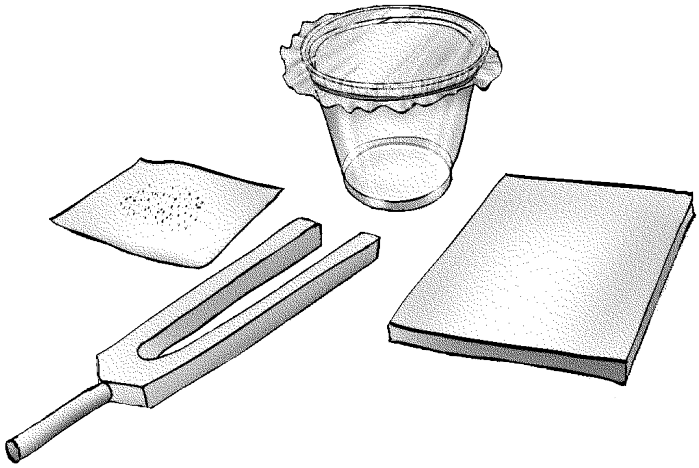
ASSESSMENT
PHYSICS OF SOUND



This folio contains a variety of resources that help teachers assess student progress in reaching Grade Level Expectations (GLEs) as outlined in the Essential Academic Learning Requirements (EALRs) for science. These materials have been designed for Washington State teachers using the 2000 edition of FOSS. Look in the Assessment Overview, available at www.smerc.org, for more on how to use these classroom-based assessments.

Scoring guides for each of the assessments begin on page 4, using a +/✓/– rubric.

+	going beyond expectations
✓	meeting expectations
–	below expectations

The summative assessment scores more complex items with a 0–4 rubric.

4	going beyond expectations
3	meeting expectations
2	close to expectations
1	below expectations
0	off task, or no response

NOTE: *This edition is the result of collaboration among FOSS staff at Lawrence Hall of Science, the Science and Math Education Resource Center (SMERC) at ESD 112, and many dedicated teachers in Washington State.*

The Washington Edition was made possible by the generous support of the following organizations: Delta Education; Educational Service District 112; Eisenhower Funding; Hewlett-Packard; Intel; Lawrence Hall of Science at the University of California, Berkeley; Washington State School Districts; and Washington State University, Vancouver.

ASSESSMENT CONTENTS

INVESTIGATION DUPLICATION MASTER CHANGES

New student sheets
- no. 2a *Drop Challenge*
- no. 3a *The Tone Generator*
- *Inquiry Project Sheets*

Modified student sheets
- no. 3 *Response Sheet—Investigation 1* (replacing *Dropping In*
- no. 6 *The Waterphone*
- no. 7 *The Xylophone*
- no. *8 The Kalimba*
- no. *9 The String Beam*
- no. *10 Response Sheet—Investigation 2* (replacing *Good Vibrations*
- no. 15 *Response Sheet—Investigation 3* (replacing *How Sound Travels)*
- no. 21 *The Minigutbucket Challenge*
- no. 24 *The Waterphone and Xylophone Challenge*

INQUIRY	INVESTIGATION SUMMARY

PART 1

DROP CHALLENGE

- What are the properties of sounds that make them identifiable?

Time: 30–40 minutes

Students explore their ability to discriminate sounds. They listen to sounds made by objects dropped into a drop chamber and attempt to identify each object from its sound.

PART 2

DROP CODES

- Can you use the discrimination of sounds to make a code for sending messages?

Time: 50 minutes or two shorter sessions

Students develop a code by assigning letters of the alphabet to a selection of objects. Using this sound code, the students send messages to one another by dropping a series of objects into the drop chamber.

PART 3

SOUND AND VIBRATIONS

- How are sounds made?

Time: 50 minutes or two shorter sessions

Students explore the production of sound with a door fiddle, an electronic tone generator, and two other sound instruments. Through these explorations, students look for vibrations at the sound source, identify sound receivers, and compare sound volume to vibration intensity.

WASHINGTON EDITION—AT A GLANCE

CONCEPTS AND PRINCIPLES	ASSESSMENT OPPORTUNITIES
• Sounds have identifiable characteristics. • Objects can be identified by the sound they make when dropped.	**New Student Sheet** *Drop Challenge* **Properties of Substances.** Understand how to use properties to sort natural and manufactured materials and objects. (GLE 1.1.1)
• The identifiable properties of sounds can be used to make a code. • Sounds can convey information.	**Modified Student Sheet** *Response Sheet—Investigation 2* **Evaluating Potential Solutions.** Analyze how well a design or a product solves a problem. (GLE 3.1.3)
• Sound is caused by vibrations. • A sound source is an object that is vibrating. • A sound receiver detects sound vibrations. • The intensity of the vibration determines the volume.	**New Student Sheet** *The Tone Generator* **Forms of Energy.** Understand that energy comes in many forms. (GLE 1.1.4) **Energy Transfer and Transformation.** Understand that energy can be transferred from one object to another and can be transformed from one form of energy to another. (GLE 1.2.2)

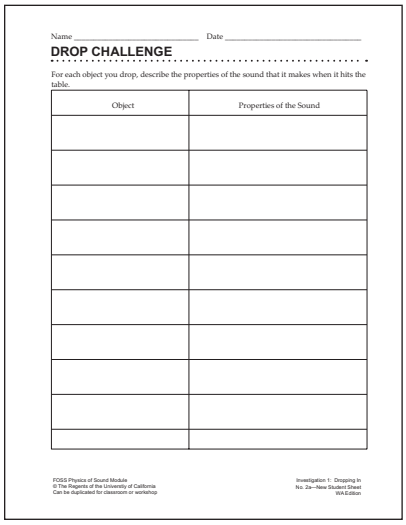
Examples of questions students might generate for inquiry projects

- What materials work best for making sounds we can tell apart?
- Does it make a louder sound to drop from a high or low position?

INVESTIGATION 1: DROPPING IN

PART 1: DROP CHALLENGE

Use new student sheet no. 2a called *Drop Challenge.*



Name _____ Date _____

DROP CHALLENGE

For each object you drop, describe the properties of the sound that it makes when it hits the table.

Object	Properties of the Sound

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Can be duplicated for classroom or workshop

Investigation 1: Dropping In
No. 2a—New Student Sheet
Kit Edition

No. 2a—New Student Sheet

Student Sheet—Drop Challenge	
Properties of Substances. Understand how to use properties to sort natural and manufactured materials and objects. (GLE 1.1.1)	
Score	**If the student...**
+	identifies multiple properties for the sound made by each object when dropped and/or gives detailed description of the sound.
✓	identifies a property of the sound made by each object when dropped.
–	is not able to identify a property of the sound or discriminate between sounds.

GOING FURTHER

If students are having difficulty describing the properties of sound, continue to work on this concept and make observations in Part 2. This concept of sound properties is important to students' success with later investigations around pitch and volume.

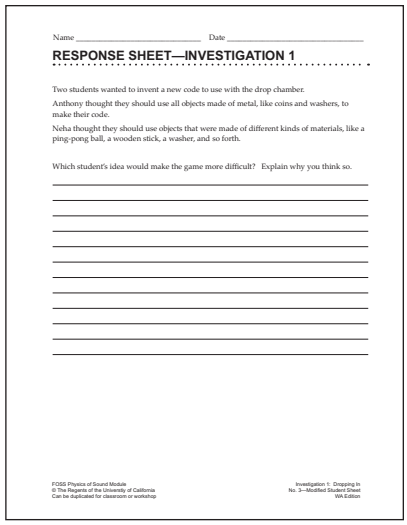
Name _____ Date _____

DROP CHALLENGE

For each object you drop, describe the properties of the sound that it makes when it hits the table.

Object	Properties of the Sound

INVESTIGATION 1: DROPPING IN
PART 2: DROP CODES



Name _____ Date _____

RESPONSE SHEET—INVESTIGATION 1

Two students wanted to invent a new code to use with the drop chamber.

Anthony thought they should use all objects made of metal, like coins and washers, to make their code.

Neha thought they should use objects that were made of different kinds of materials, like a ping-pong ball, a wooden stick, a washer, and so forth.

Which student's idea would make the game more difficult? Explain why you think so.

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Investigation 1: Dropping In
No. 3—Modified Student Sheet
WA Edition

No. 3—Modified Student Sheet

Use modified student sheet no. 3 called *Response Sheet—Investigation 1.*

Response Sheet—Investigation 1	
Evaluating Potential Solutions. Analyze how well a design or a product solves a problem. (GLE 3.1.3)	
Score	**If the student...**
+	writes that Anthony's idea would be more difficult because his items are all made of metal and metal items would sound more similar than objects made of different materials.
✓	writes that Anthony's idea would be more difficult because his items are all made of metal but does not compare how Anthony's item would sound different from Neha's.
–	writes that Neha's idea would be better or gives no explanation why Anthony's idea would be better.

Name _____ Date _____

RESPONSE SHEET—INVESTIGATION 1

Two students wanted to invent a new code to use with the drop chamber.

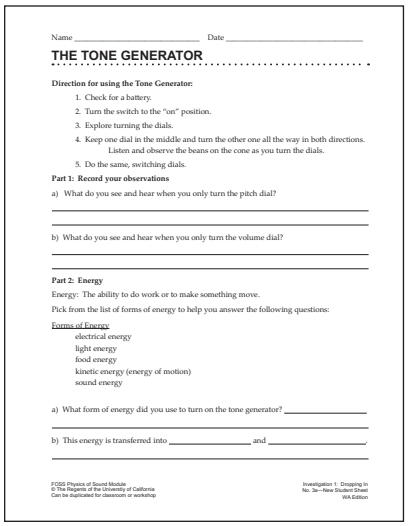
Anthony thought they should use all objects made of metal, like coins and washers, to make their code.

Neha thought they should use objects that were made of different kinds of materials, like a ping-pong ball, a wooden stick, a washer, and so forth.

Which student's idea would make the game more difficult? Explain why you think so.

INVESTIGATION 1: DROPPING IN

PART 3: SOUND AND VIBRATIONS



Name _____ Date _____

THE TONE GENERATOR

Direction for using the Tone Generator:

1. Check for a battery.
2. Turn the switch to the "on" position.
3. Explore turning the dials.
4. Keep one dial in the middle and turn the other one all the way in both directions. Listen and observe the beans on the cone as you turn the dials.
5. Do the same, switching dials.

Part 1: Record your observations

a) What do you see and hear when you only turn the pitch dial?

b) What do you see and hear when you only turn the volume dial?

Part 2: Energy

Energy: The ability to do work or to make something move.

Pick from the list of forms of energy to help you answer the following questions:

Forms of Energy
- electrical energy
- light energy
- food energy
- kinetic energy (energy of motion)
- sound energy

a) What form of energy did you use to turn on the tone generator? _____

b) This energy is transferred into _____ and _____

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Investigation 1: Dropping In
No. 3a—New Student Sheet
WA Edition

No. 3a—New Student Sheet

Answers:

1a: when the pitch dial is turned, the sound changes to high or low.

1b: when the volume dial is changed, the beans move more and the sound is louder.

2a: electrical energy.

2b: sound and kinetic energy (or energy of motion).

In order to meet WA GLEs 1.1.4 and 1.2.2, use new student sheet no. 3a called *The Tone Generator* to introduce the students to the concept of energy. Use as a station or as a teacher demonstration and have students record their observations

New Student Sheet—The Tone Generator, Part 1 and 2b	
Energy Transfer and Transformation. Understand that energy can be transferred from one object to another and can be transformed from one form of energy to another. (GLE 1.2.2)	
Score	**If the student...**
+	correctly describes the energy transfer occurring when the dials are turned (1a and 1b), **and** correctly answers 2b.
✓	correctly describes the energy transfer occurring when the dials are turned (1a and 1b), **or** correctly answers 2b.
–	is unable to correctly identify the energy transfer or transformations.

New Student Sheet—The Tone Generator, Part 2a	
Forms of Energy. Understand that energy comes in many forms. (GLE 1.1.4)	
Score	**If the student...**
✓	correctly identifies *electrical energy.*
–	identifies battery or gives other incorrect answer from the list.

Name _____ Date _____

THE TONE GENERATOR

Direction for using the Tone Generator:

1. Check for a battery.
2. Turn the switch to the "on" position.
3. Explore turning the dials.
4. Keep one dial in the middle and turn the other one all the way in both directions. Listen and observe the beans on the cone as you turn the dials.
5. Do the same, switching dials.

Part 1: Record your observations

a) What do you see and hear when you only turn the pitch dial?

_____

_____

b) What do you see and hear when you only turn the volume dial?

_____

_____

Part 2: Energy

Energy: The ability to do work or to make something move.

Pick from the list of forms of energy to help you answer the following questions:

<u>Forms of Energy</u>

electrical energy
light energy
food energy
kinetic energy (energy of motion)
sound energy

a) What form of energy did you use to turn on the tone generator? _____

_____

b) This energy is transferred into _____ and _____.

_____

INQUIRY

INVESTIGATION SUMMARY

PART 1

VIBRATION AND PITCH

- How are high and low sounds made?

Time: 30–40 minutes

Using their voices and tongue depressors, students look for evidence that different vibrations produce different pitches of sounds. They revisit the door fiddle and tone generator to look more closely at the vibrations that make high and low pitches.

PART 2

LENGTH AND PITCH

- How does length affect the rate of vibration, and therefore the pitch?

Time: 50 minutes or two shorter sessions

Students use a waterphone, xylophone, kalimba, and string beam to look at how length affects pitch. They study what happens when the length of the vibrating sound source changes.

PART 3

TENSION AND PITCH

- How does tension affect the rate of vibration, and therefore the pitch?

Time: 30–40 minutes

Students use a minigutbucket and a FOSS-ulele to look at how tension affects the pitch of a sound. They study what happens when the tension applied to a sound source changes.

WASHINGTON EDITION—AT A GLANCE

CONCEPTS AND PRINCIPLES	ASSESSMENT OPPORTUNITIES
• Sound originates from vibrating sources. • Pitch is how high or low a sound is. • Differences in pitch are caused by differences in the rate at which objects vibrate.	**Science Notebook** Vibrations and pitch **Wave Behavior.** Understand the behavior of sound in terms of vibrations and pitch and the behavior of light in terms of bouncing off, passing through, and changes in direction. (GLE 1.1.3)
• Long objects vibrate slowly and have a low pitch. • Short objects vibrate quickly and have a high pitch.	**Modified Student Sheets** *The Waterphone* *The Xylophone* *The Kalimba* *The String Beam* **Structure of Physical Earth/Space and Living Systems.** Analyze how the parts of a system go together and how these parts depend on each other. (GLE 1.2.1)
• With more tension, vibrations are faster and the pitch is higher. • With less tension, vibrations are slower and the pitch is lower.	**Modified Student Sheet** *Response Sheet—Investigation 2* **Wave Behavior.** Understand the behavior of sound in terms of vibrations and pitch and the behavior of light in terms of bouncing off, passing through, and changes in direction. (GLE 1.1.3)

Examples of questions students might generate for inquiry projects

- Will a plastic jump rope have the same pitch as a rope jump rope?
- Do different materials of the same length have different pitches?

INVESTIGATION 2: GOOD VIBRATIONS

PART 1: VIBRATION AND PITCH

Use science notebook prompts below to assess students' understanding of pitch.

Notebook Prompt

- *What is pitch?*
- *Compare how fast the vibrations are moving when you hear high and low pitches. How are they different?*

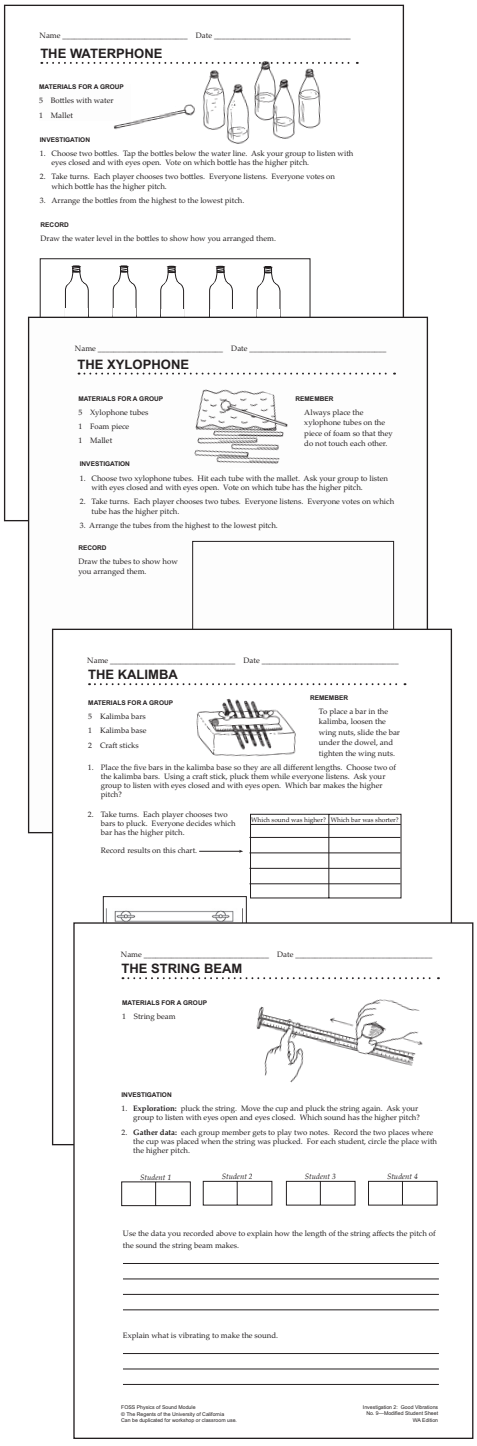
Science Notebook—Vibrations and pitch	
Wave Behavior. Understand the behavior of sound in terms of vibrations and pitch and the behavior of light in terms of bouncing off, passing through, and changes in direction. (GLE 1.1.3)	
Score	**If the student...**
✓	knows that pitch is how high or low a sound is and that the higher the pitch, the faster the vibrations; the lower the pitch, the slower the vibrations.
–	cannot define pitch or the relationship between vibration and pitch.

INVESTIGATION 2: GOOD VIBRATIONS

PART 2: LENGTH AND PITCH

Use modified student sheets nos. 6–9 called *The Waterphone, The Xylophone, The Kalimba,* and *The String Beam.*

Student Sheets—nos. 6-9	
Structure of Physical Earth/Space and Living Systems. Analyze how the parts of a system go together and how these parts depend on each other. (GLE 1.2.1)	
Score	**If the student...**
+	shows a clear understanding on all sheets that length and pitch are related—the longer the instrument, the lower the pitch; the shorter the instrument, the higher the pitch.
✓	shows a clear understanding on most of the sheets that length and pitch are related as described above.
–	does not see the relationship between length and pitch.



Name _____ Date _____

THE WATERPHONE

MATERIALS FOR A GROUP
5 Bottles with water
1 Mallet

INVESTIGATION
1. Choose two bottles. Tap the bottles below the water line. Ask your group to listen with eyes closed and with eyes open. Vote on which bottle has the higher pitch.
2. Take turns. Each player chooses two bottles. Everyone listens. Everyone votes on which bottle has the higher pitch.
3. Arrange the bottles from the highest to the lowest pitch.

RECORD
Draw the water level in the bottles to show how you arranged them.

Name _____ Date _____

THE XYLOPHONE

MATERIALS FOR A GROUP
5 Xylophone tubes
1 Foam piece
1 Mallet

REMEMBER
Always place the xylophone tubes on the piece of foam so that they do not touch each other.

INVESTIGATION
1. Choose two xylophone tubes. Hit each tube with the mallet. Ask your group to listen with eyes closed and with eyes open. Vote on which tube has the higher pitch.
2. Take turns. Each player chooses two tubes. Everyone listens. Everyone votes on which tube has the higher pitch.
3. Arrange the tubes from the highest to the lowest pitch.

RECORD
Draw the tubes to show how you arranged them.

Name _____ Date _____

THE KALIMBA

MATERIALS FOR A GROUP
5 Kalimba bars
1 Kalimba base
2 Craft sticks

REMEMBER
To place a bar in the kalimba, loosen the wing nuts, slide the bar under the dowel, and tighten the wing nuts.

1. Place the five bars in the kalimba base so they are all different lengths. Choose two of the kalimba bars. Using a craft stick, pluck them while everyone listens. Ask your group to listen with eyes closed and with eyes open. Which bar makes the higher pitch?
2. Take turns. Each player chooses two bars to pluck. Everyone decides which bar has the higher pitch.

Record results on this chart. →

Which sound was higher?	Which bar was shorter?

Name _____ Date _____

THE STRING BEAM

MATERIALS FOR A GROUP
1 String beam

INVESTIGATION
1. **Exploration:** pluck the string. Move the cup and pluck the string again. Ask your group to listen with eyes open and eyes closed. Which sound has the higher pitch?
2. **Gather data:** each group member gets to play two notes. Record the two places where the cup was placed when the string was plucked. For each student, circle the place with the higher pitch.

Student 1	*Student 2*	*Student 3*	*Student 4*

Use the data you recorded above to explain how the length of the string affects the pitch of the sound the string beam makes.

Explain what is vibrating to make the sound.

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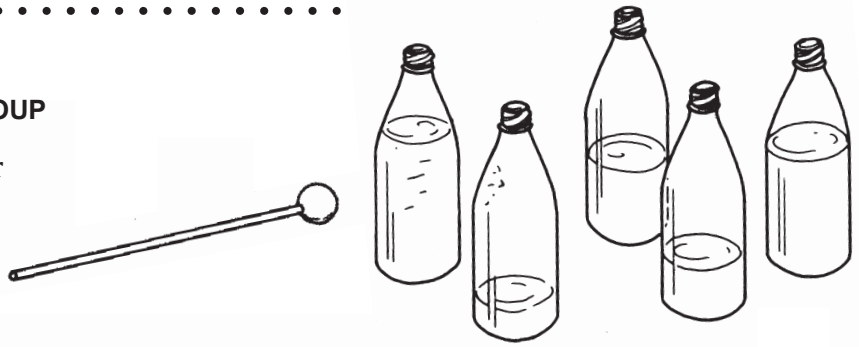
Investigation 2: Good Vibrations
No. 9—Modified Student Sheet
WA Edition

Nos. 6–9—Modified Student Sheet

Name _____ Date _____

THE WATERPHONE



MATERIALS FOR A GROUP

5 Bottles with water

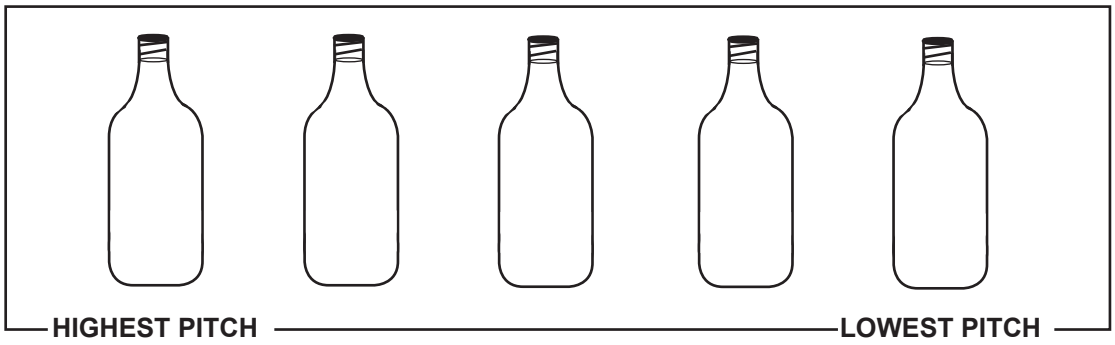
1 Mallet

INVESTIGATION

1. Choose two bottles. Tap the bottles below the water line. Ask your group to listen with eyes closed and with eyes open. Vote on which bottle has the higher pitch.
2. Take turns. Each player chooses two bottles. Everyone listens. Everyone votes on which bottle has the higher pitch.
3. Arrange the bottles from the highest to the lowest pitch.

RECORD

Draw the water level in the bottles to show how you arranged them.



Explain what is vibrating to make the sound.

_____

_____

_____

Compare a bottle with a lot of water and one with less water. How is the pitch different?

_____

_____

_____

Name _____ Date _____

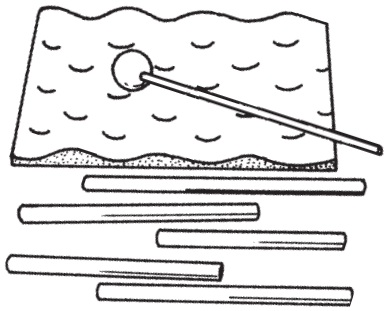
THE XYLOPHONE

MATERIALS FOR A GROUP

5 Xylophone tubes

1 Foam piece

1 Mallet



REMEMBER

Always place the xylophone tubes on the piece of foam so that they do not touch each other.

INVESTIGATION

1. Choose two xylophone tubes. Hit each tube with the mallet. Ask your group to listen with eyes closed and with eyes open. Vote on which tube has the higher pitch.
2. Take turns. Each player chooses two tubes. Everyone listens. Everyone votes on which tube has the higher pitch.
3. Arrange the tubes from the highest to the lowest pitch.

RECORD

Draw the tubes to show how you arranged them.

HIGHEST PITCH — **LOWEST PITCH**

Explain what is vibrating to make the sound.

_____

_____

_____

Compare a long tube and a short tube. How is the pitch different?

_____

_____

_____

Name _____ Date _____

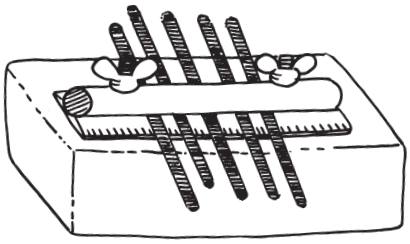
THE KALIMBA

MATERIALS FOR A GROUP

5 Kalimba bars

1 Kalimba base

2 Craft sticks



REMEMBER

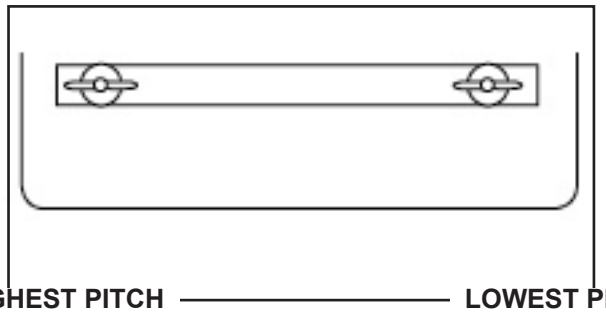
To place a bar in the kalimba, loosen the wing nuts, slide the bar under the dowel, and tighten the wing nuts.

1. Place the five bars in the kalimba base so they are all different lengths. Choose two of the kalimba bars. Using a craft stick, pluck them while everyone listens. Ask your group to listen with eyes closed and with eyes open. Which bar makes the higher pitch?

2. Take turns. Each player chooses two bars to pluck. Everyone decides which bar has the higher pitch.

   Record results on this chart. →

Which sound was higher?	Which bar was shorter?



HIGHEST PITCH ——— **LOWEST PITCH**

Explain what is vibrating to make the sound.

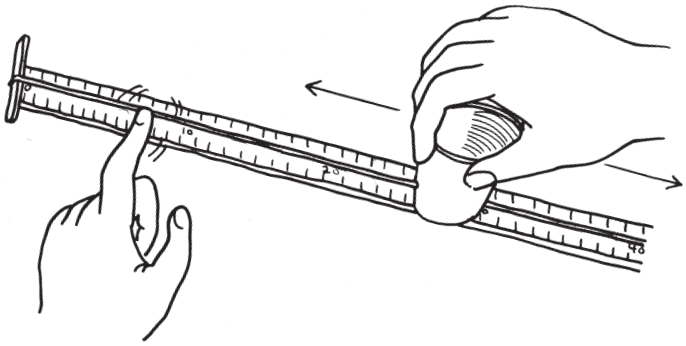
How did you change the length of the kalimba bars in order to change the pitch?

Name _____ Date _____

THE STRING BEAM

MATERIALS FOR A GROUP

1 String beam



INVESTIGATION

1. **Exploration:** pluck the string. Move the cup and pluck the string again. Ask your group to listen with eyes open and eyes closed. Which sound has the higher pitch?
2. **Gather data:** each group member gets to play two notes. Record the two places where the cup was placed when the string was plucked. For each student, circle the place with the higher pitch.

Student 1	*Student 2*	*Student 3*	*Student 4*

Use the data you recorded above to explain how the length of the string affects the pitch of the sound the string beam makes.

_____

_____

_____

_____

Explain what is vibrating to make the sound.

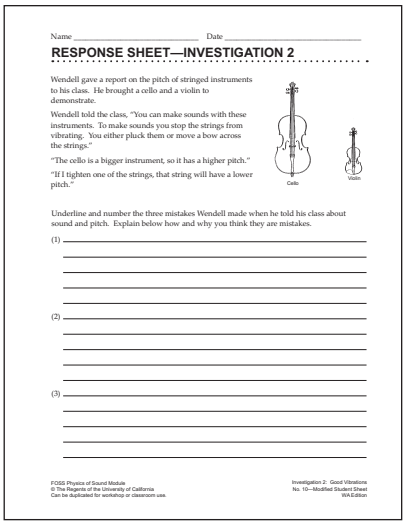
_____

_____

_____

INVESTIGATION 2: GOOD VIBRATIONS

PART 3: TENSION AND PITCH



Name _____ Date _____

RESPONSE SHEET—INVESTIGATION 2

Wendell gave a report on the pitch of stringed instruments to his class. He brought a cello and a violin to demonstrate.

Wendell told the class, "You can make sounds with these instruments. To make sounds you stop the strings from vibrating. You either pluck them or move a bow across the strings."

"The cello is a bigger instrument, so it has a higher pitch."

"If I tighten one of the strings, that string will have a lower pitch."

Cello

Violin

Underline and number the three mistakes Wendell made when he told his class about sound and pitch. Explain below how and why you think they are mistakes.

(1)

(2)

(3)

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Investigation 2: Good Vibrations
No. 10—Modified Student Sheet
WA Edition

No. 10—Modified Student Sheet

Use modified student sheet no. 10 called *Response Sheet—Investigation 2.*

Response Sheet—Investigation 2	
Wave Behavior. Understand the behavior of sound in terms of vibrations and pitch and the behavior of light in terms of bouncing off, passing through, and changes in direction. (GLE 1.1.3)	
Score	**If the student...**
4	is able to correctly identify all three mistakes (as listed under a "3" score) and gives a further explanation for each, such as "something must be vibrating in order for there to be sound" or "bigger or longer objects have a lower pitch, not higher" or "when you increase the tension the pitch gets higher, not lower."
3	is able to correctly identify all three mistakes and gives the correct responses: 1) change "stop the strings from vibrating" to "start the strings vibrating", 2) change "higher pitch" to "lower pitch"; and 3) change "lower pitch" to "higher pitch"
2	is able to correctly identify two of the three mistakes (as listed under a "3" score).
1	is able to correctly identify one of the 3 mistakes (as listed under a "3" score).
0	is not able to correctly identify any of the mistakes.

Name _____ Date _____

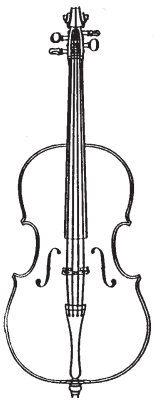
RESPONSE SHEET—INVESTIGATION 2

Wendell gave a report on the pitch of stringed instruments to his class. He brought a cello and a violin to demonstrate.

Wendell told the class, "You can make sounds with these instruments. To make sounds you stop the strings from vibrating. You either pluck them or move a bow across the strings."

"The cello is a bigger instrument, so it has a higher pitch."

"If I tighten one of the strings, that string will have a lower pitch."



Cello

Violin

Underline and number the three mistakes Wendell made when he told his class about sound and pitch. Explain below how and why you think they are mistakes.

(1) _____

(2) _____

(3) _____

INQUIRY

INVESTIGATION SUMMARY

PART 1

SOUNDS THROUGH AIR AND WATER

- Can sounds travel through liquids?
- Can sounds travel through air?
- How is sound different when heard through air or water?

Time: 30–40 minutes

Students use listening tubes and tuning forks to compare how sound travels through air in two ways—simply by playing the tuning fork in air, and by using a tube to direct the sound. They use stethoscopes placed in water to determine whether sound can travel through liquid. They compare the shape of a megaphone to that of their outer ears for directing sound through air.

PART 2

SOUNDS THROUGH SOLIDS

- Can sound travel through solids?
- How is sound different when heard through solids?

Time: 40–50 minutes

Students listen through string telephones and wood dowels to determine how well sound travels through solids. They compare the results to the sounds they observed when sound traveled through air and water.

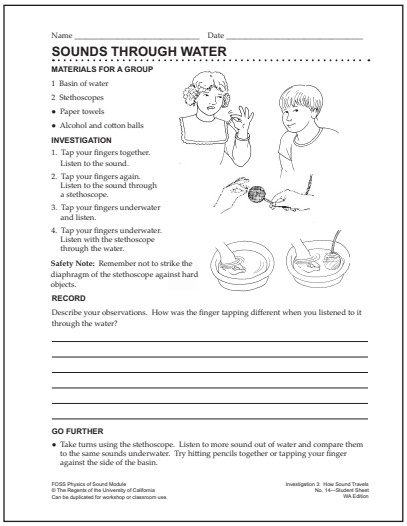
CONCEPTS AND PRINCIPLES	ASSESSMENT OPPORTUNITIES
• Sound vibrations need a medium to travel through. • Sound travels through water. • Sound travels through air. • Sound that is directed travels better through air. • Our outer ears are designed to receive, focus, and amplify sounds.	**Student Sheet** *Sounds Through Water* **Intellectual Honesty.** Understand that all scientific observations are reported accurately and honestly even when the observations contradict expectations. (GLE 2.2.1)
• Sound travels through solids.	**Modified Student Sheet** *Response Sheet—Investigation 3* **Explaining.** Understand how to construct a reasonable explanation using evidence. (GLE 2.1.3)

Examples of questions students might generate for inquiry projects

- How can I stop sound from traveling through water?
- If I bang two rocks together under water and listen with a stethoscope, does the size of the rocks affect how loud the sounds are?
- Will sounds travel through milk? Syrup?

INVESTIGATION 3: HOW SOUND TRAVELS

PART 1: SOUNDS THROUGH AIR AND WATER



Name _____ Date _____

SOUNDS THROUGH WATER

MATERIALS FOR A GROUP

1 Basin of water
2 Stethoscopes
• Paper towels
• Alcohol and cotton balls

INVESTIGATION

1. Tap your fingers together. Listen to the sound.
2. Tap your fingers again. Listen to the sound through a stethoscope.
3. Tap your fingers underwater and listen.
4. Tap your fingers underwater. Listen with the stethoscope through the water.

Safety Note: Remember not to strike the diaphragm of the stethoscope against hard objects.

RECORD

Describe your observations. How was the finger tapping different when you listened to it through the water?

GO FURTHER

• Take turns using the stethoscope. Listen to more sound out of water and compare them to the same sounds underwater. Try hitting pencils together or tapping your finger against the side of the basin.

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Investigation 3: How Sound Travels
No. 14—Student Sheet
WA Edition

No. 14—Student Sheet

Use student sheet no. 14 called *Sounds Through Water* along with teacher interview. If students are answering incorrectly, determine whether the student performed the task incorrectly or has a problem with believing their results because these results contradict their expectation.

Student sheet—Sounds Through Water	
Intellectual Honesty. Understand that all scientific observations are reported accurately and honestly even when the observations contradict expectations. (GLE 2.2.1)	
Score	**If the student...**
+	reports that the sound is louder in the water and generalizes that sound travels better in water (sound is louder and/or travels farther in water).
✓	reports that the sound is louder in the water.
–	reports that the sound is louder in the air.

Name _____ Date _____

SOUNDS THROUGH WATER

MATERIALS FOR A GROUP

1 Basin of water

2 Stethoscopes

- Paper towels
- Alcohol and cotton balls

INVESTIGATION

1. Tap your fingers together. Listen to the sound.
2. Tap your fingers again. Listen to the sound through a stethoscope.
3. Tap your fingers underwater and listen.
4. Tap your fingers underwater. Listen with the stethoscope through the water.

Safety Note: Remember not to strike the diaphragm of the stethoscope against hard

RECORD

Describe your observations. How was the finger tapping different when you listened to it through the water?

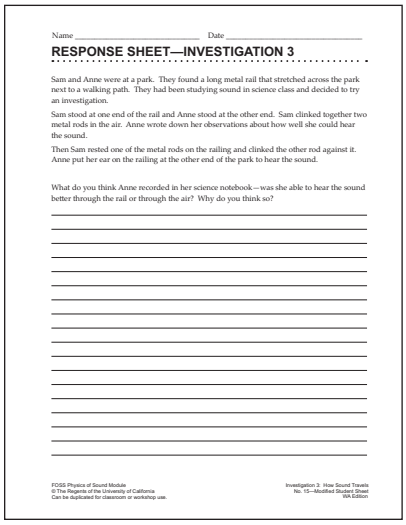
GO FURTHER

- Take turns using the stethoscope. Listen to more sound out of water and compare them to the same sounds underwater. Try hitting pencils together or tapping your finger against the side of the basin.

INVESTIGATION 3: HOW SOUND TRAVELS

PART 2: SOUNDS THROUGH SOLIDS

Use modified student sheet no. 15 called *Response Sheet—Investigation 3.*



Name _____ Date _____

RESPONSE SHEET—INVESTIGATION 3

Sam and Anne were at a park. They found a long metal rail that stretched across the park next to a walking path. They had been studying sound in science class and decided to try an investigation.

Sam stood at one end of the rail and Anne stood at the other end. Sam clinked together two metal rods in the air. Anne wrote down her observations about how well she could hear the sound.

Then Sam rested one of the metal rods on the railing and clinked the other rod against it. Anne put her ear on the railing at the other end of the park to hear the sound.

What do you think Anne recorded in her science notebook—was she able to hear the sound better through the rail or through the air? Why do you think so?

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Investigation 3: How Sound Travels
No. 15—Modified Student Sheet
WA Edition

No. 15—Modified Student Sheet

Response sheet—Investigation 3	
Explaining. Understand how to construct a reasonable explanation using evidence. (GLE 2.1.3)	
Score	**If the student...**
+	states that Anne was able to hear the sound better through the rail than through the air and explains that sound travels better through solids than through air.
✓	states that Anne was able to hear the sound better through the rail than through the air.
–	incorrectly states that Anne was able to hear the sound better through the air than through the rail.

Name _____ Date _____

RESPONSE SHEET—INVESTIGATION 3

Sam and Anne were at a park. They found a long metal rail that stretched across the park next to a walking path. They had been studying sound in science class and decided to try an investigation.

Sam stood at one end of the rail and Anne stood at the other end. Sam clinked together two metal rods in the air. Anne wrote down her observations about how well she could hear the sound.

Then Sam rested one of the metal rods on the railing and clinked the other rod against it. Anne put her ear on the railing at the other end of the park to hear the sound.

What do you think Anne recorded in her science notebook—was she able to hear the sound better through the rail or through the air? Why do you think so?

INQUIRY

PART 1

SOUND CHALLENGES

- How can pitch, volume, and the distance a sound can travel be modified or enhanced?

Time: Two 50-minute sessions

INVESTIGATION SUMMARY

Each group gets a specific problem in the area of sound generation, transmission, or modification to solve using familiar materials and students' knowledge of vibrations, pitch, and how sound travels. Students present their solutions to the rest of the class.

PART 2

CHOOSING YOUR OWN INVESTIGATION

- Students ask their own questions (or select from the pool of class questions) about how sound is generated, transmitted, or modified.

Time: 4–6 sessions

Students use what they have learned about sound as a starting point for further inquiry into sound. They may choose to conduct investigations or demonstrations using materials. They present projects to the rest of the class.

- Several variables affect pitch, including size (length) and tension of the source material.
- Sound can be directed through air, water, or solids to the sound receivers.
- The medium that sound passes through affects its volume and the distance at which it can be heard.

Student Sheets and Modified Student Sheets

The FOSS-ulele Challenge
The Kalimba Challenge
The Long-Gong Challenge
The Minigutbucket Challenge
The String-Beam Challenge
The Tuning-Fork Challenge
The Waterphone and Xylophone Challenge
The Whisper Challenge

Designing and Testing Solutions. Understand how the scientific design process is used to develop and implement solutions to human problems. (GLE 3.1.2)

Evaluating Potential Solutions. Analyze how well a design or a product solves a problem. (GLE 3.1.3)

- Apply content introduced in previous parts.

Performance Assessment

Inquiry or Design Project

Investigating Systems: GLEs 2.1.1-2.1.5

or Designing Solutions: GLEs 3.1.1-3.1.3

Examples of questions students might generate for inquiry projects

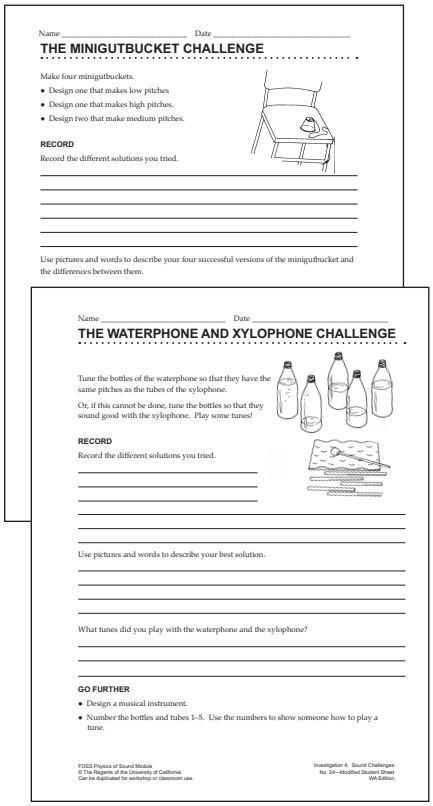
- How can you make the FOSS-ulele and the kalimba make the same pitch?
- Which instrument can make the loudest sound?
- Which instrument can be heard from the farthest distance?

INVESTIGATION 4: SOUND CHALLENGES

PART 1: SOUND CHALLENGES

NOTE: *Only the two sound challenge sheets below have been modified.*

Use student sheets nos. 18, 19, 20, 22, 23, and 25 called *The FOSS-ulele Challenge, The Kalimba Challenge, The Long-Gong Challenge, The String-Beam Challenge, The Tuning-Fork Challenge,* and *The Whisper Challenge,* and modified student sheets nos. 21 and 24 called *The Minigutbucket Challenge* and *The Waterphone and Xylophone Challenge.*



Name _____ Date _____

THE MINIGUTBUCKET CHALLENGE

Make four minigutbuckets.
- Design one that makes low pitches
- Design one that makes high pitches.
- Design two that make medium pitches.

RECORD

Record the different solutions you tried.

Use pictures and words to describe your four successful versions of the minigutbucket and the differences between them.

Name _____ Date _____

THE WATERPHONE AND XYLOPHONE CHALLENGE

Tune the bottles of the waterphone so that they have the same pitches as the tubes of the xylophone.

Or, if this cannot be done, tune the bottles so that they sound good with the xylophone. Play some tunes!

RECORD

Record the different solutions you tried.

Use pictures and words to describe your best solution.

What tunes did you play with the waterphone and the xylophone?

GO FURTHER
- Design a musical instrument.
- Number the bottles and tubes 1-5. Use the numbers to show someone how to play a tune.

Nos. 21 and 24—Modified Student Sheets

Student Sheets—Sound Challenges	
Designing and Testing Solutions. Understand how the scientific design process is used to develop and implement solutions to human problems. (GLE 3.1.2)	
Score	**If the student...**
+	tries and documents multiple solutions.
✓	tries and documents two solutions.
–	tries and/or documents only one solution.

Student Sheets—Sound Challenges	
Evaluating Potential Solutions. Analyze how well a design or a product solves a problem. (GLE 3.1.3)	
Score	**If the student...**
+	logically evaluates challenge against criteria established for design challenge (i.e., loudest, distance sound travels, pitch, etc.) and describes the reason for its effectiveness.
✓	logically evaluates challenge.
–	cannot evaluate the success of a challenge.

Name _____ Date _____

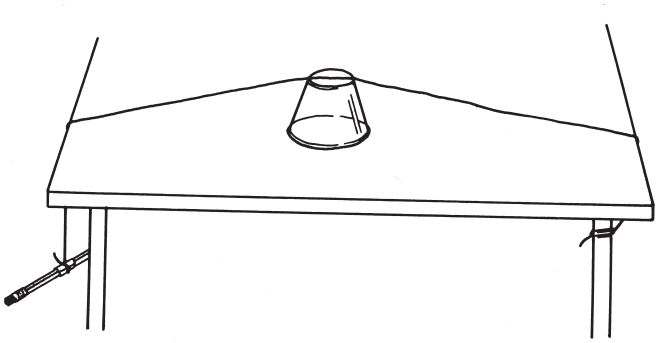
THE FOSS-ULELE CHALLENGE

Design a way to make the FOSS-ulele sound very loud.

HINTS

You can...

- Add something to the FOSS-ulele.
- Change the way the sound travels.
- Add something to your ear.



RECORD

List all the different solutions you tried.

Use pictures and words to describe your best solution.

What are all the things the sound of the FOSS-ulele traveled through on the way to your ears?

GO FURTHER

- Design a way to hear the sound of your finger tapping as far away as possible.
- Design a musical instrument.

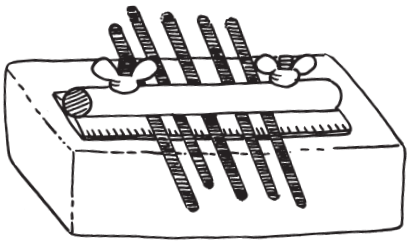
Name _____ Date _____

THE KALIMBA CHALLENGE

Design a way to hear the sound of a kalimba as far away as possible.

HINTS

- The sound of a kalimba can travel through the air, and it can also travel through other materials.
- Add something to your ear.



RECORD

List all the different solutions you tried.

Use pictures and words to describe your best solution.

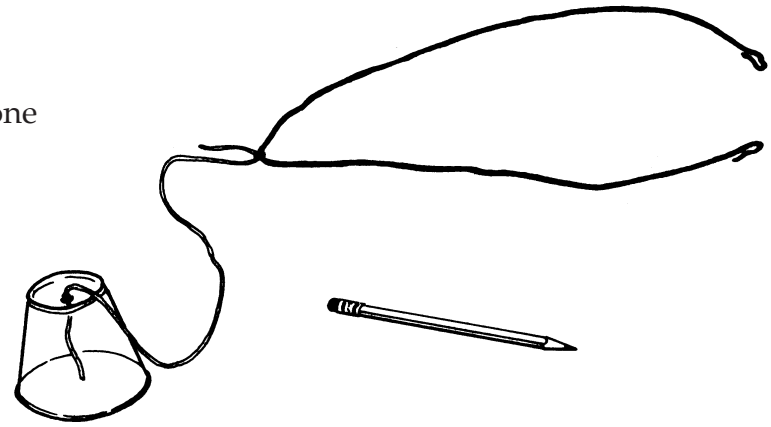
What are all the things the sound of the kalimba traveled through on the way to your ears?

GO FURTHER

- Design a way to send secret messages that only your group members can hear.
- Design a musical instrument.

Name _____ Date _____

THE LONG-GONG CHALLENGE



This is two challenges in one.

- Design a way to allow more than one person to listen to the long gong.
- Make it possible for people to to be far away from the long gong while they listen.

RECORD

List all the different solutions you tried.

_____

_____

_____

Describe your best solution.

_____

_____

_____

What are all the things the sound of the long gong traveled through on the way to your ears?

_____

_____

_____

_____

_____

_____

GO FURTHER

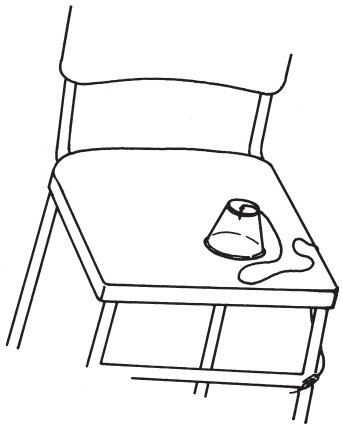
- Design a way to send secret messages that only your group members can hear.
- Design a musical instrument.

Name _____ Date _____

THE MINIGUTBUCKET CHALLENGE

Make four minigutbuckets.

- Design one that makes low pitches
- Design one that makes high pitches.
- Design two that make medium pitches.



RECORD

Record the different solutions you tried.

Use pictures and words to describe your four successful versions of the minigutbucket and the differences between them.

Why do your minigutbuckets make different pitches?

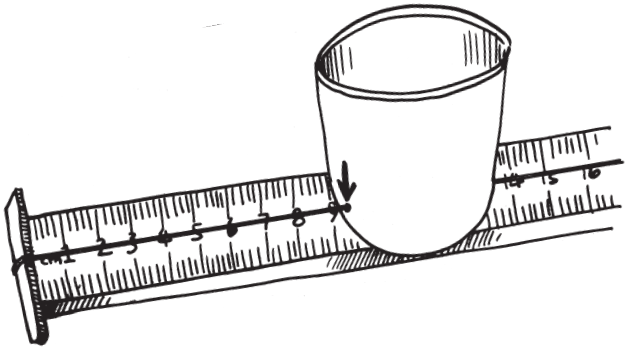
GO FURTHER

- Design a way to hear the sound of your finger tapping as far away as possible.
- Design a musical instrument.

Name _____ Date _____

THE STRING-BEAM CHALLENGE

Design a way to make the string beam sound louder.



HINTS

You can...

- Add something to the string beam.
- Change the way the sound travels.
- Add something to your ear.

RECORD

List all the different solutions you tried.

Use pictures and words to describe your best solution.

What are all the things the sound of the string beam traveled through on the way to your ears?

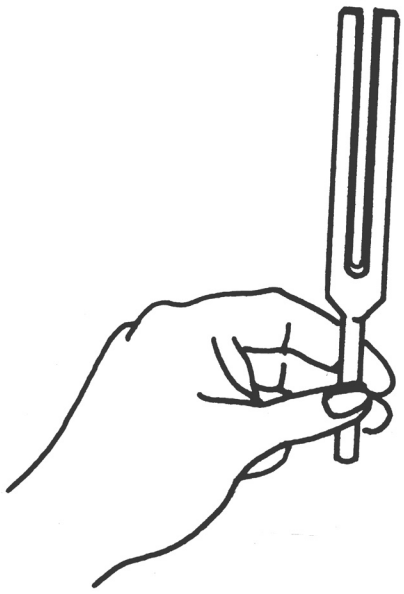
GO FURTHER

- Play a song on the string beam. Record the centimeter used for each note in the song.
- Design a musical instrument.

Name _____ Date _____

THE TUNING-FORK CHALLENGE

Design a way to hear the sound of a tuning fork as far away as possible.



HINTS

The sound of a tuning fork can travel through the air, and it can also travel through other materials.

RECORD

List all the different solutions you tried.

_____

_____

_____

_____

Use pictures and words to describe your best solution.

_____

_____

_____

_____

What are all the things the sound of the tuning fork traveled through on the way to your ears?

_____

_____

_____

_____

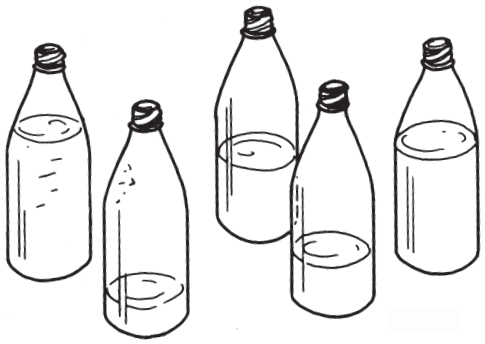
_____

GO FURTHER

- Design a way to make a permanent record of the vibrations of a tuning fork.
- Design a musical instrument.

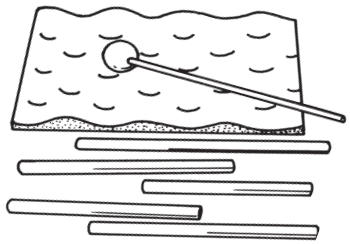
Name _____ Date _____

THE WATERPHONE AND XYLOPHONE CHALLENGE



Tune the bottles of the waterphone so that they have the same pitches as the tubes of the xylophone.

Or, if this cannot be done, tune the bottles so that they sound good with the xylophone. Play some tunes!



RECORD

Record the different solutions you tried.

_____

_____

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_____

Use pictures and words to describe your best solution.

_____

_____

_____

_____

What tunes did you play with the waterphone and the xylophone?

_____

_____

_____

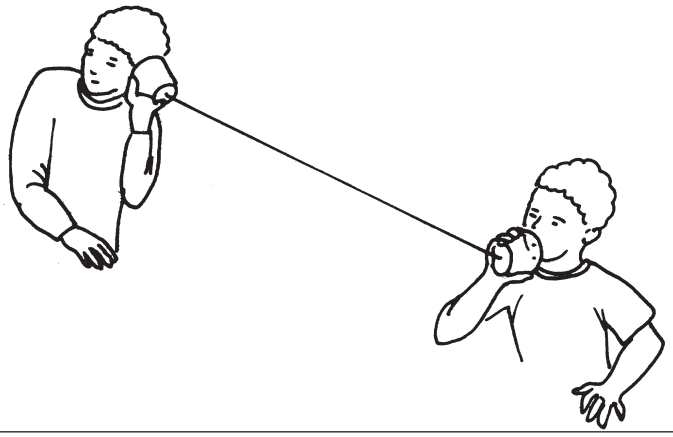
GO FURTHER

- Design a musical instrument.
- Number the bottles and tubes 1–5. Use the numbers to show someone how to play a tune.

Name _____ Date _____

THE WHISPER CHALLENGE

Design a way to allow your whole group to hear your voice when you speak very softly.



RECORD

List all the different solutions you tried.

_____

_____

_____

_____

Use pictures and words to describe your best solution.

_____

_____

_____

_____

What are all the things the sound of your voice traveled through on the way to everybody's ears?

_____

_____

_____

_____

GO FURTHER

- Design a way to make the sound of writing with a pencil seem louder.
- Design a musical instrument.

INVESTIGATION 4: SOUND CHALLENGES

PART 2: CHOOSING YOUR OWN INVESTIGATION

INQUIRY OR DESIGN PROJECT

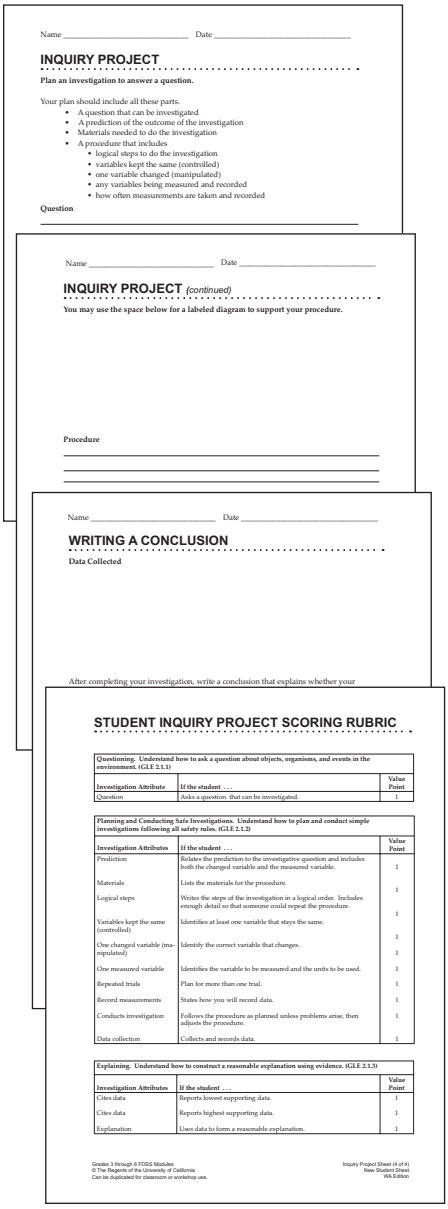
The inquiry or design project replaces "Choosing Your Own Investigation." It can be completed at any point in the module with any lesson that lends itself to students' independently carrying out an investigation, starting from their own question, to drawing a conclusion. See examples of inquiry questions at the bottom of each At a Glance page.

Use materials available from the FOSS kit and add materials as needed or possible. Use the inquiry project sheets, which are also in the Assessment Overview with more detailed information.

NOTE: Students should complete an entire inquiry project at least once in each module to build understanding of the inquiry and design process by the fifth and sixth grades.

INQUIRY OR DESIGN PROJECT SCORING GUIDES

Use the *Student Project Scoring Rubric* to grade projects. Score one point for each attribute in the list. By the end of fifth grade, students should be able to score between 10 and 13 points for planning an investigation to meet standards on the WASL.



Name _____ Date _____

INQUIRY PROJECT

Plan an investigation to answer a question.

Your plan should include all these parts.

- A question that can be investigated
- A prediction of the outcome of the investigation
- Materials needed to do the investigation
- A procedure that includes
  - logical steps to do the investigation
  - variables kept the same (controlled)
  - one variable changed (manipulated)
  - any variables being measured and recorded
  - how often measurements are taken and recorded

Question

Name _____ Date _____

INQUIRY PROJECT *(continued)*

You may use the space below for a labeled diagram to support your procedure.

Procedure

Name _____ Date _____

WRITING A CONCLUSION

Data Collected

After completing your investigation, write a conclusion that explains whether your

STUDENT INQUIRY PROJECT SCORING RUBRIC

Questioning. Understand how to ask a question about objects, organisms, and events in the environment. (GLE 2.1.1)		
Investigation Attribute	**If the student . . .**	**Value Point**
Question	Asks a question that can be investigated.	1

Planning and Conducting Safe Investigations. Understand how to plan and conduct simple investigations following all safety rules. (GLE 2.1.2)		
Investigation Attributes	**If the student . . .**	**Value Point**
Prediction	Relates the prediction to the investigative question and includes both the changed variable and the measured variable.	1
Materials	Lists the materials for the procedure.	1
Logical steps	Writes the steps of the investigation in a logical order. Includes enough detail so that someone could repeat the procedure.	1
Variables kept the same (controlled)	Identifies at least one variable that stays the same.	1
One changed variable (manipulated)	Identify the correct variable that changes.	1
One measured variable	Identifies the variable to be measured and the units to be used.	1
Repeated trials	Plan for more than one trial.	1
Record measurements	States how you will record data.	1
Conducts investigation	Follows the procedure as planned unless problems arise, then adjusts the procedure.	1
Data collection	Collects and records data.	1

Explaining. Understand how to construct a reasonable explanation using evidence. (GLE 2.1.3)		
Investigation Attributes	**If the student . . .**	**Value Point**
Cites data	Reports lowest supporting data.	1
Cites data	Reports highest supporting data.	1
Explanation	Uses data to form a reasonable explanation.	1

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Inquiry Project Sheet (4 of 4)
New Student Sheet
WA Edition

Name _____ Date _____

INQUIRY PROJECT

Plan an investigation to answer a question.

Your plan should include all these parts.

- A question that can be investigated
- A prediction of the outcome of the investigation
- Materials needed to do the investigation
- A procedure that includes
  - logical steps to do the investigation
  - variables kept the same (controlled)
  - one variable changed (manipulated)
  - any variables being measured and recorded
  - how often measurements are taken and recorded

Question

_____

_____

Prediction

_____

_____

Materials

_____

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Name _____ Date _____

INQUIRY PROJECT *(continued)*

You may use the space below for a labeled diagram to support your procedure.

Procedure

Name _____ Date _____

WRITING A CONCLUSION

Data Collected

After completing your investigation, write a conclusion that explains whether your prediction was correct. Your conclusion should include these parts.

- Supporting data from your data table
- An explanation of how this data supports your conclusion

Supporting Data

_____

_____

_____

Explanation

_____

_____

_____

_____

_____

_____

_____

_____

_____

STUDENT INQUIRY PROJECT SCORING RUBRIC

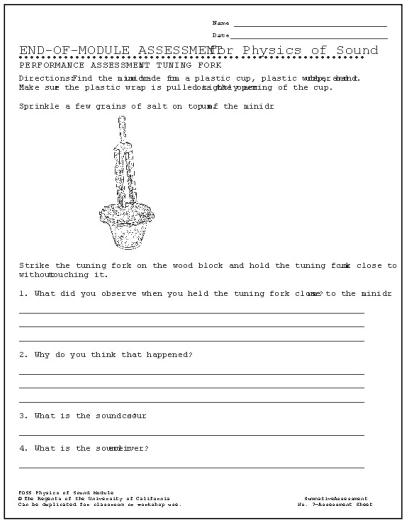
Questioning. Understand how to ask a question about objects, organisms, and events in the environment. (GLE 2.1.1)		
Investigation Attribute	**If the student . . .**	**Value Point**
Question	Asks a question that can be investigated.	1

Planning and Conducting Safe Investigations. Understand how to plan and conduct simple investigations following all safety rules. (GLE 2.1.2)		
Investigation Attributes	**If the student . . .**	**Value Point**
Prediction	Relates the prediction to the investigative question and includes both the changed variable and the measured variable.	1
Materials	Lists the materials for the procedure.	1
Logical steps	Writes the steps of the investigation in a logical order. Includes enough detail so that someone could repeat the procedure.	1
Variables kept the same (controlled)	Identifies at least one variable that stays the same.	1
One changed variable (manipulated)	Identify the correct variable that changes.	1
One measured variable	Identifies the variable to be measured and the units to be used.	1
Repeated trials	Plan for more than one trial.	1
Record measurements	States how you will record data.	1
Conducts investigation	Follows the procedure as planned unless problems arise, then adjusts the procedure.	1
Data collection	Collects and records data.	1

Explaining. Understand how to construct a reasonable explanation using evidence. (GLE 2.1.3)		
Investigation Attributes	**If the student . . .**	**Value Point**
Cites data	Reports lowest supporting data.	1
Cites data	Reports highest supporting data.	1
Explanation	Uses data to form a reasonable explanation.	1

END-OF-MODULE ASSESSMENT

This assessment is used as an evaluative tool after all the investigations have been completed. It checks student content knowledge, skills in conducting investigations, and explanation building. Items are in three formats: performance tasks, multiple-choice/short-answer items (which give students practice for standardized tests), and narrative items that require students to write short explanations.



Name _____
Date _____

END-OF-MODULE ASSESSMENT Physics of Sound
PERFORMANCE ASSESSMENT TUNING FORK

Directions Find the mini drum made from a plastic cup, plastic wrap, and rubber band. Make sure the plastic wrap is pulled tight and flat covering the opening of the cup.

Sprinkle a few grains of salt on top of the mini drum.

Strike the tuning fork on the wood block and hold the tuning fork close to the mini drum without touching it.

1. What did you observe when you held the tuning fork close to the mini drum?

2. Why do you think that happened?

3. What is the sound source?

4. What is the sound receiver?

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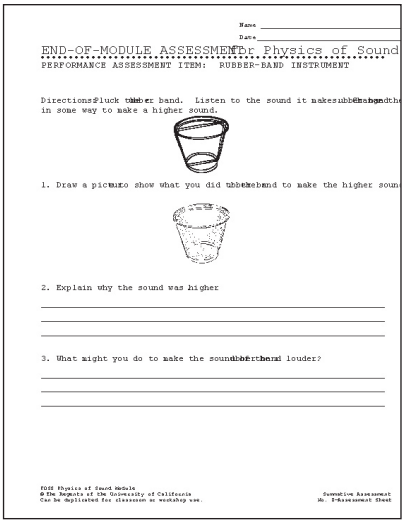
Formative Assessment
No. 7 Assessment Sheet

No. 7—Assessment Sheet



Name _____
Date _____

END-OF-MODULE ASSESSMENT Physics of Sound
PERFORMANCE ASSESSMENT ITEM: RUBBER-BAND INSTRUMENT

Directions Pluck the rubber band. Listen to the sound it makes. Change the rubber band in some way to make a higher sound.

1. Draw a picture to show what you did to the rubber band to make the higher sound.

2. Explain why the sound was higher

3. What might you do to make the sound of the rubber band louder?

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Formative Assessment
No. 8 Assessment Sheet

No. 8—Assessment Sheet

MATERIALS FOR EACH TUNING-FORK STATION

- 1 Plastic cup
- 1 Tuning fork
- 1 Wood block
- 1 Piece of plastic wrap, 15 cm X 15 cm *
- Salt *

❒ • Assessment sheet no. 7 called *Performance Assessment: Tuning Fork*

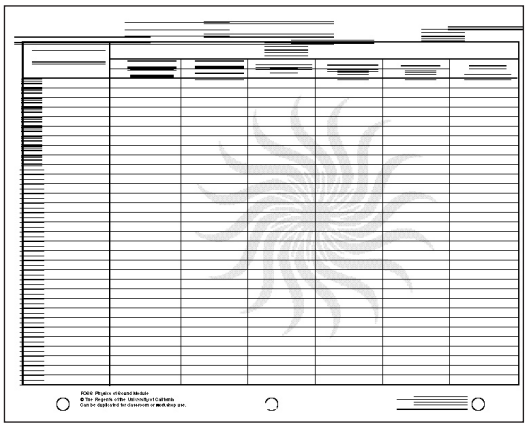
MATERIALS FOR EACH RUBBER BAND–INSTRUMENT STATION

- 1 Plastic cup
- 1 Rubber band

❒ • Assessment sheet no. 8 called *Performance Assessment: Rubber-Band Instrument*

* Supplied by the teacher

❒ Use the duplication master to make copies.



No. 5—Assessment Sheet

GETTING READY

1. SCHEDULE THE ASSESSMENT

You may need to give the assessment in two sessions: one for the performance items, and one for the multiple-choice/short-answer and narrative items. Read through Steps 2 and 3 below before deciding how you will proceed.

2. ADMINISTER THE PERFORMANCE ITEMS

The performance assessment is in two parts: one assesses understanding of vibrations causing sounds, and the other, the sound properties of pitch and volume.

Individual Assessment. If you want students to work individually, you can assess up to eight students at a time. Set up four identical stations for the tuning fork and four identical stations for the rubber-band instrument around the room. Or set up both tasks at each station (four stations, instead of eight). Students will need about 10 minutes to complete each task and to fill in the assessment sheet at each station. Send shifts of students to the stations until all have had a chance to complete both tasks. Students waiting to take their turn at the performance tasks can be completing the multiple-choice/short-answer and narrative items, or working on some other quiet activity.

Collaborative-Group Assessment. If you don't have time for each student to complete the performance tasks, have students work in groups. After the group completes the task, each student fills in his or her assessment sheet individually. The completed assessment sheets should reflect each student's learning.

3. ADMINISTER THE MULTIPLE-CHOICE/SHORT-ANSWER AND NARRATIVE ITEMS

Assessment items in content areas such as science often require a fairly high level of reading. If you feel that students will have a difficult time reading the items on their own, you can read each item and its possible answers (when appropriate) aloud. Have students mark their answers and move on to the next item, working together through the assessment, item by item.

4. COPY ASSESSMENT SHEETS

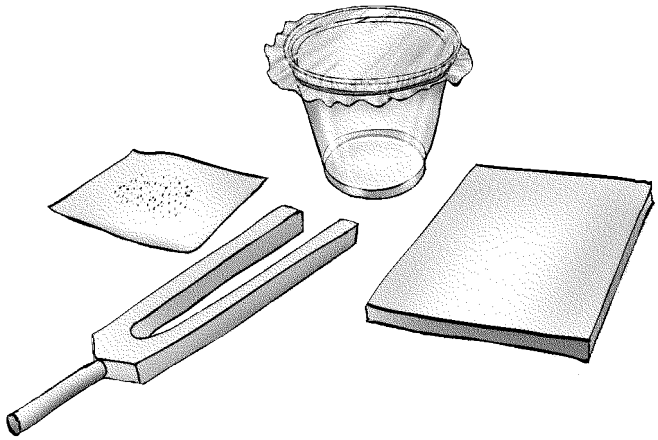
Make copies of the assessment masters provided after this folio. Each student needs one set of sheets nos. 7–14. Make a copy of assessment chart no. 5 to record scores.

5. SET UP THE PERFORMANCE STATIONS

Set up stations for the performance tasks as suggested below.

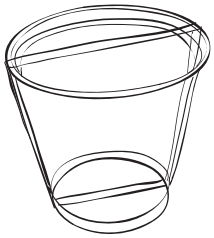
Tuning-Fork Station

- Cover a plastic cup with the square of plastic wrap to make a minidrum. Secure the plastic wrap around the rim of the cup with a rubber band.
- Put the minidrum, tuning fork, wood block, and salt on the table.



Rubber Band-Instrument Station

- Stretch a rubber band around a plastic cup, so that the rubber band crosses the opening of the cup.

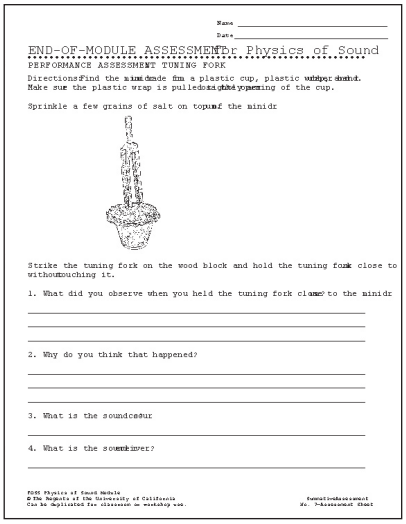


PERFORMANCE ASSESSMENT ITEMS—Physics of Sound

END-OF-MODULE ASSESSMENT SCORING GUIDES

PERFORMANCE ITEMS

Performance Assessment Item—Tuning Fork	
Score	**If the student...**
4	(1) clearly describes the salt jumping around on the minidrum (may include hearing the sound made by the tuning fork); (2) explains that the salt is jumping because the sound vibrations from the tuning fork travel through the air to the minidrum, making the plastic wrap vibrate and the salt move; (3) identifies the source as the tuning fork; (4) identifies the receiver as the plastic wrap; may include the ear since he or she heard a sound.
3	correctly completes three of the four parts described above.
2	correctly completes two of the four parts described above.
1	correctly completes one of the four parts described above.
0	does not complete the task, or gives information that has nothing to do with what was asked.



Name _____

Date _____

END-OF-MODULE ASSESSMENT Physics of Sound

PERFORMANCE ASSESSMENT TUNING FORK

Directions: Find the minidrum made from a plastic cup, plastic wrap, and a rubber band. Make sure the plastic wrap is pulled tight across the opening of the cup.

Sprinkle a few grains of salt on top of the minidr

Strike the tuning fork on the wood block and hold the tuning fork close to without touching it.

1. What did you observe when you held the tuning fork clos to the minidr

2. Why do you think that happened?

3. What is the sound sour

4. What is the sound receiver?

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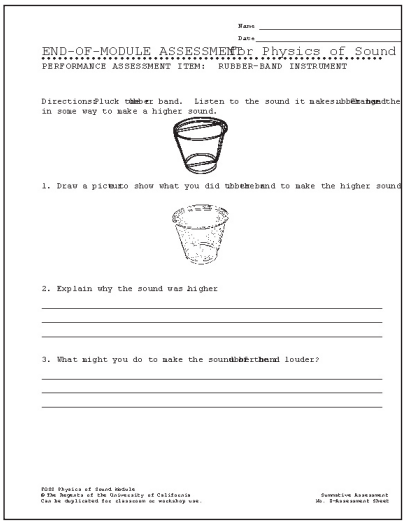
Sound Assessment
No. 7—Assessment Sheet

No. 7—Assessment Sheet



Name _____

Date _____

END-OF-MODULE ASSESSMENT Physics of Sound

PERFORMANCE ASSESSMENT ITEM: RUBBER-BAND INSTRUMENT

Directions: Pluck the rubber band. Listen to the sound it makes. Change the instrument in some way to make a higher sound.

1. Draw a picture to show what you did to the rubber band to make the higher sound.

2. Explain why the sound was higher.

3. What might you do to make the sound of the rubber band louder?

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Summative Assessment
No. 8 Assessment Sheet

No. 8—Assessment Sheet

Performance Assessment Item—Rubber-Band Instrument	
Score	**If the student...**
4	(1) draws a clear picture showing that he or she stretched the rubber band to change the pitch; (2) explains that the pitch changed because stretching the rubber band increases the tension, making a higher pitch; (3) describes a reasonable way to make the sound louder, such as using a megaphone or cardboard tube to direct the sound.
3	(1) draws a reasonably clear picture; (2) explains that the rubber band stretched changing the pitch; (3) describes a reasonable way to make the sound louder.
2	correctly completes two of the three points above.
1	correctly completes one of the three points above.
0	does not complete the task, or gives information that has nothing to do with what was asked.

MULTIPLE-CHOICE ITEMS

Score **1 point** for each correct answer.

1. B
2. D
3. A
4. C
5. B
6. C
7. A
8. D
9. B
10. A

SHORT-ANSWER ITEMS

Short-Answer Item 11

(a) Score **1 point** if the student chooses bottle A as the one with the highest pitch.
(b) Score 1 point if the student gives a reasonable explanation, including the idea that, when comparing objects, shorter objects make higher pitches. In this case the "shorter" object is the one with the least amount of water.

Short-Answer Item 12

Score **1 point** if the student explains that the tuning fork is vibrating and it is the vibrations that splash the water.

Short-Answer Item 13

(a) Score 1 point if the student writes that the thicker string will have a lower pitch or the thinner string will have a higher pitch.
(b) Score 1 point if the student writes that the pitch of the thinner string will be even higher because of the increased tension from the heavy weight.

NOTE: *Students have not had direct experience with thick vs. thin mediums, but should be able to deduce this from experiences they have had.*

Short-Answer Item 14

Score 1 point if the student puts each object in the correct column.

- Sources: whistle, siren.
- Receivers: dog's ear, stethoscope.
- Both: telephone, microphone.

Short-Answer Item 15

(a) Score 1 point if the student writes that sound is produced with these instruments by blowing air through them.
(b-c) Score 1 point if the student correctly labels the third instrument from the left with an L and writes that it plays the lowest notes because it has the longest wind pipe.
(d-e) Score 1 point if the student correctly labels the first instrument from the left with an H and writes that it plays the highest notes because it has the shortest wind pipe.

NARRATIVE ITEMS

Item 16 Hitting Rocks Together	
Score	**If the student...**
3	(a) writes that he or she would hear the clearest or loudest sound when the rocks are hit on the desk; (b) writes that the sounds differ because they are traveling through different mediums and that sound travels best through solids.
2	(a) writes that he or she would hear the clearest or loudest sound when the rocks are hit on the desk; (b) implies somehow that sounds travel in different ways.
1	(a) writes that he or she would hear the clearest or loudest sound when the rocks are hit in the air or in the water; (b) implies somehow that sounds travel in different ways.
0	does not complete the task, or gives information that has nothing to do with what was asked.

Item 17 How Sound Travels	
Score	**If the student...**
3	clearly describes the following: (1) sound begins with a source that is vibrating; (2) the sound must travel through a medium (solid, liquid, or gas) from the source to the receiver; (3) the receiver senses the vibrations from a source and translates it into sound.
2	includes two of the three points above.
1	includes one of the three points above.
0	does not complete the task, or gives information that has nothing to do with what was asked.

Item 18 Examples of Sounds and Meanings	
Score	**If the student...**
3	clearly describes two examples of how sounds mean different things (e.g., when people hear a siren it means to clear the way for emergency vehicles, or when people hear the familiar ring of the telephone, they know that someone is calling and that they should pick up the receiver).
2	clearly describes one example and attempts a second example but is unclear.
1	clearly describes one example and gives no second example, or gives two examples but neither is clear.
0	does not complete the task, or gives information that has nothing to do with what was asked.

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PHYSICS OF SOUND BLUEPRINT

3-5 Grade Level Expectations (GLE) Assessment Opportunities

SYSTEMS	FORMATIVE	SUMMATIVE	COMMENTS
Properties of Substances. Understand how to use properties to sort natural and manufactured materials and objects. (GLE 1.1.1)	Inv. 1, Pt. 1	1, 6, 14, 15	Covered in several other modules.
Wave Behavior. Understand the behavior of sound in terms of vibrations and pitch and the behavior of light in terms of bouncing off, passing through, and changes in direction. (GLE 1.1.3)	Inv. 2, Pt. 1, 3	PA-Tuning Fork 2–13, 15–17	Important to cover in this module.
Forms of Energy. Understand that energy comes in many forms. (GLE 1.1.4)	Inv. 1, Pt. 3		Important to cover in this module.
Structure of Physical Earth/Space and Living Systems. Analyze how the parts of a system go together and how these parts depend on each other. (GLE 1.2.1)	Inv. 2, Pt. 2		Covered in several other modules.
Energy Transfer and Transformation Understand that energy can be transferred from one object to another and can be transformed from one form of energy to another. (GLE 1.2.2)	Inv. 1, Pt. 3		Important to cover in this module.
INQUIRY			
Explaining. Understand how to construct a reasonable explanation using evidence. (GLE 2.1.3)	Inv. 3, Pt. 2	PA-Tuning Fork PA-Rubber -Band Instrument	Assessed throughout grades in inquiry projects.
Intellectual Honesty. Understand that all scientific observations are reported accurately and honestly even when the observations contradict expectations. (GLE 2.2.1)	Inv. 3, Pt. 1	PA-Tuning Fork PA-Rubber-Band Instrument 11-13, 15-18	Covered in several other modules.
APPLICATION			
Designing and Testing Solutions. Understand how the scientific design process is used to develop and implement solutions to human problems. (GLE 3.1.2)	Inv. 4, Pt. 1		Important to cover in this module.
Evaluating Potential Solutions. Analyze how well a design or a product solves a problem. (GLE 3.1.3)	Inv. 1, Pt. 2 Inv. 4, Pt. 1		Important to cover in this module.
INQUIRY OR DESIGN PROJECT			
Investigating Systems: GLEs 2.1.1—2.1.5 or Designing Solutions: GLEs: 3.1.1—3.1.3	Projects		Important to do one project per module.

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