Lesson Closing

4) Summarize: Reflect on teamwork and design

What's going well? What can we work on? Give students some silent think time about their teamwork today. Think of something they did well and something to work on. Could do a compliment circle or apologies depending on how well teamwork went during the activity.

Close with a preview of part 2. The next part, students will get with their group and practice using their device and sending a message before they take some "official" data as a class for each design.

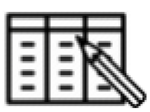
Part 2


Teamwork

1) **Frame -** Briefly recap shared criteria from part 1. If needed, set a teamwork goal for today or remind students of a teamwork norm to work on.

2) **Explore - Finish the design, practice, then collect data**

   Have students return to their teams and practice sending a message and prepare for today's data collection. Remind students that their designs do not need to be perfect. In fact, it can be helpful to explain why something isn't working!


Collect data
(using criteria list)

   After a set amount of time, announce that the "official" data collection will begin. Have the criteria list/chart ready so students can decide for each design which criteria each design addresses. Test devices and collect data on each criteria.


Discuss

4) Summarize - Examine criteria and data as a class across all designs. Select a question or two for students to really think (silent think time), pair up and discuss, then discuss as a whole group.

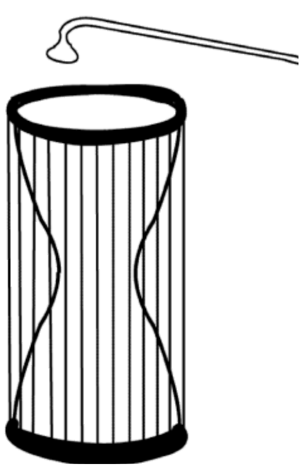
- What trends do you see in the data? Were any designs similar? Did the perform the same?
- Which design features helped sound vibrations travel? Why? What science learning have we done that might help explain that?
- Which design features helped sound travel a far distance? Why do you think that helped? What science learning have we done that might help explain that?
- Which design features made it easy to clearly communicate a message? Why do you think so? Was there something frustration or hard to understand in the message? Why?

AFRICAN TALKING DRUMS

In schools, we use a bell sound to start school and to signal when to leave. We know what this bell sound means. Horns, sirens, bells. There are many examples around us of how we use sounds to communicate. We have to know what the sound means when we hear them. For example, when you hear the fire alarm, you know to go outside with your class because there might be a fire. When you hear a car horn, there might be something wrong in the road or some heavy traffic. If you hear a siren, there is an emergency and a police car or ambulance is going to help. These sounds do not tell us about *what* is happening. They just tell us *that* something is going on. To find out more information about an emergency, we might get a text or email message on our cell phones. Or we could turn on the television or radio to get more information.

But imagine you lived over 100 years ago. Think of a time when there was no electronic communication.There were no cell phones, telephone, internet, radio, and no television. How could we communicate with people who lived next door? Down the street? Or in other houses or towns? How could we send messages over a long distance farther than we could reach just with our human voice?

Over a hundred years ago, people in Africa created their own drumming language to send news from one village to another quickly. Drummers hit drums hard to make sure the volume was loud enough to reach across distances. Drummers could also change the pitch or tune to change the meaning of the message. Talking drums mimic the rhythms and tones of their spoken languages. They can reproduce the sounds of well known phrases or praise songs.Talking drums can be easily understood by a knowledgeable audience.



Talking drums can be played in various patterns and rhythms for different reasons. There are different rhythms played for celebrations, war, naming ceremony, burial, inaugurations, games and sports, rites of passage, healing, storytelling, and initiations. If you grew up using and hearing drums, you would know what each rhythm means and would know what the news is for your village and nearby towns when you heard these drum rhythms. These drumed messages can travel up to four miles away!

Adapted from sources: https://drummaterialsreviews.com/african-talking-drums/ and https://iyailu.wordpress.com/2011/03/23/talking-drum-presentation-3/

Optional: Lesson 9 - Exploring Records

Purpose

In this lesson, students experience and explore analog record technology as an opportunity to notice, wonder, and hypothesize about how records work to store information and how record players work to retrieve information in the form of sound *(computer science integration)*

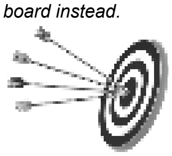
Responsibilities

Teacher's primary responsibilities:
- Provide questions and think time around demonstration and/or video examples
- Prompt and press to hear students' ideas about vibrations, sound waves, and volume

Students' primary responsibilities:
- Make and share observations
- Ask questions or make "I wonder…" statements
- Develop a model collaboratively to explain how records work using what they know about how vibrations make sounds.

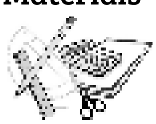
Learning Target

You do not need to post a target. But could pose a question on the board instead.



I can **make observations**, **ask questions**, and use what I know to **explain** how I think records work.

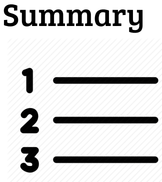
Materials



➢ Photo: Record grooves (link)
➢ Video: How to play a record (link)
➢ Video: Paper cone player (link) 1:08
➢ 1 old vinyl record
➢ 1 sheet computer paper
➢ 1 straight pin
➢ tape
➢ 1 pencil
➢ 1 plastic cup w/hole in bottom, for stability when turning the record

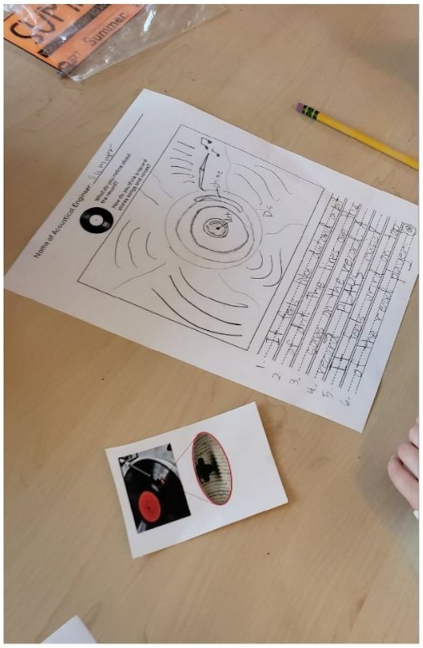
Set-up: Place cup on the pencil through the hole in the cup. Place record on top of the cup on the pencil. Try spinning it at a constant speed. Create a cone from the paper. Tape to secure. Stick a needle to the point of the cone.

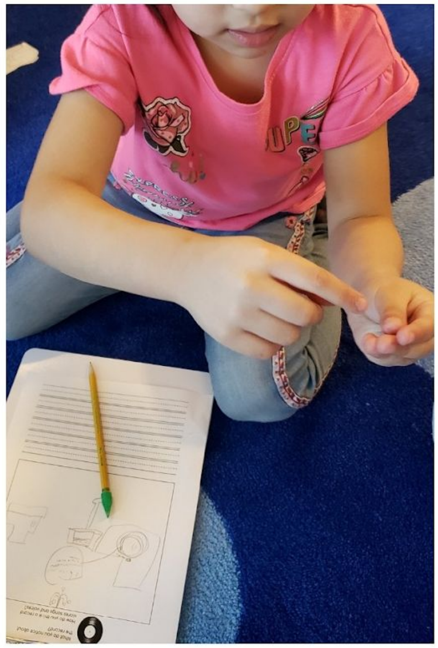
Lesson Steps Summary

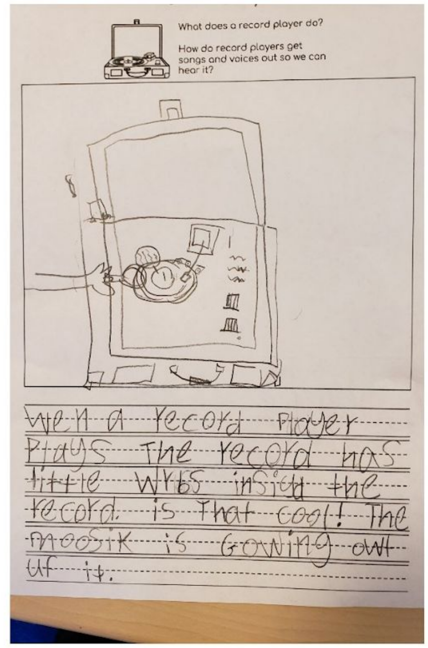


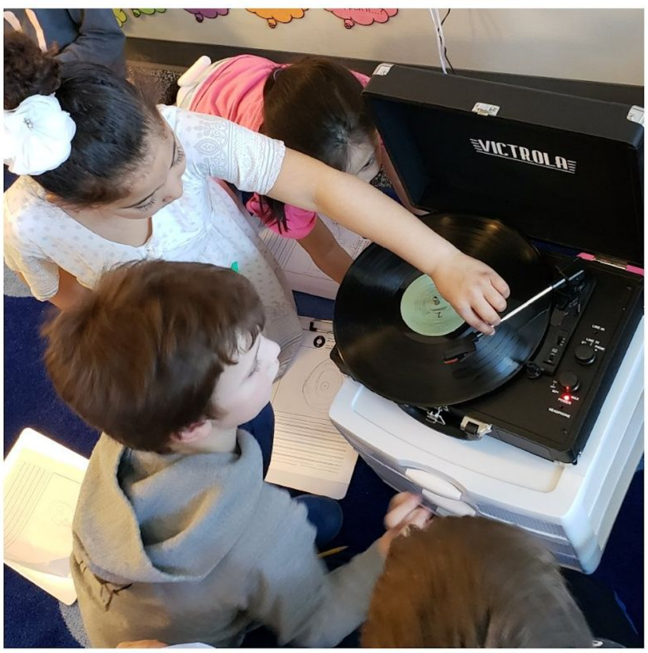
1) **Frame:** Purpose of today's lesson is exploring some older technologies about how data can be stored and retrieved while continuing to use what we've been learning about vibration, volume, and how sounds are made and how sound travels
2) **Explore:** Play a record. Make observations. Say *what* happens. Show the zoom-in photo cards. Have students think and share how or why they think records store songs and how record players play back the songs. Write and draw with a partner about what they think is going on. Prompt students to try using "zoom-in" on their model to show something super tiny that we can't see.
3) **Summarize:** Ask students to share their ideas through modeling with a partner and sharing ideas.

Lesson Photos









Students used the “super microscope” photo of the needle in the record groove to help their reasoning. One student exclaimed, “They (bumps on the grooves) ;look like tiny words!” Another noted that it was words because some gray spots look short and others look long, like words, and the singer says words. Later on, another student said, “I can tell when the song is going to change.” *How?* “Well, there are no tiny words on those lines (pointing at space on record) because it is silent between songs.

Zoom-in Photograph:
Needle in a Groove on a Record

How do songs get into a record?

How can we get the songs out of the record so we can hear them?

What do you know about sound that can help us figure this out?

record player

record

LP or EP

Name of Acoustical Engineer: ______________________________

What do you notice about the record?

How do you think a record stores songs and voices?

Name of Acoustical Engineer: ______________________________

What does a record player do?

How do record players get songs and voices out so we can hear it?

[This page intentionally left blank.]