the phoenix symphony

The Science of Sound

Education Guide

Education Guide

Acknowledgements

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Funding for The Science of Sound Education Guide was provided by the Craig & Barbara Barrett Foundation

The Science of Sound:

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music
engineering
science

Introduction:

Music is Science

Making music is a scientific process. Scientists and historians have tried to explain the complex phenomena of music for thousands of years. Many questions exist:

How is sound produced?

What causes music notes to be loud or soft?

Why are some notes high and others low?

What is the difference between "noise" and music?

The science behind how a musical instrument functions is fascinating. Most people can tell by listening if an instrument is in tune, but understanding the scientific process of how it works makes it much more interesting.

For example, to tune any two instruments the **sound waves** must be at the **same frequency** or the notes will not match. So when a musician tunes their instrument, they are trying to **match the frequency of one note to another.** In addition to frequency, musicians also use **vibration** and **amplification** in order to translate "noise" into music. Understanding the connections between music and science is both intriguing and fun.

The Phoenix Symphony's *The Science of Sound Education Guide* contains several lessons that explore how music and science intersect. It should be used to prepare students to attend Symphony education concerts and to assess student learning in both music and science following their concert experience.

frequency
amplification
vibration

Learning Objectives:

Academic Connections

The Science of Sound Education Guide aligns with Arizona Academic Content Standards. Each lesson contained in the *Guide* targets specific standards for music, science and other core subjects. The *Guide* as a whole, when taught and assessed, aligns with the following strands:

Arizona Academic Content Standards:

MUSIC

Strand 1; Concept 2
Create: Playing instruments, alone and with others, music from different genres and diverse cultures.
Learning Objective: Students will be able to explain how adjustments made to various parts of an instrument affect sound production.

Strand 2; Concept 1
Relate: Understanding the relationships among music, the arts & other disciplines outside the arts.
Learning Objectives: Through music, students will explore authentic connections between science, engineering, technology and math. Students will compare and contrast the properties of various musical instruments. Students will explore sound as a form of vibration. Students will identify and explain the science behind how musical instruments produce sound and change pitch.

Strand 3; Concept 1
Evaluate: Listening to, analyzing, and describing music.
Learning Objective: Students will use appropriate terminology to describe and explain music.

SCIENCE

Strand 1; Concept 1
Observations, Questions, and Hypotheses: Observe, ask questions, and make predictions.
Learning Objective: Through scientific inquiry, students will explore authentic connections between music and science.

Strand 1; Concept 2
Scientific Testing (Investigating and Modeling): Participate in planning and conducting investigations, and recording data.
Learning Objectives: Students will investigate the mechanics of various musical instruments and record findings. Students will understand the role engineering, math and technology play in musical instrument design.

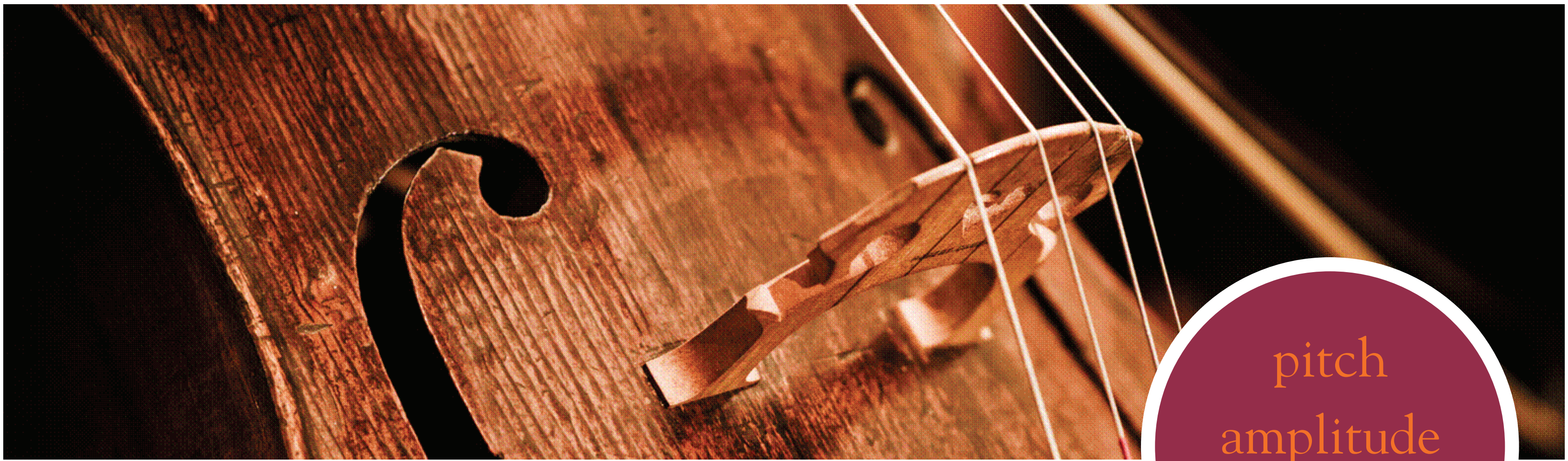
Strand 5; Concept 1
Properties of Objects and Materials: Classify objects and materials by their observable properties.
Learning Objectives: Students will discover the observable properties of various musical instruments. Students will understand the impact of materials (wood, metal, etc.) used to make musical instruments. Students will be able to classify musical instruments by family.

Strand 5, Concept 3
Energy and Magnetism: Investigate different forms of energy.
Learning Objectives: Students will investigate different forms of energy, including sound. Students will understand the role of vibration, amplification and frequency in producing music. Students will understand the difference between "noise" and "music."

energy

instrument

The Science
Behind Sound



pitch
amplitude
sound

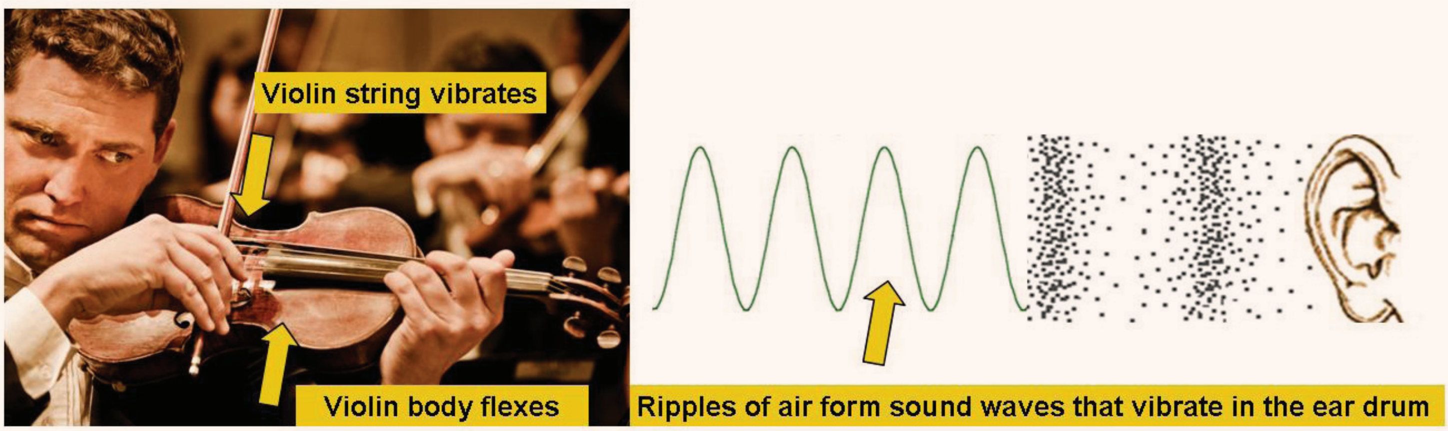
HOW IS SOUND PRODUCED?

Sound is a form of energy that travels in waves. Sound is made by vibrations. When an object (such as the string of a violin) vibrates, it causes air molecules to move and bump into each other. The vibration pushes into the molecules and creates a wave of sound. The sound wave starts at whatever is making the sound and travels all the way to your ears, where you hear it.

Four things are needed for musical instruments to produce sound:

- a vibrating object (such as a violin string)
- a medium (such as the body of a violin)
- air
- an ear drum

When a violin is played, the **strings** of the instrument are the **vibrating object**. The musician draws a bow against them or plucks them, causing the strings to vibrate. This moves air particles through the medium. The **medium** is the **body** of the violin, which consists of the wooden top and back of the instrument. The body of the violin flexes in and out, causing the air particles to ripple and form sound waves. These sound waves travel through time, ultimately reaching your **ear drum**, where they vibrate and change pressure. Your brain then translates them into recognizable sound.



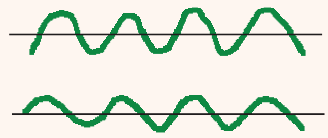
WHAT CAUSES MUSIC NOTES TO BE LOUD OR SOFT?

Amplification is the process used to describe how loud or soft an instrument plays. Each instrument amplifies sound in its own unique way, producing sound waves that are either tall (loud) or short (quiet), depending on the amount of force applied. The measure of the amount of energy in a sound wave is called **amplitude.** For example, the amount of pressure a musician places on the strings of a violin determines the **amplitude** of the sound wave as it travels through the wooden body of the violin. The more energy the sound wave has, the louder the sound seems.

Remember the amplitude or height of a sound wave is a measurement of the amount of energy in the wave.

Greater force = greater amplitude = taller sound waves = a louder sound

Lesser force = lesser amplitude = shorter sound waves = a quieter sound



WHY ARE SOME NOTES HIGH AND OTHERS LOW?

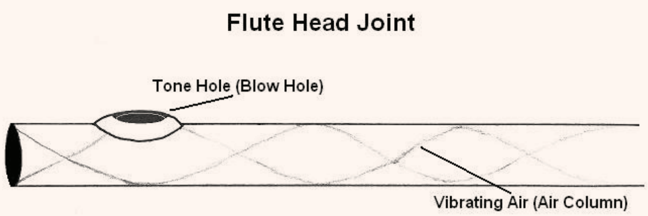
The highness or lowness of a note is called **pitch**. One of the main factors determining pitch is frequency. **Frequency** is simply the number of times per second that a sound wave vibrates.

- Fast vibration = high frequency = high pitch = more waves per second
- Slow vibration = low frequency = a low pitch = fewer waves per second

For a stringed instrument, three properties that affect its frequency are length, diameter and tension.

When the **length** of a string is changed, it vibrates with a different frequency. **Shorter strings** have **higher frequency** and therefore **higher pitch.** When a musician presses her finger on a string, she shortens its length. The more fingers she adds to the string, the shorter she makes it, and the higher the pitch will be.

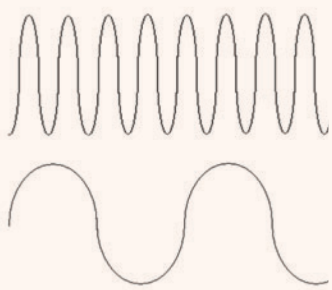
Diameter is the thickness of the string. Thick strings with large diameters vibrate slower and have lower frequencies than thin ones.



Tension refers to how tightly the string is stretched. Tightening the string gives it a higher frequency while loosening it lowers the frequency. When string players tighten or loosen their strings, they are altering the pitches to make them in tune. In wind instruments, like the flute and trumpet, vibrating air makes the sound. Air particles move back and forth creating sound waves. Blowing across a flute's blow hole creates waves of air in the tube. In the clarinet, a vibrating reed (a thin piece of wood set in the mouthpiece) gets the waves started. Different pitches are played by pressing keys that open or close holes in the tube making the air column inside the tube longer or shorter. **Longer air columns** produce **lower pitches.**

How to Calculate Frequency: Hertz (Hz) is the standard measure of frequency and is determined by the number of waves per unit of time. When one sound wave occurs every one second, the frequency is 1 Hz. The terms "hertz" is named after the German physicist Heinrich Hertz. To calculate frequency, you can use a simple math formula. Count the number of times a sound wave occurs within a specific time period, then divide the count by the length of the time period. For example, if 71 sound waves occur within 15 seconds the frequency is:

$$f = \frac{71}{15\text{sec}} \approx 4.7 \text{ hertz}$$



HIGH FREQUENCY
= more sound waves per second

LOW FREQUENCY
= less sound waves per second

tension
frequency
rhythm

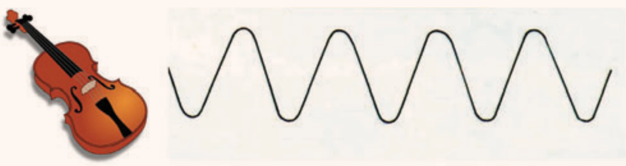
WHAT'S THE DIFFERENCE BETWEEN "NOISE" AND MUSIC?

Music and noise are both sound, but how can we tell the difference? It's not as easy as you might think. Some people might consider a sound like a hammer on an anvil to be interesting and musical, while another person may detest it and call it noise. The ocean, though it is pleasing to listen to, is not typically referred to as "music."

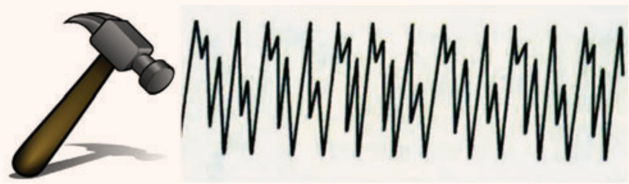
People define music in different ways: it must be pleasing; have a definite pitch or harmony; or it must have patterns that repeat. Noise, on the other hand, is typically described as having no identifiable pitch, no pleasing tone and no steady rhythm. All of those can be true, but ultimately, the most important qualification for sound to be called music is that is ***organized*** and ***communicates an idea.*** Anyone can accidentally make a sound on a trumpet or bang away on a drum. Does this qualify as music? Probably not, because it isn't organized and doesn't clearly communicate a purpose. Musicians spend years perfecting their technique and sound on their instrument, so it is important that we are careful about what we call "noise" and what we call "music."

Sound waves produced by most musical instruments are ordered, not random. When playing a string instrument, such as the violin, the sound waves will be regular and uniform. By contrast, when striking some **percussion instruments**, like a metal plate with a hammer, the **sound waves** are disjointed and irregular.

music



noise



noise

communicate

music

Lesson Plans:

Science of Sound

violin
percussion
valve

SCIENCE LESSON: EXPLORING VIBRATION AND SOUND

Grades: 2-8

Arizona Music Standards:
Strand 2; Concept 1; PO 2: Explain the nature of sound as vibration; Describe the effect of an instrument's physical properties on its sound; Identify and explain the basic concepts behind the science of sound.

Arizona Science Standard:
Strand 5; Concept 5; PO 1: Describe ways in which matter and energy interact.

matter
properties
energy

Learning Objectives:
TSW be able to define the words "vibration" and "pitch."
TSW observe that vibrating objects produce sound.
TSW understand the role of vibration in tuning a stringed instrument.
TSW observe how the speed of a vibrating object impacts pitch.
TSW determine that sounds travels through different mediums (solids and liquids).
TSW record data.

Materials:
Activity 1: A large drum; styrofoam "popcorn" pieces (real popcorn or rice will also work); a violin; paper and pencil to record predictions.
Activity 2: 30 wooden rulers; paper and pencil to record data/predictions or science journal.
Activity 3: 24 small-mouthed glass bottles of comparable size (glass jelly jars work well) and 4 metal spoons.

Activity 1:
Begin by defining **"vibration."** Discuss how sound waves travel, specifically in **percussion instruments.** Demonstrate how vibrating objects, like drums, produce sound by placing the styrofoam popcorn on the head of the drum. As the drum is played, guide students in articulating what they **see and hear** as the popcorn vibrates. Does the **force (or energy)** used in playing the drum impact the **vibration?** Does the popcorn jump higher if you strike the drum harder? Allow students a chance to experiment hitting the drum while watching the popcorn move.

Next, explain to students how vibration works with **stringed instruments** using the tuning pegs of a violin to shorten and lengthen the strings. Define their **pitch**. Have students predict whether the sound will be higher or lower based on the length of the string. Have students record predictions.

Activity 2:
Students will hold a ruler on a table with **half its length** over the edge. Have students pluck the end of the ruler and listen to the sound. Now have students predict whether the pitch will be higher or lower if they make the ruler shorter. Repeat having students predict if the pitch will be higher or lower if they make the ruler longer. Have the students record their predictions.

Starting with the ruler as long as possible over the edge of the desk, have students pluck the end. Record the sound as high or low. Continue to make the ruler shorter, and record the data. Students can complete a graph of their findings. Ask the students how the results compared to their predictions.

Activity 3:
Students should be divided into 4 groups. Pre-fill 6 bottles for each group with varying amounts of water. Label each bottle A, B, C, D, E, and F. Each group should have 6 bottles and a metal spoon. Have students make predictions about how the different amounts of water change the **pitch.** They may record their predictions on a piece of paper or in their science journals.

The students will gently tap each bottle with the metal spoon to determine the difference in the pitch produced. The students will record data on a chart to show which bottle has the highest pitch. The students should explain why the variations in water levels change the pitch. As a whole class compare the student results. **As a great exercise, use the "Making Music with Science" interactive game in the Assessment Tools section of this Guide.*

MUSIC AND TECHNOLOGY: COMPARING AND CONTRASTING MUSIC INSTRUMENTS

Grades: 3-8

Arizona Music Standards:
Strand 3, Concept 1, PO 2: Classify and identify musical instruments and instrument families.

Arizona Technology Standards:
Strand 3, Concept 2, PO 2: Use primary and secondary sources; PO 4: Use appropriate digital tools to synthesize research, information and develop new ideas.

Learning Objectives:
TSW utilize technology skills to distinguish music facts through interactive websites and Web 2.0 applications.
TSW learn the characteristics of different instruments.
TSW define and put into practice the characteristics of a comparison/contrast paper through graphic organizers, pre-writing, and a final paper.

Materials:
Internet access; smart board or individual computers; chart paper; graphic organizer; paper and writing utensils.

Procedure:
Guide students in articulating what it means to compare and contrast. Provide a brief overview of the four different **instrument families** using the Dallas Symphony Orchestra's website to quickly demonstrate both visually and audibly:

www.dsokids.com/listen/instrumentlist.aspx

Lead students through a compare/contrast exercise using the interactive website. Make two columns on the board or chart paper and invite students to brainstorm characteristics of one of the objects (e.g., flute) and then another object (e.g., trumpet). Invite students to add and revise information as they work, moving between the two columns.

Next, either as a smart board lesson or using individual computers, link to the New York Philharmonic's Kidzone "Instrument Storage Room" application:

www.nyphilkids.org/lockerroom/main.phtml

Have students select two different instrument families to research to compare and contrast. Using individual graphic organizers, ask students to identify characteristics that are included in both of the columns. Either mark these similarities using a different colored pen, or create a new chart with the column headings of "Comparison" and "Contrast." You can also use a Venn Diagram (see the sample in the Assessment Tools section) to compare and contrast the two instruments. For increased technology skills, have students create interactive Venn diagrams using this website:

www.readwritethink.org/files/resources/interactives/venn/index.html

Suggested questions for guiding the discussion may include:

- Out of what material is each instrument made?
- How does it make a sound?
- How is it played?
- How big is the instrument?
- Does it make high pitched sounds or low pitched sounds?
- To what instrument family does it belong?
- How are the two instruments similar? How are they different?

Students should have enough time to pre-write and write a final copy including their T diagrams or Venn diagrams.

tubes
amplifier
length

MUSIC LESSON: ENGINEERING MUSICAL INSTRUMENTS

Grades: 2-8

Arizona Music Standards:
Strand 2; Concept 1; PO 2: Explain the nature of sound as vibration; Describe the effect of an instrument's physical properties upon its sound; Identify and explain the basic concepts behind the science of sound.

Arizona Science Standards:
Strand 5; Concept 2; PO 2: Describe effects forces can have on a object; PO 3: Examine force and motion through investigations using simple machines.

Learning Objectives:
TSW understand how the design of wind and brass instruments impact sound waves and amplification.
TSW engage in engineering an instrument from scratch.
TSW experiment with adding/deducting to made instruments to alter sound and pitch.
TSW practice "buzzing" into a mouthpiece.
TSW record data.

Materials:
Activity 1: A cardboard tube (paper towel rolls work well); a piece of construction paper; duct tape.
Variation 1: You may also need wax paper cut into squares, and rubber bands.
Variation 2: You may also need a smaller tube to go inside the tube horn.
Activity 2: Two 10"-12" latex balloons for each drum set; and duct tape; two large thick tubes cut no shorter than 6" and 8". You want to vary the length of the tubes. (The post office and other "pack-and-ship" stores have long thick tubes that they discard. Upon request, they will sometimes save them for teachers. These heavier tubes work well because they are very thick. An alternate solution is using tubes that rolls of butcher paper are wrapped around.
Activity 3: A shoe box for each student; 6 rubber bands of varying thickness and length for each student; and scissors.

Activity 1: Engineering a Tube Horn
Begin by explaining how wind and/or brass instruments work by **producing sound through tubes**. Explain that sound is produced by placing the lips on the mouthpiece and blowing while vibrating or **"buzzing"** the lips. The larger the **mouthpiece,** the lower the sound of the instrument. Have the student practice buzzing their lips and making sounds by blowing into the cardboard tubes. Guide them in articulating the sound the tube makes. Explain that by tightening or loosening the lips, it is possible to produce different notes; however, few notes can be created this way. To overcome the problem, brass instruments have lots of tubes, which can be selected with **valves** in order to change the **length** of the instrument, and thus the **pitch** of the note. Instruments like the trombone directly modify the length of the instrument with an adjustable slide. Wind instruments have **keys or fingerholes** to vary the pitch of the sound, and different methods may be used to create the basic sound. Wind instruments also use reeds which produce a sound by vibrating against the mouthpeice when blown. The reed is held down by a metal ligature. Reeds are very sensitive and must be cared for to produce the right tone.

Shape the cardboard into a funnel as big around as the tube. Secure the funnel to one end of the tube with the tape. The tube should not be too far into the funnel, but just enough to secure with the tape. The funnel will act as an amplifier.

To play:
1. First, have students practice buzzing their lips.
2. Have students press their lips up to tube and buzz away!
3. Have students experiment with making their lips buzz faster and slower. They will discover that when they buzz their lips correctly, they will produce the best sound from

the horn. This is because of an effect of sound waves. When the length of the sound wave created matches up well with the **length** of the tube, the sound is stronger. The **funnel acts as an amplifier** - it makes the sound much louder.

Variations for older grades:

Variation 1: Add a piece of wax paper to the end of the tube not attached to the funnel. Secure the wax paper with a rubber band. Ask students how the sound changed with the wax paper. Why did the sound change?

Variation 2: Add a smaller tube inside the tube horn. It should be smaller, but snug. An empty aluminum foil roll or small gift wrap roll works. If the smaller tube is too small, you can add tape to the end that goes inside the tube horn to create a tighter seal. Slide the larger tube back and forth along the smaller tube as you buzz. This creates a "trombone" effect. Ask the students how the sound changes when they move the slide. Why does the sound change?

Activity 2: Engineering Balloon Drums **not suitable for students with latex allergies**

Cut the valve ends off the balloons. Stretch the balloon over the end of the tube and secure with tape. Lightly tap the balloons with your finger. For a louder sound you can pinch a piece of the balloon between your fingers. It is best to hold the tubes between your legs like a bongo. Ask the students to explain the difference in sound between the two lengths of tube. Why does pinching a piece of balloon make the sound louder?

Activity 3: Engineering A Rubber Band Guitar

Have students cut a hole in the middle of a shoe box. Next, stretch several rubber bands of various lengths and thickness across the top of the box leaving a gap of about half an inch between each one. Have the students pluck the rubber bands to discover what sounds are vibrating. What happens when you pluck the bands? Is the pitch made by the looser bands higher or lower? Have students record data.

MUSIC AND SCIENCE: EXPERIMENTING WITH SOUND WAVES

Grades: 5-12

Arizona Music Standards:

Strand 2; Concept 1; PO 1: Identify and describe ways in which the principles and subject matter of other disciplines are related to music; PO 2: Identify and explain the basic concepts behind the science of sound

Arizona Science Standards:

Strand 1; Concept 1; PO 1: Formulate a relevant question through observations that can be tested by an investigation.
Strand 5; Concept 5; PO 2: Describe characteristics of waves.

Learning Objectives:

TSW be able to define "frequency."
TSW utilize technology skills to distinguish music facts through interactive websites and Web 2.0 applications.
TSW learn the characteristics of different instruments.

Materials:

Slinky; accessible computer/projector to display Youtube video; different musical instruments; "Longitudinal Waves in Music" worksheet (see attachment).

Objective:

Students will be able to identify the nature of sound produced by musical instruments by observing the physical motion of a slinky.

Procedure:

1. Prior to the lesson, set up 5 or 6 instrument stations in the classroom where an instrument and its stick or mallet are placed on a desk or table with the name of the station and the name of the instrument. Suggested instruments:

- -one note from a glockenspiel
- -large suspended cymbal and mallet
- -woodblock (or several different pitched ones)
- -low-pitched drum
- -triangle
- -log drum

2. Have two students firmly hold either end of a Slinky, stretched about 3-4 yards on a table or the floor. Have one of the students quickly push his/her end toward the other student, and quickly bring it back. Discuss with students:

What happened?
What part of the Slinky is moving?
Did the Slinky move backward?

3. Explain to students that this is a **wave of energy.** The Slinky shows the way energy moves through a solid, liquid or gas. These three mediums contain molecules which are evenly spaced apart. The **molecules** compress when the molecules vibrate as a result of the source's energy, and then return to their original position. This video shows sound waves in a different way:

www.fearofphysics.com/Sound/dist_hear.html" http://www.fearofphysics.com/Sound/dist_hear.html

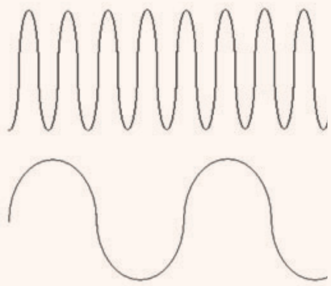
4. Ask students, can you think of other ways we can "see" waves? (i.e. ripples in a pond when a stone is tossed in)

Explain that we can pretty accurately recognize sounds in our world, but we can get a better understanding of them by interpreting their sound waves. Today, they will be scientists by experimenting and hypothesizing with sound waves. We cannot see sound waves in action, but we can use information about the sound to figure out what the wave would look like.

Frequency defines how ofter air particles vibrate, which determines if the sound is "high" or "low." This video shows the difference between loud and soft sounds' compression waves:

www.integracoustics.com/MUG/MUG/articles/phase/

We see that low sounds have separated, low-frequency compressions, while high-pitched sounds have closer-together, high-frequency compressions.



HIGH FREQUENCY
= more sound waves per second

LOW FREQUENCY
= less sound waves per second

5. Distribute "Longitudinal Waves" data worksheet. Place students in groups of 2 or 3. Have students spend about five to ten minutes at each instrument station, playing the instrument and determining its relative pitch (high or low) and to draw what they think the compression wave might look like for each instrument. You can use a timer to regulate the time spent at each station.

If possible, you can bring in a student musician to play their instrument (cello, clarinet, etc) at one of the instrument stations.

After the students have completed the worksheet, review the results.

***Assessment: Students will complete "Longitudinal Waves" worksheet in the Assessment Tools section and share their results*

MUSIC, MATH & ENGINEERING LESSON: CREATING STRAW PANPIPES

Grades: 4-8

Arizona Music Standards:
Strand 2; Concept 1; PO 2: Describe the effect of an instrument's physical properties upon its sound

Arizona Common Core Math Standards 1, 2, & 4:
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.

Arizona Science Standards:
Strand 5; Concept 2; PO 2: Describe effects forces can have on a object; PO 3: Examine force and motion through investigations using simple machines.

Learning Objectives:
TSW engineer a musical instrument.
TSW be able to solve equations involving conversion between the English and Metric systems.

Materials:
Straws; Scissors; Rulers; Masking or Duct tape; Popsicle or chop sticks; hot glue gun to seal the ends of the straws

Procedure:
Cut a piece of straw, block off the bottom with your finger and blow over the top (for added complexity, check the resulting pitch on a piano and trim the straw to the desired pitch). Use a hot glue gun to close off the straws. Another option is to leave the straw longer than needed, fold the straw at the desired length and use a small strip of duct tape to keep the straw folded. Note that the pitch may change slightly as your glue stops up the bottom. It is best to leave the lengths of straw longer than they should be, and then trim the TOP part of the straw if needed. Avoid simply taping the end of the straw (it doesn't work as well). Cut other straws by using the whole-step/half-step ratio to get the correct pitches for a diatonic scale. Below are possible straw lengths to create a straw panpipe (all lengths are approximate); for a math lesson, give the students the measurements in centimeters, and have the students convert to inches. To increase or decrease the complexity of the lesson, give the measurements in meters, and have the students convert to centimeters.

Suggested lengths:
5 inches (12.7cm)
4 and 4/16ths (11 cm)
3 and 14/16ths (9.8 cm)
3 and 10/16ths (9.1 cm)
3 and 3/16ths (8.1 cm)
2 and 13/16ths (7.2 cm)
2 and 8/16ths (6.5 cm)
2 and 5/16ths (6 cm)

Conversion formula:
cm x 0.39 = in
in x 2.54 = cm

Lay a long strip of duct tape sticky side-up on the table. Place the straws on the duct tape in size order, with the open ends even and the closed ends staggered. You may wish to separate the straws slightly as you lay them on the tape to make it easier to blow a single pitch. Place the popsicle or chopstick across the straws and wrap the tape around it. The stick acts as a stiffener.

Building this instrument is a math exercise in itself. The process of measuring the straws gives students more experience in working with rulers and precise measurements. The structure of a major scale in whole steps and half steps can shed some light on the nature of musical scales. For more advanced students, they can begin to find ratios in measurement by starting with longer or shorter straws (e.g., what would the measurements be if you started with the first straw being 7 inches long? 3 inches long?)

If it is done correctly, the students should end up with a major scale when played.

Other:

Assessment Tools

teach
measure
learn

the phoenix symphony
Michael Christie | Virginia G. Piper Music Director

Longitudinal Waves in Music

((((((((((((((((((((((((((((((

Group Members:

______________________ ______________________ ______________________

For each instrument station, play the instrument, listen to its pitch (high or low), and draw its compression wave in the box.

Station: _______

Instrument: ____________________

Station: _______

Instrument: ____________________

Station: _______

Instrument: ____________________

Station: _______

Instrument: ____________________

Station: _______

Instrument: ____________________

Station: _______

Instrument: ____________________

Station: _______

Instrument: ____________________

Station: _______

Instrument: ____________________

Station: _______

Instrument: ____________________

Station: _______

Instrument: ____________________

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QUIZ: HOW IS SOUND PRODUCED?

Name:____

1. **Sound is a form of energy that travels in:**
   a. circles b. headphones c. waves
2. **Sound is made by:**
   a. pitch b. vibration c. frequency
3. **Four things needed for musical instruments to produce sound are:**
   a. Strings, a mouthpiece, keys, bow
   b. vibrating object, a medium, an ear drum, air
   c. speakers, notes, pitch, amplifier
4. **On a violin, which part of the instrument vibrates?**
   a. tuning pegs b. bridge c. strings
5. **How does a musician play a violin?**
   a. With a bow or by plucking the strings
   b. With mallets
   c. With a guitar pick
6. **The highness or lowness of a note on the musical scale is called:**
   a. Tone b. Hertz c. Pitch
7. **How loud or how soft an instrument plays is called:**
   a. Tone b. requency c. Amplification
8. **To tune an instrument, the sound waves must be at the same:**
   a. Volume b. Frequency c. Amplification
9. **The unit of measure used to calculate frequency is called:**
   a. Hertz b. Centimeters c. Multiplication
10. **The difference between music and noise is:**
    a. Music is soft and noise is loud
    b. Music has an identifiable pitch and a repeating pattern; noise does not
    c. Music can change pitch while noise remains the same

SCIENCE OF SOUND WRITING PROMPTS

Name:____

1. Describe the difference between "music" and "noise." Give personal examples of music you listen to and noises you hear to support your arguments.

2. Describe how sound waves are produced in a violin. Be specific in explaining how each component of the instrument works.

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INTERACTIVE QUIZ: NAME THAT INSTRUMENT!

Students will access the "Guess the Instrument" website by Arts Alive. They will listen to a brief musical selection, and then choose the appropriate instrument.

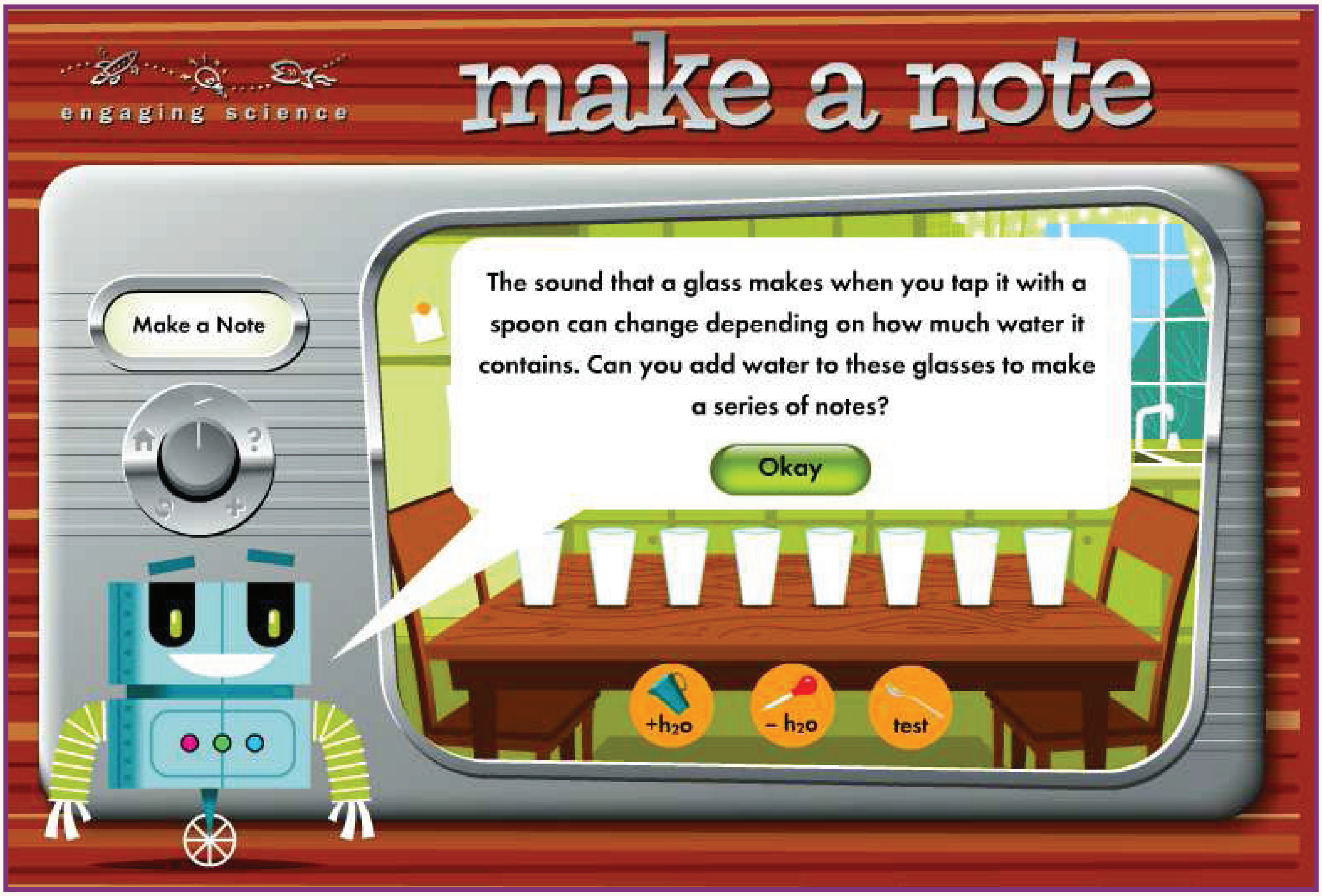
To begin the quiz, have students log on to:
www.artsalive.ca/en/mus/activitiesgames/games/guess_instrument.swf

make music

INTERACTIVE GAME: MAKING MUSIC WITH SCIENCE

Students will access the "Make a Note" website by EngagingScience.org. They will use technology skills to experiment with glasses of water to play different pitches.

To begin the exercise, have students log on to:
www.engagingscience.org/games/onlinegames/games.html



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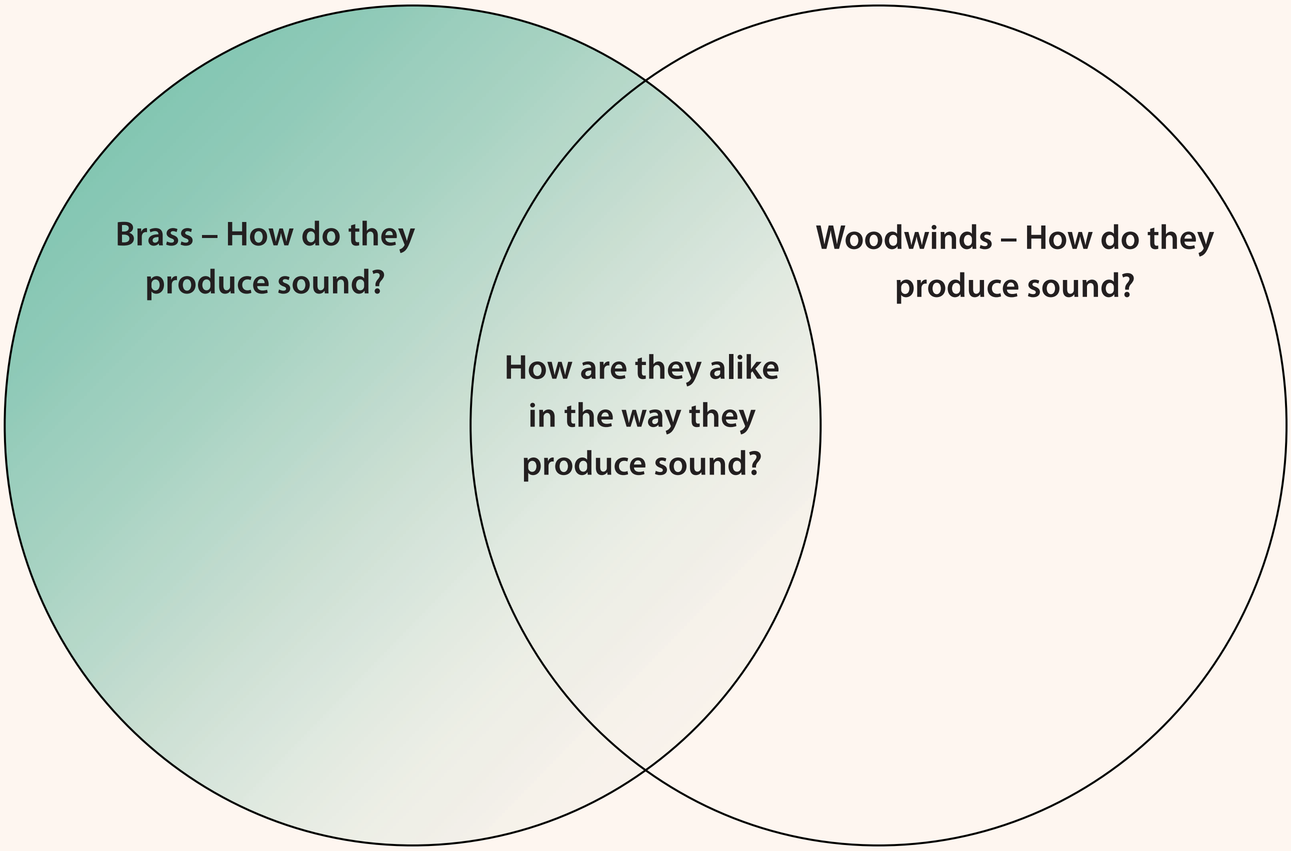
VENN DIAGRAM: INSTRUMENT FAMILIES

Name: ____



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INSTRUMENT FAMILY WORD SEARCH

Find musical instrument terms by searching vertically, horizontally, diagonally & BACKWARD!

X	K	J	X	T	Q	R	N	P	H	N	Y	S	X	X
F	V	E	W	D	O	E	F	J	K	C	I	Q	W	E
W	B	W	Y	E	M	S	I	O	C	R	H	K	V	A
V	O	J	I	S	M	B	G	F	R	P	N	N	S	J
T	Q	O	I	S	E	G	A	E	N	F	K	T	F	Y
P	J	H	D	N	S	O	E	L	X	A	L	K	K	V
A	E	F	Y	W	L	D	X	W	I	M	O	U	T	F
K	Z	R	B	W	I	S	S	A	R	B	H	I	T	K
C	Z	G	C	R	B	N	Q	U	D	Z	H	X	Q	E
Z	Y	Z	H	U	P	U	D	Z	H	B	K	D	W	H
V	W	X	S	F	S	A	Y	S	F	Q	F	U	M	U
W	O	B	I	T	L	S	T	H	E	R	E	M	I	N
F	J	Y	P	O	U	G	I	V	D	S	H	Q	S	A
P	J	Z	I	C	S	B	F	O	B	K	P	N	Q	G
N	J	V	K	B	S	H	A	R	N	S	U	I	X	G

BRASS **BOW** **FLUTE**

KEYS **PERCUSSION** **REED**

THEREMIN **TUBA** **VIOLA**

WOODWINDS

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