

## **Education Program Handbook for Teachers**

### **WELCOME**

We look forward to welcoming you and your students to the Sheldon Concert Hall for one of our Education Programs. We hope that the perfect acoustics and intimacy of the hall will make this an important and memorable experience.

### **ARRIVAL AND PARKING**

We urge you to arrive at The Sheldon Concert Hall 15 to 30 minutes prior to the program. This will allow you to be seated in time for the performance and will allow a little extra time in case you encounter traffic on the way. Seating will be on a first come-first serve basis as schools arrive. To accommodate school schedules, we will start on time. The Sheldon is located at 3648 Washington Boulevard, just around the corner from the Fox Theatre. Parking is free for school buses and cars and will be available on Washington near The Sheldon. Please enter by the steps leading up to the concert hall front door. If you have a disabled student, please call The Sheldon (314-533-9900) to make arrangement to use our street level entrance and elevator to the concert hall.

### **CONCERT MANNERS**

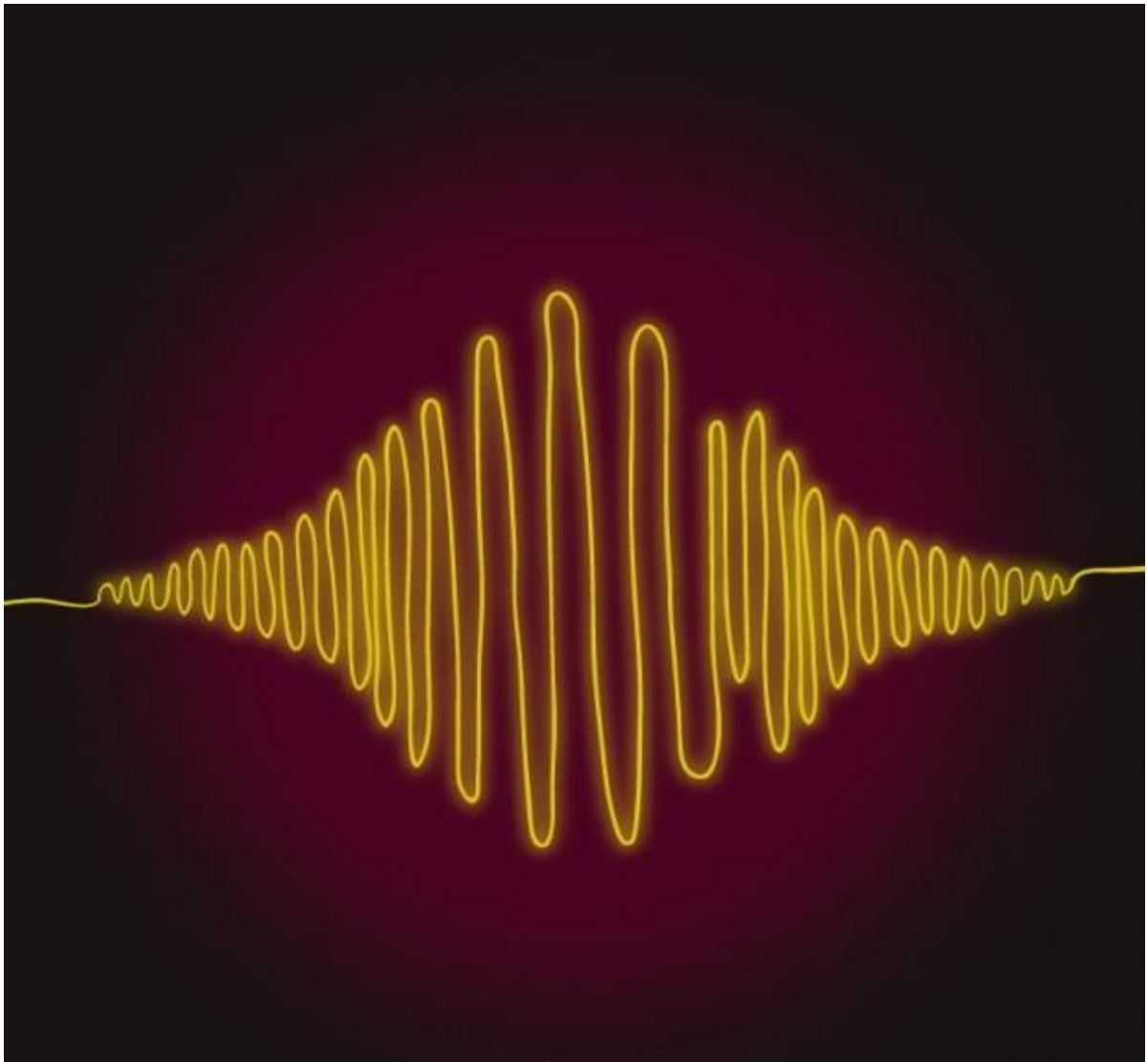
Please coach your students on good concert manners before coming to The Sheldon Concert Hall. Good audiences love to listen to music and they love to show their appreciation with applause, usually at the end of an entire piece and occasionally after a good solo by one of the musicians. Urge your students to take in and enjoy the great music being performed. Food and drink are prohibited in The Sheldon Concert Hall. Any device (cell-phone, alarm watch or toy) that makes noise is a distraction for both the musicians on stage and your fellow audience members and should be put away prior to the performance. No photos or video are allowed during the performance. Restrooms are located on the same level as the concert hall close to the Art Galleries. Please encourage students to use restrooms at school or to use Sheldon restrooms before the concert begins. If a student does need to use the restroom during the performance, the best time to get up is between musical numbers.

### **ART GALLERIES**

The Sheldon features seven art galleries in the Emerson Galleries building that adjoins the Concert Hall, including the Bellwether Gallery of St. Louis Artists, Gallery of Music, Gallery of Photography, Bernoudy Gallery of Architecture, the AT&T Gallery of Children's Art and on the lower level, The Nancy Spiritas Kranzberg Gallery and Ann Lee and Wilfred Konneker Gallery. You are invited to call The Sheldon and add a 20 or 30-minute visit to the galleries when you attend a Sheldon Education Program.

# Good Vibrations: The Science of Sound

Presented by Matt Gandolfo, Syrhea Conaway & Sandy Weltman



## Meet the Presenters

### **Matt Gandolfo**

Matt graduated in 2014 with his B.S. in Elementary Education and began working at the St. Louis Science Center the same year. Matt started out giving science demonstrations on the Center Stage for public viewings, but then transitioned to the public outreach department where he now presents in schools, libraries, and community centers.

### **Syrhea Conaway**

Syrhea Conaway is a multi-instrumentalist and music instructor who lives and works in St. Louis. Syrhea frequently presents workshops at local schools and is a teaching artist at Center of Creative Arts (COCA)'s Summer Institute which aims to bring art integration to school curriculum. Currently she is the instructor for a plethora of arts-based programs in St. Louis, and a core member of the Great River's Greenway Artist of Color Council.

### **Sandy Weltman**

Sandy Weltman is a virtuoso harmonica and banjo player who performs in many settings, including with his own group the "Sandroids." He has won numerous awards and is one of the St. Louis areas most versatile and innovative musicians.

# The Science of Sound

Have you ever thought about how sound is created?

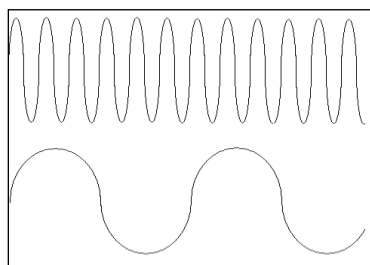
An object produces sound when it vibrates in some kind of material. These vibrations travel as sound waves through the air to your ears. The human eardrum is a stretched membrane, like the skin of a drum. When the sound waves hit your eardrum, it vibrates and the brain interprets these vibrations as sound!

The sound a vibration makes depends on the size, shape, and material creating it. These three factors can affect the **volume**, **pitch**, and **tone** quality of the sound.

## Frequency & Pitch

It turns out that sound waves vibrate at different speeds. The number of times a sound vibrates per second is called its **frequency**. Frequency is the scientific name for the musical term **pitch**.

The faster a sound vibrates, the higher the frequency and higher the pitch. The slower a sound vibrates, the lower the frequency and lower the pitch. Frequency is measured in **hertz** (Hz).



Fast Frequency/  
High Pitch

Slow Frequency/  
Low Pitch

### Consider the Size!

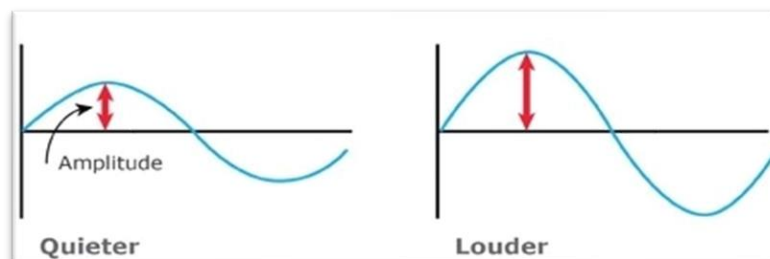
Will two drums of different sizes make different sounds?

Yes! The body of a large instrument has more air to vibrate which makes the pitch lower. A smaller instrument has less air to vibrate, making the pitch higher. The more air there is inside an object, the slower the sound vibrates, creating a lower frequency.

## Amplitude & Volume

Sound waves also vary in intensity. The strength or intensity of a sound wave is called **amplitude**.

To understand this, imagine waves like an ocean. Sometimes the water is still. Other times waves rise well above the surface of the water. The distance between the highest point of the wave and the calm surface of water is called amplitude. When the amplitude is higher, the sound wave creates a **louder volume**. When the amplitude is lower, the sound wave creates a **softer volume**. Amplitude is measured in **decibels** (Db).



# Instrument Classification

Instruments can be classified into three musical families based on the way they create vibrations. The three families are **percussion**, **wind**, and **string**.

**Percussion instruments** produce sound through vibration by being struck, shaken, or scraped.

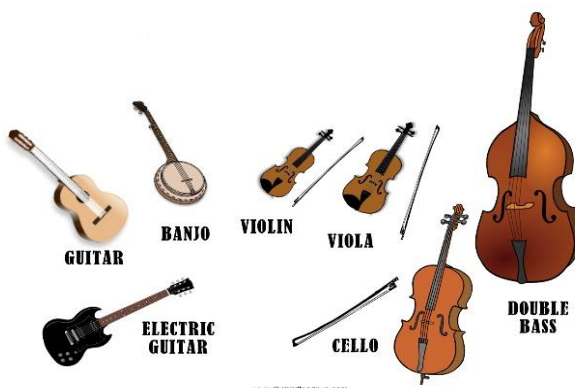


Percussion instruments can be made from a variety of materials, including wood, metal, and plastic. Drums often have animal skin or a similar synthetic material stretched over the top. Marimbas, steel drums, maracas, gongs, and tambourines are all examples of percussion instruments.

**Wind instruments** produce sound through air being blown through a cylinder or reed. Many traditional wind instruments are made from wood or metal. You may be familiar with wind instruments like the flute, tuba, and bassoon. The size and material of those instruments are different and this produces very different sounds!



**String instruments** produce sound by strings being plucked or struck OR by the friction of a bow pulled across the strings causing sustained vibration. Stringed instruments are most commonly made from wood, but the only requirement for it to be a stringed instrument is for it to have ... strings! The violin, cello, and guitar are a few common string instruments.



# Video Links

Understanding the science of sound:

[What Is Sound](#)

[Physics of Sound](#)

[Sound Waves](#)

Cymatics demonstration – The study of visible sound and vibration:

[Incredible Cymatics Performance](#)

[Chladni Plates Showing Frequency](#)

Creating sound through repurposed materials:

[The Recycled Orchestra](#)

[Recycled Percussive Band](#)

[Ted Talk on Making a Clarinet out of Paper](#)

[Ted Talk on the Saxophone Carrot](#)

[Incredible Handmade Guitars](#)

Sound sculpture examples:

[Singing Tree](#)

["The Wing" Sound Sculpture](#)

[Waterphone Instrument](#)

[Yaybahar Instrument](#)

Learn more about world music!

[Grindell World Music Collection](#)

# Vocabulary

**Acoustic** – Acoustic is the name given to the scientific study of how sound travels in a space

**Sound** – When vibration travels as a wave through air or matter it can be heard as sound.

**Vibration** – Applying a force to an object causes repeating movement called vibration. When this happens, the object produces sound.

**Amplitude** – The measure of the strength or intensity of a sound wave is called amplitude.

**Hertz** - The unit in which a sound's frequency is measured.

**Volume** – Volume is the musical term for amplitude. In music, volume is defined as the loudness or softness of a sound.

**Frequency** – The number of times a sound vibrates every second is called its frequency. It can be pictured as a wave. Sound waves vibrate at different speeds. **Frequency** is how fast or slow a sound vibrates.

**Pitch** – Pitch is the musical term for frequency. The faster the vibration, the higher the frequency and the higher the pitch. The slower the vibration, the lower the frequency and the lower the pitch.

**Decibel** – The unit in which a sound's volume is measured.

**Percussion** – A *percussion* instrument produces sound when it is struck, shaken, or scraped.

**String** – A *string* instrument produces sound by causing the strings to vibrate.

**Wind** – A *wind* instrument produces sound by passing of air through a cylinder.

# Music Word Search

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

PERCUSSION  
FREQUENCY  
KARAOKE  
MICROPHONE  
RADIO  
HERTZ  
SOUND

CLASSICAL  
GUITAR  
KEYBOARD  
EARDRUM  
RECORD  
SING

BLUES  
JAZZ  
ROCK  
PITCH  
WAVE  
DECIBEL



# Trivia

1. Can sound travel under the water?
2. Is there sound on the moon?
3. What is the speed of sound?
4. Who can hear at a higher frequency, dogs or humans?
5. Who can hear at a higher frequency, flies or humans?
6. What do you call a sound that has a frequency higher than humans can hear?
7. What do you call a sound that has a frequency lower than humans can hear?
8. Up to how many hertz can a dolphin's ear hear?
9. Our voices are instruments too! Which family of instruments does our voice belong to?

## Trivia Answer Key

1. Can sound travel under the water? (Yes! Actually, sound moves four times faster through water than through the air. It can travel so far that a whales can communicate with each other from more than 100 miles apart!)
2. Is there sound on the moon? (No, there is no sound in space, this is because sound needs something to travel through like air or water.)
3. What is the speed of sound? (Sound travels through at 340 meters per second. Sound travels through water at 1482 meters per second.)
4. Who can hear at a higher frequency, dogs or humans? (Dogs can hear at a higher frequency than humans which means dog can hear noises we can't!)
5. Who can hear at a higher frequency, flies or humans? (Actually, flies can't hear at all!)
6. What do you call a sound that has a frequency higher than humans can hear? (An ultrasound)
7. What do you call a sound that has a frequency lower than humans can hear? (An infrasound)
8. Up to how many hertz can a dolphin's ear hear? (A dolphin can hear up to 100,000 Hz! Think of all the high pitched noises that dolphins can hear that humans can't!)
9. Our voices are instruments too! Which family of instruments does our voice belong to? (Woodwind)

# BUILD YOUR OWN MUSICAL INSTRUMENT!

## THE SHELDON SOLID PROJECT ( SCIENCE OF LEARNING INSTRUMENT DESIGN)

For further learning we encourage you to register for The Sheldon SOLID Project, a STEAM-based program in which students are challenged to design and create their own musical instruments by following the steps of the engineering cycle. Students will receive instruction from St. Louis Science Center and Sheldon staff and will learn about the connected worlds of sound, science and art. This program is designed to get students excited about creative problem solving by combining the creativity of the arts with STEM disciplines.

### **SOLID is a three-step process:**

1. Bring your students to The Sheldon to see “Good Vibrations: The Science of Sound” or request a St. Louis Science Center representative to visit your school for FREE.
2. Implement SOLID curriculum, provided by The Sheldon, into your classroom. Teaching artists are available to assist in your school. Teachers are encouraged to devote 3-6 class periods to the project.
3. Submit your students’ instruments to be displayed at The Sheldon for the spring reception.



To sign up for The Sheldon SOLID Project, follow this link [The Sheldon SOLID Project](#) or contact Katelyn Galenski at [kgalenski@thesheldon.org](mailto:kgalenski@thesheldon.org) or 314-533-9900 ext 33

