



SCIENCE OF SOUND

STUDY GUIDE

DESCRIPTION OF PROJECT

New West Symphony presents this year's 2022 Symphonic Adventures: SCIENCE OF SOUND, an educational and fun online orchestral experience for schoolchildren. Science, Technology, Engineering, Math and Music (STEMM) weave together to explore of how the physical attributes of sound production translate into uniquely emotional experiences. Featuring Music Director Michael Christie, a musical guest artist/musician, the New West Symphony orchestra and experts in science and sound. This year's event includes science demonstrations with NWS musicians and science experts filmed at MOXI, The Wolf Museum of Exploration + Innovation in Santa Barbara. This is an annual concert that has been presented for more than 20 years by the Symphony.

IMPACT: Symphonic Adventures is designed to help development in cognitive, social, cultural, and emotional capacities. It encourages students to seek and create new perspectives, perceive and know the world, and gain understanding that can shape the strength and wellbeing of society by viewing the world linguistically, scientifically, mathematically, socially and historically.

OBJECTIVES

- Develop musically literate students
- Use music as a connector of science, culture and history
- Use music to communicate
- Use music to create community

OUTCOMES (students will gain)

- Understanding of basic elements of music, note-reading, clapping (body percussion) and singing along, identify orchestra instruments, pitch, consonant and dissonant intervals, timbre,
- Understanding of science core standards: What is sound, what is a sound waves, frequency in lower and higher notes, how brains translate frequencies and melodies, dynamics and volume in percussion, decibel, amplitude
- Stronger understanding of musical instruments in the orchestra, how they are played, how each instrument creates sound, why they sound different when playing the same note.

Educators recognize the emotional impact the COVID pandemic has had on family members of all ages, particularly youth. Music has helped people through the stress of learning at home, social isolation, and fear of illness. Music is one of humanity's most treasured and enduring experiences combining physical science and human emotional response. Local districts renewed their commitment to the arts but have difficulty holding to the high standards they once had for music education. Art is offered mostly after school and for a fee. Many families do not have resources for music education or to attend concerts. Teachers are over-burdened and must be assisted if we wish to have music in the curriculum.

Music education develops engaged, creative, expressive, responsive, and artistically literate citizens who connect through arts experiences that transcend historical, cultural, and societal contexts. We have seen that the impact of hearing a live orchestra, meeting a musician, or simply being exposed to and learning a musical instrument is immeasurable. NWS is committed to making these experiences possible for all young people and their families by providing free, high-quality, sequential music education and teacher training, to promote the development of critical cognitive functions necessary for navigating and existing in a complex world.

With online programming, we can increase access because schools will no longer need costly transportation, allowing nearly every child in the county to participate at a time convenient to them.

About New West Symphony



Founded in 1995, the New West Symphony is a professional orchestra that draws its players from the rich talent pool of professional Los Angeles-area musicians. The Symphony is a resident company of Bank of America Performing Arts Center in Thousand Oaks. It presents six Masterpiece Series concerts annually, performing major works from the symphonic repertoire with internationally-acclaimed artists as guest soloists. It also provides quality outreach and educational opportunities for the communities it serves through its annual Symphonic Adventures concert programs for youth, its traveling Music Van, and its New West Symphony Harmony Project of Ventura. More information is available at www.newwestsymphony.org or follow us on Facebook at www.facebook.com/newwestsymphony.

About Michael Christie

Named Artistic and Music Director of the New West Symphony in December 2018, GRAMMY® Award-winning conductor Michael Christie is a thoughtfully innovative conductor, equally at home in the symphonic and opera worlds, who is focused on making the audience experience at his performances entertaining, enlightening, and enriching. Deeply committed to bringing new works to life, he has championed commissions by leading and emerging composers alike.

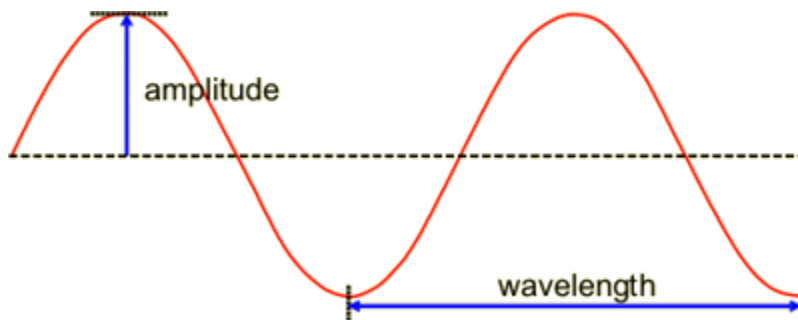
About MOXI, The Wolf Museum of Exploration + Innovation

As Santa Barbara's newest hands-on destination for families and curious minds of all ages, MOXI is a place where you can explore and discover new things about the world around you, ask questions, seek answers and have a blast doing so. Learn more about our history, exhibits + programs, and plans for the future here: <https://www.moxi.org/>.

MOXI delivers on its mission through play-based STEAM learning experiences available to the public at the museum located at 125 State Street in beautiful Santa Barbara, California. The museum's three floors are filled with interactive exhibits, rotating art installations, the Innovation Workshop makerspace and a multipurpose Exploration Lab.

GLOSSARY

Amplitude - Amplitude is a measure of the wave's height. It also tells us how much energy a wave has. Waves with more energy have higher amplitudes. The amplitude of a sound wave determines the sound's loudness.



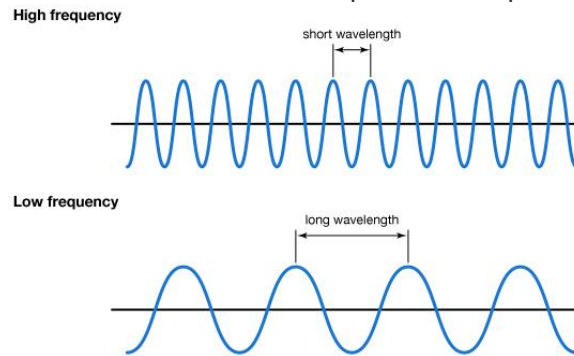
Consonant interval - In music, consonance and dissonance are words which are used to describe certain musical intervals or chords. The adjectives are consonant and dissonant. A consonant interval or chord is one which sounds stable and pleasant. It could, for example, be the end of a piece of music. For example: C and E sound well together, or the chord C, E and G (a C major chord). Scientifically a consonant interval is one in which the two notes vibrate at frequencies which have a simple mathematical relationship, e.g. in two notes which are an octave apart the higher note vibrates exactly twice as fast. If they are a fifth apart the top note vibrates 1 1/2 times as fast as the lower note. The more complicated mathematically the interval, the more dissonant it will sound.

Decibel - A unit for measuring the loudness of sounds.

Dissonant interval - A dissonant interval or chord is one which sounds unstable. It may even sound harsh by itself. The notes seem to clash. It cannot be the end of the piece of music (if the music is a normal, traditional tonal piece). It sounds as if it wants to move on to a consonant interval (this is called "resolving" onto a consonant chord). The notes C and Fsharp together make a dissonant interval. The chord C - Dsharp - Fsharp is a dissonant interval: it is full of tension, and it sounds as if it wants to "resolve" onto C - E - G.

Ear Drum – A thin flap of skin that is stretched tight like a drum and vibrates when sound hits it. These vibrations move the tiny bones of the middle ear, which send vibrations to the inner ear.

Frequency – A measure of the number of wave crests that pass a fixed point per second.



Inner Ear – The inner part of the ear that is located in a bony cavity and plays a key role in hearing and keeping the body properly balanced.

Interval - The ratio between two sonic frequencies. For example, any two notes an octave apart have a frequency ratio of 2:1.

Instrument - An object that can be used to produce music.

Melody – 1. A pleasing arrangement of sounds. 2. A series of musical notes or tones arranged in a definite pattern of pitch and rhythm. 3. The main part in a musical composition.

Middle ear – A small membrane-lined cavity that is separated from the outer ear by the tympanic membrane and that transmits sound waves from the tympanic membrane to the partition between the middle and inner ears through a chain of tiny bones.

Music – A group of sounds that people have arranged in a pleasing or meaningful way. All cultures of the world make some form of music. Music can be simple—for example, one person tapping out a beat on a log drum or singing a children's song.

Outer Ear – The outer ear is made up of the pinna — also called the auricle (say: OR-ih-kul) — and the ear canal. The pinna is the part of the ear you see on the side of your head. It's made of tough cartilage covered by skin.

Pitch - The quality of a sound (high or low) and depends on the speed of the vibrations. Different materials produce different pitches; if an object vibrates quickly we hear a high-pitched sound, and if an object vibrates slowly we hear a low-pitched sound. Sounds are usually a mixture of lots of different kinds of sound waves.

Sound is created when something vibrates and sends waves of energy (vibration) into our ears. The vibrations travel through the air or another medium (solid, liquid or gas) to the ear. The stronger the vibrations, the louder the sound. Sounds are fainter the further you get from the sound source. Sound changes depending on how fast or slow an object vibrates to make sound waves.

Sound waves - Vibrating forms of energy that are made of molecules and look like waves. Sound waves can travel through solids, liquids and gases. The vibrations from sound waves cause our ears to send signals to our brains to create sound.

Timbre – (Pronounced Tam-ber) The quality of a musical note. It is what makes a musical note sound different from another one. Words like round, brassy, sharp, or bright can be used to describe the timbre of a sound. A good comparison to timbre in music is the flavor of different apples: they are all apples, but they all have their own flavors. A violin will have a different timbre to a guitar, even though they are both string instruments and can play the same notes. But even two violins have different timbres! This is because sounds - almost all sounds, not just those in music - have multiple layers of tone. Part of being an experienced musician is being able to bring these sounds out of your instrument and expressively use timbre in music.

Vibration - Sound vibrations can be transferred from one material to another. Frequency measures how fast sound waves are vibrating. Sound waves are mechanical waves that transfer energy via the propagation of vibrations through matter.

INNER EAR DIAGRAM

LEARN THE PARTS OF THE INNER EAR



CLASSROOM ACTIVITIES

1. Explain how you hear sounds. Be sure to use the following words from your glossary: (Inner ear, middle ear, outer ear, eardrum.)
2. How are sounds made? Can you give an example?
3. What kind of matter can sound travel through? Name all three.
4. WHY ARE THESE THINGS RELATED?
 - a. Pitch and frequency
 - b. Amplitude and volume
5. Name an instrument of the orchestra that plays a very low note
6. Name an instrument of the orchestra that plays very loudly.

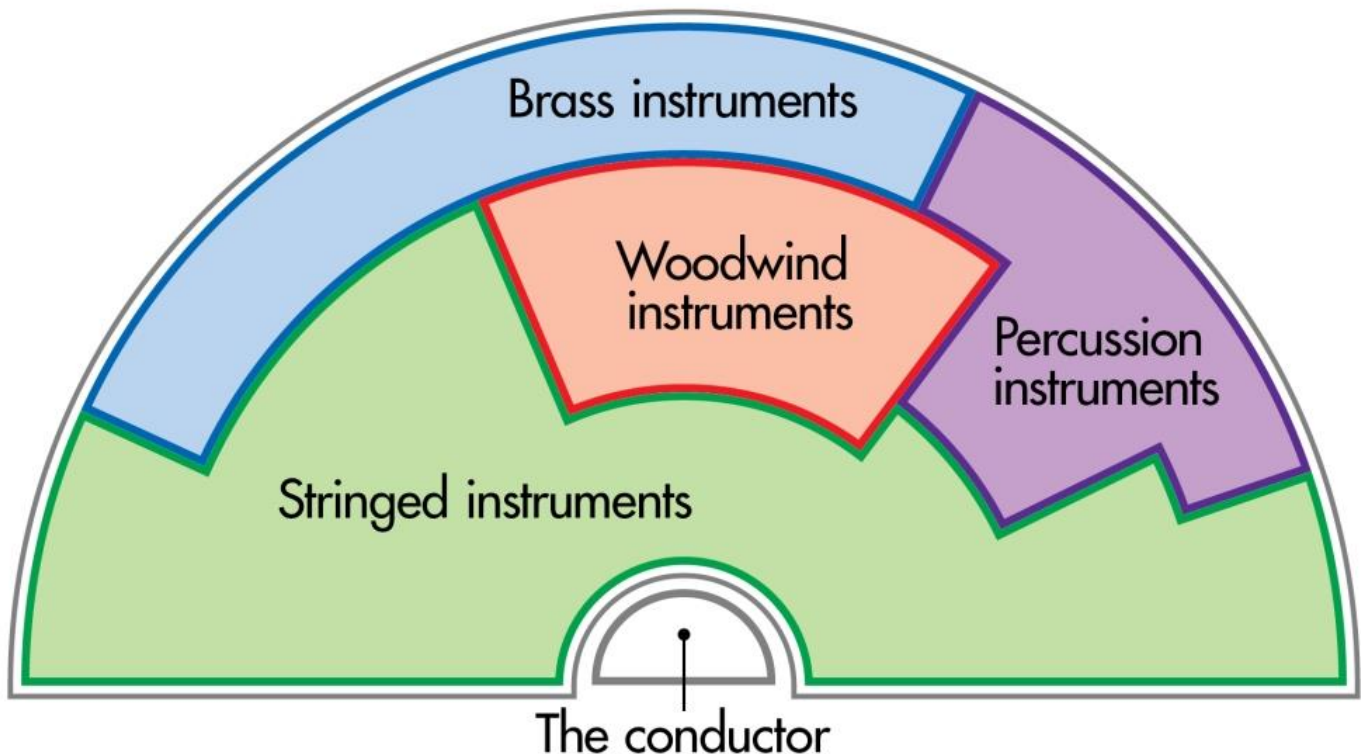
NATURALLY QUIET PLACES

These are the Ten Naturally Quiet Places Around the World. See if you can find them on a map, and read about why they are so quiet.

1. Hoh Rain Forest
2. Kronotsky Nature Reserve
3. Haleakala Crater
4. Yangmingshan National Park
5. Boundary Waters Canoe Area
6. Kelso Dune Field
7. Zabalo River
8. Doñana National Park
9. Marconi Beach
10. Wadi Rum Protected Area

SECTIONS OF THE ORCHESTRA

The Orchestra



BRASS INSTRUMENTS are made of metal. A musician plays a brass instrument by blowing into it. The brass section is very loud. That is why it is at the back of the orchestra.



STRINGED INSTRUMENTS make music when their strings are plucked or played with a bow. String players sit up front.



WOODWIND INSTRUMENTS can be made of wood or metal. A musician plays a woodwind instrument by blowing into it. The woodwind section sits at the center of the orchestra.



PERCUSSION INSTRUMENTS make sounds when they are tapped, struck, or shaken. One percussion player may play a few instruments. They are usually not played at the same time.



MUSICAL SELECTIONS YOU WILL HEAR IN SCIENCE OF SOUND

John Williams | Star Wars Suite

Arturo Marquez | Máscaras, Concerto for Harp and Orchestra “La pasión según San Juan de Letrán”

Xavier Foley | For Justice and Peace

Ralph Vaughn Williams | Fantasia on a Theme by Thomas Tallis

Edward Kennedy “Duke” Ellington | Echoes of Harlem

Antonio Vivaldi | from “Winter” Four Seasons

Ludwig van Beethoven/Arroyo | String Quartet No. 10, op. 74 “Harp” Allegro

ABOUT THE COMPOSERS

John Williams is a living American composer, conductor, and pianist. In a career that has spanned seven decades, he has composed some of the most popular, recognizable, and critically acclaimed film scores in cinematic history. Williams has won 25 Grammy Awards, seven British Academy Film Awards, five Academy Awards, and four Golden Globe Awards. With 52 Academy Award nominations, he is the second most-nominated individual, after Walt Disney. His compositions are considered the epitome of film music; Classic FM considers Williams to be one of the greatest composers of classical music in history.

Williams has composed for many critically acclaimed and popular movies, including the Star Wars saga, Jaws, Close Encounters of the Third Kind, Superman, E.T. the Extra-Terrestrial, the first two Home Alone films, the Indiana Jones films, the first two Jurassic Park films, Schindler's List, and the first three Harry Potter films. Williams has also composed numerous classical concertos and other works for orchestral ensembles and solo instruments. He served as the Boston Pops' principal conductor from 1980 to 1993 and is its laureate conductor. He has been associated with director Steven Spielberg since 1974, composing music for all but five of his feature films, and George Lucas, with whom he has worked on both of his main franchises.

Arturo Marquez is a living Mexican composer of orchestral music who uses musical forms and styles of his native Mexico and incorporates them into his compositions. Márquez has been the recipient of several prestigious awards and honors. He was awarded the National Prize for Arts and Sciences (Mexico) by President Felipe Calderón on December 14, 2009. In February 2006, he made history when he became the first musician to receive "La Medalla De Oro De Bellas Artes de Mexico" (Gold Medal of Fine Arts of Mexico), one of Mexico's most coveted award for career accomplishments in the fine arts. Other awards have included the Medalla Mozart (awarded by the Austrian embassy), Medalla Dr. Alfonso Ortiz Tirado, California Institute of the Arts Distinguished Alumnus Award, Unión de Cronistas de Música y de Teatro, and many others. In 2000, the German public paid homage to the composer at a concert in his honor in Berlin.

Xavier Foley is a living bassist, and was First Prize winner of the 2014 Sphinx Competition, the Young Concert Artists Auditions 2016, and a winner of the Astral Artists National Auditions 2014. He has appeared as soloist with the Sphinx and Atlanta symphony orchestras, Philadelphia Orchestra, and the Nashville Symphony. He made his Carnegie Hall solo debut with the Sphinx Virtuosi, with which he was also soloist on East and West coast tours. Also a composer, he is a 2016 graduate of the Curtis Institute of Music, where he studied both

composition and performance. Xavier Foley strives to become a world artist on the double bass as he continues to incorporate all styles of music, whether it be cultural, national, or folk music.

Ralph Vaughn Williams was an English composer. His works include operas, ballets, chamber music, secular and religious vocal pieces and orchestral compositions including nine symphonies, written over sixty years. Strongly influenced by Tudor music and English folk-song, his output marked a decisive break in British music from its German-dominated style of the 19th century. He was musically a late developer, not finding his true voice until his late thirties; his studies in 1907–1908 with the French composer Maurice Ravel helped him clarify the textures of his music and free it from Teutonic influences. Among the most familiar of his other concert works are *Fantasia on a Theme by Thomas Tallis* (1910) and *The Lark Ascending* (1914). He went on composing through his seventies and eighties, producing his last symphony months before his death at the age of eighty-five. His works have continued to be a staple of the British concert repertoire, and all his major compositions and many of the minor ones have been recorded.

Edward Kennedy “Duke” Ellington was an American composer, pianist, and leader of a jazz orchestra from 1923 through the rest of his life. Born in Washington, D.C., Ellington was based in New York City from the mid-1920s and gained a national profile through his orchestra's appearances at the Cotton Club in Harlem. In the 1930s, his orchestra toured Europe several times. Some of the jazz musicians who were members of Ellington's orchestra, such as saxophonist Johnny Hodges, are considered among the best players in the idiom. Ellington melded them into the best-regarded orchestral unit in the history of jazz. Some members stayed with the orchestra for several decades. A master at writing miniatures for the three-minute 78 rpm recording format, Ellington wrote or collaborated on more than one thousand compositions; his extensive body of work is the largest recorded personal jazz legacy, and many of his pieces have become standards. Following a low-profile period (Hodges temporarily left), an appearance by Ellington and his orchestra at the Newport Jazz Festival in July 1956 led to a major revival and regular world tours. Ellington recorded for most American record companies of his era, performed in and scored several films, and composed a handful of stage musicals.

Antonio Vivaldi was an Italian Baroque composer, virtuoso violinist, teacher, impresario, and Roman Catholic priest. Born in Venice, the capital of the Venetian Republic, Vivaldi is regarded as one of the greatest Baroque composers. Vivaldi composed many instrumental concertos, for the violin and a variety of other musical instruments, as well as sacred choral works and more than fifty operas. His best-known work is a series of violin concertos known as the *Four Seasons*. After almost two centuries of decline, Vivaldi's musical reputation underwent a revival in the early 20th century, with much scholarly research devoted to his work. Many of Vivaldi's compositions, once thought lost, have been rediscovered – in one case as recently as 2006. His music remains widely popular in the present day and is regularly played all over the world.

Ludwig van Beethoven was a German composer and pianist. Beethoven remains one of the most admired composers in the history of Western music; his works rank amongst the most performed of the classical music repertoire and span the transition from the Classical period to the Romantic era in classical music. His career has conventionally been divided into early, middle, and late periods. His early period, forged his craft. His middle period showed an individual development from the styles of Joseph Haydn and Wolfgang Amadeus Mozart, and is sometimes characterized as heroic. During this time, he began to suffer increasingly from deafness. In his late period, from 1812 to 1827, he extended his innovations in musical form and expression.

His first major orchestral work, the *First Symphony*, premiered in 1800, and his first set of string quartets was published in 1801. Despite his hearing deteriorating during this period, he continued to conduct, premiering his *Third* and *Fifth Symphonies* in 1804 and 1808, respectively. He was almost completely deaf by 1814, and he then gave up performing and appearing in public. After 1810, increasingly less socially involved, Beethoven

composed many of his most admired works, including later symphonies, mature chamber music and the late piano sonatas. His only opera, Fidelio, first performed in 1805, was revised to its final version in 1814. He composed his final Symphony, No. 9, one of the first examples of a choral symphony, between 1822 and 1824. After some months of bedridden illness, he died in 1827. Beethoven's works remain mainstays of the classical music repertoire.

DISCLAIMER

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