SUCCESS ACADEMY EDUCATION INSTITUTE

Sound: Engineering a Concert

Grade 1

Our Vision of Elementary School Science Excellence

Success Academy's unique commitment to science starts in kindergarten. We strive to cultivate a passion for the sciences early in life, build a comprehensive foundation of knowledge, and teach students to investigate and analyze real-world problems. Our vision of science relies on two related commitments: mastery of a substantive body of scientific knowledge and an inquiry-based approach to accumulating this knowledge. Equipping students with a firm grasp of scientific concepts is central to our model, and students must understand that these concepts aren't simply plucked from the air, but rather arrived at through scientific thinking and experimentation. To that end, our scholars do science to understand that scientific knowledge comes from posing questions, designing experiments, gathering data, and drawing conclusions. Rather than viewing scientific knowledge as etched in stone, they come to understand that ideas about the world change with new evidence. In addition, our program incorporates The Next Generation Science Standards (NGSS) and the BSCS 5E Instructional Model.

We believe excellent science classrooms are ones in which students experience curiosity and joy, and make connections between classroom science and the natural world around them. Embedded in our program is the belief that struggle and student-led inquiry are inherent to the mastery process. Through our progressive approach to learning, students realize that unexpected results do not signal failure, but instead present valuable opportunities for new questions.

Through our science program, students learn that science and engineering are creative and exciting fields. They discover that there are countless, fascinating scientific questions to be asked and engineering challenges to be solved—and will be inspired and equipped to seek out answers and solutions. No matter what path students choose to pursue in life, the SA science program will spark curiosity, sharpen problem-solving capabilities, and fuel passion for knowledge.

Essential Questions

The best questions point to and highlight the big ideas. They serve as doorways through which learners explore the key concepts, themes, theories, issues, and problems that reside within the content, perhaps as yet unseen: it is through the process of actively "interrogating" the content through provocative questions that students deepen their understanding.[1]

Use the essential question to drive the unveiling and mastery of ideas, and ground the unit in an overarching purpose, often as a storyline. Mentioning the essential question or having students answer it at the end of some lessons does not mean the teacher is using it purposefully.

[1] From Wiggins, G., & McTighe, J. (2005). *Understanding by design*. Alexandria, VA: Association for Supervision and Curriculum Development.

Purpose: The Why, What, and How of This Unit

Essential Question: How can humans use sound to create an outstanding concert?

Why This Unit?

Your lab is hosting a Science Concert, and your scholars will be the stars! In this unit, scholars will dive headfirst into the world of sound waves, exploring their characteristics and the ways that humans detect waves to better understand the world around them. Scholars will investigate the nature of sound waves and use their observations to make meaning of the relationship between vibrations, waves, and sounds. Can scholars use these discoveries to create their own instrument in time for your lab's Science Concert?

What is the bottom line?

Science and Engineering Concepts highlighted in this unit:

- **Big Idea:** Vibrating matter can create sounds, and sounds are created by vibrating matter.
- **Big Idea:** Waves, created by regular patterns of motion, can be detected by humans to help them better understand the world.

Science and Engineering Practices highlighted in this unit:

- **Develop and Use Models**
  - Distinguishing between a model and the actual object, process, and/or events the model represents.
- **Analyze and Interpret Data**
  - Using observations to describe patterns and relationships in order to answer scientific questions and solve problems.

Note: As with any unit, scholars engage in many practices in a given investigation. These practices are highlighted because they appear in most lessons.

How will scholars be assessed?

- Teachers are expected to give scholars grades for every unit. Use the materials throughout this guide to assess scholar mastery.

Safety

Plan carefully for safety in all lessons. The top safety risks in this unit include:

- Exercise caution when using rubber bands; ensure scholars understand expectations for safe use.
- Scissors may present a safety hazard.

Unit Outline

Lesson 1: Sounds for the Show

Scholars only have a few weeks to make an instrument for the Science Concert! Can they determine what sounds are and how they're made?

- **Big Science Idea**: Matter moving in a particular way creates sound.
- **Science and Engineering Practice**: Analyze and Interpret Data

Lesson 2: Vibrations

Could the key to sound really be vibrations? Today, scholars use their senses to explore the effect of vibrating a variety of objects.

- **Big Science Idea**: Vibrating matter has predictable effects.
- **Science and Engineering Practice**: Analyze and Interpret Data

Lesson 3: Moving and Shaking

A new challenge is revealed about the Science Concert. Can scholars learn everything they need to know about vibrations and sounds in time for the show?

- **Big Science Idea**: Repeated patterns of motion create waves.
- **Science and Engineering Practice**: Develop and Use Models

Lesson 4: Making Waves

Scholars have unearthed the secret behind vibrating Slinkys, but what do *all* vibrating objects have in common? Today, scholars explore more vibration models in order to prepare for the upcoming Sound Experts presentation.

- **Big Science Idea**: All vibrating matter creates a wave.
- **Science and Engineering Practice**: Develop and Use Models

Lesson 5: Waves and Matter

A difficult audience question leads to scholars' toughest challenge yet. Can they use a water wave model to determine what happens to molecules inside a wave?

- **Big Science Idea**: Waves have predictable motions.
  Science and Engineering Practice: Develop and Use Models

Lesson 6: Seeing Sound

Scholars deeply studied the patterns among vibrating objects, but what about vibrations you *can't* see? Today, scholars return back to sound vibrations and explore ways to make the invisible visible.

- **Big Science Idea**: Sound moves matter in a particular way.
- **Science and Engineering Practice**: Develop and Use Models

Lesson 7: Detecting Different Sounds

The Sound Experts' problem has been solved, and the wave presentation is being finalized! Scholars will now extend their knowledge of sound to determine different sounds they can create in order to perform the most exciting concert possible for their audience.

- **Big Science Idea**: Humans use their senses to detect the effect of waves.

- **Science and Engineering Practice**: Develop and Use Models

Lesson 8: Communication Challenge

How can scholars make sure their sound waves travel to everyone in the audience? Today, scholars will sort sounds based on the differences they noticed from the previous lesson and discuss which types of sounds they should use during the concert to ensure that everyone can hear their beautiful music.

- **Big Science Idea**: Waves can be used to communicate information.
- **Science and Engineering Practice**: Develop and Use Models

Lesson 9: Engineering an Instrument: Design

The opening night of the Science Concert is just a few short days away! Can scholars put together all of their knowledge about vibrations, waves, and sound in order to create their concert instrument?

- **Big Science Idea**: Humans create and use tools to communicate over long distances.
- **Science and Engineering Practice**: Develop and Use Models

Lesson 10: Engineering an Instrument: Build

Scholars have worked hard and prepared diligently for the Science Concert. They will finally use their plans to create an instrument that can create both loud and soft sounds for the performance.

- **Big Science Idea**: Humans create and use tools to communicate over long distances.
- **Science and Engineering Practice**: Develop and Use Models

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Lesson 1: Sounds for the Show

Scholars only have a few weeks to make an instrument for the Science Concert! Can they determine what sounds are and how they're made?

Lesson Objectives

- **Big Science Idea**: A matter moving in a particular way creates sound.
  - **Key Takeaways**:
    - Back and forth motions create vibrations.
    - There is an observable relationship between vibrating objects and sound.
- **Science and Engineering Practice**: **Analyze and Interpret Data** Scholars engage in this Science and Engineering Practice as they use observations to describe relationships.

Materials Needed

- For each pair of scholars: rubber band, cup, hand lens

Launch

- Show scholars a video clip (0:35 to 0:55) of a live concert on mute.
  - What are these people doing? How do you know?
  - What could we change to make this concert more interesting for the audience?
- Explain to scholars that they will be creating and playing their own instruments for the Science Concert in just a few weeks!
  - How can we make sure that our audience can hear and enjoy the music during the concert?
  - What questions do you have about sound?
- Present the lesson challenge:
  - Act as a musician by creating sound with the provided materials. Discuss and determine how sounds are created.

Activity

- Scholars work in pairs to create a sound with their rubber band and determine how sounds are created.
- Circulate to look for scholars who are discussing their observations. Press them to explain the relationship between sound and the rubber band's movement.
- **Procedure**:
  - Scholars try to create a sound with the rubber band by using the materials provided.
  - Scholars use a hand lens to closely observe the rubber band as their partner repeats their method of creating a rubber band sound.
  - Scholars record their observations and discuss how sounds are made.

Discourse

- **Debrief activity:**
  - How did you use your materials to get the rubber band to make a sound? Define **motion**.
  - What did you observe when the rubber band was moving?
  - What other sounds can be made when you move something?
- Model putting your fingers over your throat and making a humming noise. Ask scholars to try.

    - What did you observe when you made a sound? Define **vibration**.
    - What is the relationship between vibrations and sound? How are they connected? Define *relationship*.
- **Introduce the essential question:** How can humans use sound to create an outstanding concert?
- **Make broader connections:**
    - Show scholars your cell phone. Explain that you noticed that your phone can be put on a “vibrate mode” when it rings.
        - What do you predict the phone will do when it rings?
    - Lay your phone on a hard surface to demonstrate its vibrate mode. Allow a scholar to feel the phone and report what they notice to the class.

Accountability (Informal)

By the end of the lesson, scholars must know that vibrations are back and forth motions. They will see this when they pluck the rubber band and see it move back and forth. Use your observations during the lesson to determine how well scholars understand that there is a relationship between the rubber band moving and sound being produced. Consider which scholars need additional support with this concept—they will have an additional chance to master this idea in Lesson 2.

Lesson 2: Vibrations

Could the key to sound really be vibrations? Scholars use their senses to explore the effect of vibrating a variety of objects.

Lesson Objectives

- **Big Science Idea**: Vibrating matter has predictable effects.
  - **Key Takeaways**:
    - All vibrating objects create a sound.
    - There is an observable pattern between vibrations and sound.
- **Science and Engineering Practice**: **Analyze and Interpret Data** Scholars engage in this Science and Engineering Practice as they use observations to describe patterns.

Materials Needed

- For each table: closed film canister with small pebbles inside, closed deli tray with beads inside, wooden block

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Launch

- Yesterday, we began to prepare for our Science Concert. We noticed that there were vibrations in the rubber band when there was a sound!
  - Do you think this will be a pattern? Will there always be vibrations when there is a sound? Define *pattern*.
- Present the lesson challenge:
  - Search for patterns by vibrating different objects. Discuss if we need vibrations during the Science Concert, and why.

Activity

- Scholars work together in table groups to explore vibrations with the materials at their table.
- Circulate to look for scholars who are recording their observations in their lab notebooks and press them for evidence that explains the relationship between vibrating objects and sound.
- **Procedure**:
  - Scholars take turns vibrating the different objects (shaking the film canister, tapping the bead drum with a pencil, and rubbing the block back and forth on the table/another flat surface) at their table.
  - Scholars discuss and record what they observed when they vibrated each object.
  - Scholars discuss the patterns they noticed about vibrating objects and decide how they will ensure that their instruments make sounds during the Science Concert.

Discourse

- **Debrief activity:**
  - What did you hear when you vibrated each object?
  - What did you see when you vibrated each object?
  - What patterns did you notice when you vibrated each object?
- **Make connections to the essential question:** How can we make sure that our instruments make sound during the Science Concert? Why do you think that will work?

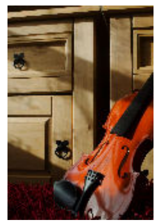
- **Make broader connections:** Watch a video clip (2:20 to 3 minutes) of different sounds.
    - What similarities and/or differences do you notice about the sounds?
    - What patterns did you notice about the sounds?

Accountability (Exit Ticket)

This Exit Ticket assesses scholars' understanding of the lesson's Big Science Idea. By the end of the lesson, scholars must know that vibrations are back and forth motions and that vibrations cause sound. They should observe a pattern in the results of vibrating objects; these objects create sound. In upcoming lessons, scholars will learn that vibrations create waves.

Assignment:

Lianna bought a new violin. She took it out of the case and noticed that the strings were not moving.



Will Lianna's violin make a sound? Circle your answer below. [1]

Yes No

Scoring:

1. Award 1 point for indicating "No."

Lesson 3: Moving and Shaking

A new challenge is revealed about the Science Concert. Can scholars learn everything they need to know about vibrations and sounds in time for the show?

Lesson Objectives

- **Big Science Idea**: Repeated patterns of motion create waves.
  - **Key Takeaways**:
    - Vibrating objects create waves.
    - Models are used to better understand phenomena that are difficult to directly observe.
- **Science and Engineering Practice**: **Develop and Use Models** Scholars engage in this Science and Engineering Practice as they distinguish the difference between a model and the scientific phenomena the model represents.

Materials Needed

- For the teacher: tuning fork, ping pong ball taped to a string, cup, one Lego block
- For each pair of scholars: Slinky

Prep

- Cut a piece of string about 11/2 feet long and tape or tie one end of it to the Ping-Pong ball.

Launch

- Show scholars a cup with one Lego block (or other small material) inside.
  - How can I use these materials to make a sound? What's your evidence?
- Explain to scholars that the audience wants to learn about the sounds they'll create during the Science Concert, and some audience members have already submitted their questions to the class. Some scholars will get to join a special group, the Sound Experts, who will answer audience questions during the show!
- Present the lesson challenge:
  - Model vibrations to explore the audience's first question—"How do sounds travel from place to place?"

Activity

- Scholars work together in partnerships to complete different modeling vibrations activities with a Slinky and determine how sound travels.
- Circulate to look for scholars who are recording their noticings in their lab notebooks and press them to explain what their model demonstrates and how they know.
- **Procedure**:
  - Activity 1: Partners stretch out Slinky in the air. Partner 1 holds his or her end of the Slinky still while Partner 2 vibrates the Slinky up and down.
  - Activity 2: Partners stretch out Slinky on the floor. Partner 1 holds his or her end of the Slinky still while Partner 2 vibrates the Slinky side to side on the floor.
    Scholars discuss and record their observations in their lab notebooks.
  - Scholars discuss how their Slinky model shows how sound vibrations travel.

[**Material Management Tip**: Ask two scholars to model each Slinky vibration activity. Explicitly point out the importance of only one partner vibrating the Slinky at a time.]

Discourse

- **Debrief activity:**
  - What did you observe when you vibrated the Slinky? Why do you think that happened?
  - What does this model teach us about sound?
- **Make connections to the essential question:** How can this model help the Sound Experts teach the audience about how sound travels?
- **Make broader connections:** Hold the string attached to the Ping-Pong ball away from your body. Ask a scholar to slowly move the tuning fork near the Ping-Pong ball.
  - What did you notice?
  - Ask the scholar not only to repeat the process but also to strike the tuning fork on a hard surface before moving it near the Ping-Pong ball.
    - What does this model prove about sound vibrations?

Accountability (Informal)

Use scholar conversation and scholar work to determine how well scholars understand the Big Science Idea: Repeated patterns of motion create waves. By the end of this lesson, scholars must know that a vibrating object can create a wave. They should observe the effect of vibrating a Slinky: a wave. In the next lesson, scholars will have one more opportunity to understand that vibrating matter creates waves. Consider which students will need additional support with this concept.

Lesson 4: Making Waves

Scholars have unearthed the secret behind vibrating Slinkys, but what do *all* vibrating objects have in common? Today, scholars explore more vibration models in order to prepare for the upcoming Sound Experts presentation.

Lesson Objectives

- **Big Science Idea**: All vibrating matter creates a wave.
  - **Key Takeaways**:
    - Waves are created when matter vibrates.
- **Science and Engineering Practice**: **Develop and Use Models** Scholars engage in this Science and Engineering Practice as they use models to understand scientific phenomena.

Materials Needed

- For the teacher: small music box
- For each table: clear water bin, deli tray lids, thin rope, ribbon

Prep

- Fill each bin ⅓ full with water.
- Tie one end of the rope to the bottom of one table leg at each table.

Launch

- You have used the Slinky as a model, but now, we must understand what all vibrating objects have in common. We know that vibrations and sound are connected, so it is important we understand what vibrating objects do!
- Scientists use multiple models to understand what they observe.
  - Show scholars a picture of an animal skeleton model and show an additional picture of a different model of the same animal.
    - Why would a scientist use both these models to study a horse?
- Present the lesson challenge:
  - Use different models to determine what all waves have in common. Choose which models the Sound Experts should use to explain waves at the Science Concert.

Activity

- Scholars work together in partners to explore the different wave models at their table and determine what waves have in common and what they teach us about vibrations.
- Circulate to look for scholars who are recording their noticings in their lab notebooks. Press them to explain how each model helps them understand more about waves.
- **Procedure**:
  - Activity 1: Partner 1 sits on the floor and vibrates the rope tied to the table leg back and forth on the floor while Partner 2 observes the wave.
    - Partners switch roles and then record their observations in their lab notebooks.
  - Activity 2: Partner 1 vibrates the water in the bin by quickly and repeatedly dipping the deli tray lid (or other wide, flat object) into the water. Partner 2 observes the waves overhead and at water level.

        - Partners switch roles and then record their observations in their lab notebooks.
    - Activity 3: Partner 1 vibrates the ribbon by moving it up and down in the air while Partner 2 observes the wave.
        - Partners switch roles and then record their observations in their lab notebooks.
        - Scholars discuss the similarities between their wave models and the characteristics that waves share.

Discourse

- **Debrief activity:**
    - How did you create a wave with your materials?
    - What did you notice about each wave?
    - How do these models prove how sound travels?
- **Make connections to the essential question:** Which model do you think the Sound Experts should use to explain waves to the audience at the Science Concert?
- **Make broader connections:** Show scholars the music box under the document camera. Point out the wheel, the bumps on the wheel, and the metal keys to scholars.
    - What do you predict will happen when I start to spin the handle connected to the wheel?
    - Play music box for scholars under the document camera.
        - What happened when the keys reached a bump on the handle?
    - Revisit the anchor chart listening to audience questions for the Science Concert and add new information.

Accountability (Exit Ticket)

This Exit Ticket assesses scholars' understanding of the lesson's Big Science Idea. Vibrating matter can create sounds, and sounds are created by vibrating matter. By the end of the lesson, scholars must know that regular patterns of motion always create waves and the vibrating matter will produce a wave. This is the last lesson that directly addresses this idea. If scholars are still struggling to articulate how sound is created, consider planning a flex lesson, allowing scholars additional opportunities to master this idea.

Assignment:

Put an **X** next to each activity that makes a wave. [2]

__x__ Shaking a tambourine.

_____ Sitting in a chair.

__x__ Waving a flag.

_____ Reading a book.

Scoring:

1. Award points as follows:
   - Award 1 point for each accurate response.
   - Deduct 1 point for each inaccurate response.

Lesson 5: Waves and Matter

A challenging audience question leads to scholars' toughest challenge yet. Can they use a water wave model to determine what happens to molecules inside a wave?

Lesson Objectives

- **Big Science Idea**: Waves have predictable motions.
    - **Key Takeaways**:
        - Waves transfer energy through matter while matter stays in place.
- **Science and Engineering Practice**: **Develop and Use Models** Scholars engage in this Science and Engineering Practice as they distinguish between a model and the scientific phenomena the model represents.

Materials Needed

- For each table: clear water bins, cork, small rubber duck, deli tray lid

Prep

- Fill each bin ⅓ full with water.

[**Materials Tip**: Materials can easily be substituted.]

Launch

- Show scholars a picture of a world map.
    - What do all of the blue parts of this map represent?
    - What would happen if any tiny water molecules were vibrating? Define **molecule**.
- Present the lesson challenge:
    - Explore a model to determine the answer to another audience question, "What happens to molecules inside a wave?"

[**Instructional Tip**: Explicitly explain the model scholars will be using. They should know that the objects in the water represent molecules, and scholars will be creating vibrations in the water.]

Activity

- Scholars work together in groups to explore the wave model at their table and determine how molecules behave in a wave.
- Circulate to look for scholars who are recording their noticings in their lab notebooks. Press them to explain how the object in the water helps them understand what happens to molecules inside a wave and how they know. Look for scholars who are showing the movement in their drawings.
- **Procedure**:
    - One scholar places the cork inside one end of the water bin.
    - One scholar vibrates the other end of the water bin by quickly and gently moving the deli tray lid up and down inside the water, discussing and recording their observations in their lab notebooks.
    - Scholars repeat the process with a different material (rubber duck).

    - Scholars discuss what each part of their model (moving deli tray lid, objects in water) represents and how their water wave model shows how all molecules in all waves behave.

Discourse

- **Debrief activity:**
    - What happened to the objects in the water bin when the waves moved through them? Why do you think that happened?
    - How does this model help us understand how other waves work?
- Draw a wave on the classroom easel. Draw three small circles at the beginning of the wave and explain to scholars that the three circles represent three water molecules. Define *molecule*.
- Tell (or write down) the following claim for scholars to analyze: “Water molecules move from the beginning to the end of a wave.”
    - Do you agree or disagree with that idea?
    - Why do you think that?
- **Make broader connections:** Show scholars a video of the world’s largest crowd wave.
    - What do the people in this model represent?

Accountability (Informal)

Use scholar work and conversation to assess how well scholars understand the Big Science Idea: Waves have predictable motion. By the end of the lesson, scholars must understand that when waves move across the surface of deep water, the water goes up and down in place and does not move in the direction of the wave, as indicated by the floating materials in the bin.

Lesson 6: Seeing Sound

Scholars deeply studied the patterns among vibrating objects, but what about vibrations you *can't* see? Today, scholars return back to sound vibrations and explore ways to make the invisible visible.

Lesson Objectives

- **Big Science Idea**: Sound moves matter in a particular way.
  - **Key Takeaways**:
    - There is an observable relationship between waves and the movement of small bits of matter.
- **Science and Engineering Practice**: **Develop and Use Models** Scholars engage in this Science and Engineering Practice as they use observations to describe relationships.

Materials Needed

- For the teacher: small container of bubbles
- For each table: large plastic cup, plastic wrap, rubber band, aluminum pie pan, wooden spoon, a pinch of salt

Prep

- Tightly stretch plastic wrap over the mouth of the cup and secure with a rubber band.

Launch

- Show scholars a video clip of wind blowing over people.
  - What's happening to the people? How do you know?
- Explain to scholars that some molecules, such as air molecules, are invisible. Even though we can't see air, we know it's there because we can observe the moving air pushing people!
- Present the lesson challenge:
  - Explore the connection between sounds and molecule movements. Search for evidence that sounds move in waves through the air for the Sound Experts to use during the Science Concert.

[**Content Tip**: Scholars may struggle to make the connection between invisible sound waves and their effect on small bits of matter. If time permits, consider conducting this extra experiment with your scholars that proves the existence of air before teaching Lesson 6.]

Activity

- Circulate to look for scholars who are recording their noticings in their lab notebooks. Press them to explain the relationship between sound and the movement of salt.
- **Procedure**:
  - Scholars sprinkle salt (or other similarly sized particles) on top of the large cup covered in plastic wrap.
  - Scholars hold the pan and spoon in the air near the large cup and hit the pan with the spoon.
  - Scholars observe and record what happens to the salt when a sound is made.
  - Scholars discuss how sound moves through the air and how they know.

Discourse

- **Debrief activity:**
    - How did you make a sound with the pan and spoon?
    - What happened to the salt when you hit the pan with the spoon?
    - What is your evidence that the sound is moving in a wave?
- **Make broader connections:** Show scholars a picture of a bubble.
    - Ask scholars to predict what might happen if they make a sound near the bubble.
    - Blow a bubble for scholars. Clap near the bubble, which will cause it to pop.
        - Why did the bubble pop when I clapped?
    - Answer the second audience question on the questions anchor chart (What happens to molecules inside a wave?).
        - How can we use a model to show the audience how molecules move inside a wave?
    - Show scholars a video clip of the "Catch a Sound Wave" Sid the Science Kid song.

Accountability (Informal)

Use scholar conversation and work to assess how well scholars understand the lesson's Big Science Idea: Sound moves in a particular pattern. By the end of this lesson, scholars must know that sound travels in waves through air, comparable to waves traveling in water. They will see this as they observe the salt "jumping" when they bang on the metal tray. Note scholars that struggle to articulate the relationship between sound waves and their effect on small bits of matter. Consider how you can support these scholars in upcoming lessons.

Lesson 7: Detecting Different Sounds

The Sound Experts' problem has been solved, and the wave presentation is being finalized! Scholars will now extend their knowledge of sound to determine different sounds they can create in order to perform the most exciting concert possible for their audience.

Lesson Objectives

- **Big Science Idea**: Humans use their senses to detect the effect of waves.
  - **Key Takeaways**:
    - There are observable patterns within different kinds of sound.
- **Science and Engineering Practice**: **Develop and Use Models** Scholars engage in this Science and Engineering Practice as they use observations to describe patterns.

Materials Needed

- For the teacher: 2 pennies, 2 hex nuts, 2 balloons
- For each table: deli trays with lids, beads, closed film canister with small materials inside, open deli tray, 3 rubber bands with different thickness

Prep

- Place the penny inside a balloon, inflate, and tie. Repeat the process with a hex nut and the second balloon. Keep an extra penny and hex nut available, so scholars can observe the differences in their shapes, sizes, etc.
- Place beads inside each deli tray and close the lid. Consider taping the lid shut to prevent accidental spills.
- Stretch three different rubber bands over the open deli tray. Consider securing the rubber bands by taping them to the bottom of the tray.

Launch

- Show scholars a picture of a child covering their ears.
  - Why would this child cover his ears?
  - What sense is he protecting?
- Present the lesson challenge:
  - Create sounds to answer the next audience question, "What are the different kinds of sound that humans can detect?" Use your senses to detect patterns between different kinds of sounds.

Activity

- Circulate to look for scholars who are collaborating to complete each activity and recording their data accurately in their lab notebook. Press scholars to explain what senses they use to detect each sound and the patterns they notice between the different sounds.
- **Procedure**:
  - Activity 1: Scholars take turns tapping the bead drum gently with their pencil and then discuss and record the kind of sound they heard.
  - Activity 2: Scholars take turns tapping the bead drum hard with their pencil and then discuss and record the kind of sound they heard.

    - Activity 3: Scholars take turns shaking the film canister gently and then discuss and record the kind of sound they heard.
    - Activity 4: Scholars take turns shaking the film canister hard and then discuss and record the kind of sound they heard.
    - Activity 5: Scholars take turns plucking each rubber band stretched over the deli tray and then discuss and record the different sounds they heard.
    - Scholars discuss all the ways they can describe each sound and the patterns they noticed between the different sounds.

Discourse

- **Debrief activity:**
    - How would you describe the different sounds you detected?
    - What patterns did you notice about the different sounds?
    - Can you think of other sounds that follow the same pattern?
        - [**Instructional Tip**: Ask scholars to think of other sounds that follow the same pattern that they notice. For example, if scholars notice that sounds become louder when you hit the material harder, prompt scholars to think about clapping as a way to continue the pattern.]
- **Make connections to the essential question:** What type of sounds will be best for the Science Concert? How can we make these sounds?
- **Make broader connections:** Show scholars a picture of a penny and a hex nut under the projector. Explain that you placed each of these objects in different balloons and are curious what kind of sounds they'll make when you spin the balloon.
    - Hold the balloon with the penny inside upside down in the palm of your hand and spin the balloon in a rapid circular motion. Repeat the process with the hex nut balloon.
        - What patterns did you notice about the two sounds?
    - Add any new words that describe the sound to the anchor chart created during the discussion.

Accountability (Exit Ticket)

This Exit Ticket assesses scholars' understanding of the lesson's Big Science Idea. In this lesson, scholars should notice patterns while exploring at the table. Scholars do not need to know that sounds can have different pitches and volumes.

Assignment:

Shadae noticed that her baby sister responded differently to different sounds. She recorded what she observed in the chart below.

Noise	Baby Reaction
Loud vacuum cleaner	Baby cries

Loud car honk	Baby cries
Quietly purring cat	Baby smiles
Quiet lullaby song	Baby smiles

1. Circle the pattern below that is true. [1]

The baby cries when there are quiet sounds.
The baby cries when there are loud sounds.
The baby smiles when there are loud sounds.

Scoring:

1. Award 1 point for indicating **“The baby cries when there are loud sounds”.**

Lesson 8: Communication Challenge

How can scholars make sure their sound waves travel to everyone in the audience? Today, scholars will sort sounds based on the differences they noticed from the previous lesson and discuss which types of sounds they should use during the concert to ensure that everyone can hear their beautiful music.

Lesson Objectives

- **Big Science Idea**: Waves can be used to communicate information.
  - **Key Takeaways**:
    - Sounds are used to communicate over different distances.
    - Sounds can be described in different ways.
- **Science and Engineering Practice**: **Develop and Use Models** Scholars engage in this Science and Engineering Practice as they use observations to describe relationships.

Materials Needed

- For each table: pictures of different sounds, including (for example):
  - Whispering
  - Ticking clock
  - Blowing fan
  - Yelling
  - Fire truck siren
  - Fireworks
  - Mouse
  - Baby bird
  - Squeaky door
  - Lion
  - Thunderstorm
  - Explosion

Prep

- Print and cut out enough pictures of different sounds for each group.

Launch

- Play a sound of a baby crying.
  - How would you describe this sound?
  - Why would a baby cry? Define **communicate**.
- Present the lesson challenge:
  - Sort different sounds into groups based on what they have in common. Discuss what kind of sounds the Sound Experts should use during their presentation so that they can communicate to everyone in the audience, even if they are far away.

Activity

- Circulate to look for scholars that are collaborating while they sort. Press scholars to explain how they sorted their objects and identify similarities and differences between each group they created.

    - [**Materials Tip**: The pictures should show sounds with different volumes and pitches. Consider adding pictures to represent different kinds of sounds based on the way that scholars described sounds.]
- **Procedure**:
    - Scholars sort the pictures into groups based on their similarities and record their sort in their lab notebook.
    - Scholars discuss what kind of sound will be able to communicate information to the audience and why.

Discourse

- **Debrief activity:**
    - How did you sort the sound pictures?
    - What does each group of sounds have in common?
    - Can you sort these pictures in more than one way?
- **Make connections to the essential question:** What kind of sound should the Sound Experts use to communicate what they've learned to the audience?
- **Make broader connections:** Show the scholars' individual sound pictures they used to sort with during the activity.
    - What kind of information is this sound communicating to you?

Accountability (Exit Ticket)

This Exit Ticket assesses scholars' understanding of the lesson's Big Science Idea. Use this Exit Ticket as well as scholar work and conversation to assess how well scholars understand that waves can be used to communicate different types of sounds.

Assignment:

Yolanda wanted to get the attention of a friend who was all the way at the other end of the playground. She decides to play her new drum to get her friend's attention.

1. How should she play the drum to get her friend's attention? Circle the answer below. [1]

With a lot of energy **With a little energy**

Scoring:

1. Award 1 point for selecting "with a lot of energy".

Lesson 9: Engineering an Instrument: Design

The opening night of the Science Concert is just a few short days away! Can scholars put together all of their knowledge about vibrations, waves, and sound in order to create their concert instrument?

Lesson Objectives

- **Big Science Idea**: Humans create and use tools to communicate over long distances.
    - **Key Takeaways**:
        - Tools (e.g., instruments) can be used to communicate information to others over long distances.
        - Different models can be used to solve the same problem. These models have at least some similarities.
- **Science and Engineering Practice**: **Develop and Use Models** Scholars engage in this Science and Engineering Practice as they use models to understand scientific phenomena.

Materials Needed

- For each table: engineering materials (suggested materials: cardboard tubes, beads, rubber bands of different sizes, empty boxes and containers of different sizes [cups, tissue box, deli trays], straws, film canisters, Ziploc bag, tape, scissors)

Launch

- Show scholars a picture of a large empty concert hall and a microphone.
    - What are some challenges our team will face if the Science Concert was in this room?
    - What tool do you see that could help you communicate to the people in the very back of the audience?
- Present the lesson challenge:
    - Brainstorm ideas for an instrument that can communicate soft and loud sounds to the audience, using the materials provided. Choose one instrument to create and begin building your instrument as a team.

[**Instructional Tip**: Lessons 9 and 10 can be structured in multiple ways. This lesson and lab notebook is currently written to challenge scholars to create an instrument that creates loud sounds and soft sounds. Based on your class's progress, consider altering the constraints by eliminating this requirement or add constraints based on the types of sounds your scholars have noticed during the previous two lessons (e.g., medium sounds, high and low sounds).]

Activity

- Scholars work together as a table half to design and begin building an instrument that will play loud and soft sounds during the Science Concert.
- Circulate to look for scholars who can explain how their team's chosen design will make loud and soft sounds. Choose scholars to share their designs during Discourse.
- **Procedure**:
    - Scholars brainstorm ideas for their instrument using the materials provided and record their ideas in their lab notebook.

    - Scholars select a final design for their instrument and begin to build their instrument together.

[**Instructional Tip**: Consider showing scholars pictures of homemade instruments if scholars are having difficulties brainstorming ways to create an instrument with the provided materials.]

Discourse

- **Debrief activity:** Show two scholar designs.
    - Why did you choose these materials to create your instrument?
    - How will you make sure that everyone in the audience can hear your instrument?
    - How can you make your instrument make loud and soft sounds?
- **Make connections to the essential question:** How did you design an instrument to use in the outstanding Science Concert?

Accountability (Informal)

Use conversations and scholar work to assess how well scholars understand the lesson's Big Science Idea: Humans create tools to communicate over long distances. Scholar work should reflect two different volumes. If scholars are struggling with this idea, consider how you can support them in the final lesson.

Lesson 10: Engineering an Instrument: Build

Scholars have worked hard and prepared diligently for the Science Concert. They will finally use their plans to create an instrument that can create both loud and soft sounds for the performance.

Lesson Objectives

- **Big Science Idea**: Humans create and use tools to communicate over long distances.
  - **Key Takeaways**:
    - Tools (e.g., instruments) can be used to communicate information to others over long distances.
    - Different models can be used to solve the same problem. These models have at least some similarities.
- **Science and Engineering Practice**: **Develop and Use Models** Scholars engage in this Science and Engineering Practice as they use models to understand scientific phenomena.

Materials Needed

- For each table: engineering materials (suggested materials: cardboard tubes, beads, rubber bands of different sizes, empty boxes and containers of different sizes [cups, tissue box, deli trays], straws, film canisters, Ziploc bag, tape, scissors)

Launch

- Ask scholars to raise their hand if they have a family member or a friend that they communicate with that lives far away.
  - How do you communicate with them if you can't travel all the way to their house?
- Present the lesson challenge:
  - Complete your instrument model started in the previous class. Play your instrument in the Science Concert.

Activity

- Scholars work together as a half-table group to finish building an invention that will play loud and soft sounds during the Science Concert.
- Circulate to look for scholars who can explain how their team's chosen design will make loud and soft sounds. Choose scholars to share their instruments with the whole class during the Activity.
- **Procedure**:
  - Scholars finish building their instruments using the materials they selected the previous day.
  - Scholars test their instruments to see if they can make loud and soft sounds.
  - Scholars discuss ways to improve their instrument and record in their Lab Notebooks.

[**Content Tip**: If time permits, consider extending the engineering lessons by asking each table to create a small presentation that answers one of the audience questions throughout the unit. Scholars can answer these questions during the Science Concert if you're choosing to invite others to the event. Alternatively, you can film scholars' presentations.]

Discourse

- **Debrief activity:** Showcase scholar instruments.

    - How will you play your instrument so that everyone in the audience can hear it?
    - How does your instrument make loud and soft sounds?
    - What could you do to make your instrument even better?
- **Make connections to the essential question:** How did you design an instrument to use in the outstanding Science Concert?
- **Make broader connections:**
    - Show scholars a picture of a telegraph. Briefly explain to scholars that telegraphs were invented before telephones were invented and that the telegraph could only make one beeping sound.
    - Show scholars a picture of the Morse code alphabet and briefly explain what the dots and dashes mean.
        - How did people use this tool to communicate without using their voices?

Accountability (Informal)

Use conversations, scholar designs, and scholar revision ideas to assess how well scholars understand the lesson's Big Science Idea: Humans create tools to communicate over long distances. Scholar work should reflect two different volumes. If time allows, plan a flex lesson where scholars get to make revisions to their designs. Consider how you can support scholars who struggle to articulate that humans create tools to communicate over long distances and support them in incorporating this idea into their instrument.

Unit Vocabulary

- **matter** - anything that has mass and takes up space
- **molecule** - the smallest bits of matter
- **motion** - a change in position
- **vibration** - back and forth motions
- **wave** - regular patterns of motion
- **sound wave** - a type of **wave** that can be detected by humans' ears
- **communicate** - the way that humans share thoughts, feelings, and information
- **travel** - to move to a new location
- **relationship** - a type of connection

Extra Resources

In addition to the resources linked throughout the guide, use the following materials to help you prepare to launch this unit with scholars:

- Lab Notebook
- Unit-Specific Content - Resources to help you understand content at an adult level

