



Music: Math and Science You Can Hear

Know the *Ode to Joy*? Can you hum the theme song for *Star Wars*? Do you change ring tones more often than your socks? Are you more likely to buy an MP3 than a candy bar with a found dollar?

Whether you *play* an instrument or not, music is a constant soundtrack of daily life for most of us. We listen to music. We make music. We are surrounded by music. But we don't always stop and think about what music *is*. In this special issue of the *Science Buddies Project Ideas Newsletter*, we've gathered projects that let you explore the science of sound and music. Whether you're interested in creating music, in building instruments, in wiring a musical device, or in audio technologies, we've got science projects with all the right notes.



Vibrating Strings: Fret-ting Do, Re, Mi



Plucking a guitar string makes the string vibrate, which creates a "standing sound wave." Frets on a guitar are spots where you can *interrupt* the wave to create a specific sound or note. When you press a string against a fret, you change the length of the string and the frequency of the vibration (or the pitch). Charting differences that occur when you pluck each string at each fret puts "sound" into measurable perspective!

The following science project ideas offer fun, hands-on exploration of strings.

- **Guitar Jingle: Discovering the Locations of Harmonics:** Lightly pluck your strings in certain spots, and you might hear "bell" sounds! Explore the relationship between string length and harmonics on an acoustic guitar. (Difficulty: 4-5)
- **Pick This Project!:** Explore the function of the magnetic "pickups" on an electric guitar. (Difficulty: 5-8)

Win an iTunes Gift Card!

We're giving away five \$10 iTunes gift cards! For a chance to win, send an email to itunes@sciencebuddies.org with the following information:

- Your full name
- Your grade (or the grade you teach)
- Your favorite song

We'll randomly draw five lucky winners from all *complete* entries received before May 11. (*U.S. entries only. One entry per person.*)

Do You Hear What I Hear?



You don't have to be a musician reading notes or composing a song to analyze music. **Listening** to music can also lead to intriguing scientific insights. *Tune in* to the following science projects and put your listening skills to the test.

- **Sound Bites: Tasting the Texture of Classical Music:** Explore the texture of music from different periods -- from thin and open to thick and layered. (Difficulty: 3)
- **Comparing Vocal Ranges: How High and Low Can You Go?:** Investigate how age and gender determines a person's vocal range. What's *your* vocal range? Will it be

- [Guitar Fundamentals: Wavelength, Frequency, & Speed](#): First foray into tracking frets and determining the speed of the wave on each string. (Difficulty: 7)
- [Don't You Fret! Standing Waves on a Guitar](#): What happens when you pluck a string somewhere other than the fret? (Difficulty: 7)

Hands-On Music Theory at Home



Exploring the science of sound and musical scales can be a perfect at-home activity for students of all ages. A set of empty bottles on their way out to the recycling bin, a group of wine glasses, and even strategically cut straws can be put to use to experiment with musical scales and composition.

A step up from banging on pots and pans with a wooden spoon, these science projects offer immediate results for parent-led activities, but can be expanded and turned into more robust science projects for school use.

- [Blowing Bottletops: Making Music with Glass Bottles](#) (Difficulty: 5-7)
- [Singing Wine Glasses](#) (Difficulty: 5-7)
- [Do-Re-Mi with Straws](#) (Difficulty: 6)

Tip: Write down the notes each musician plays to experiment with the basics of composition *or* use the melody from familiar songs to practice "playing" the instruments you build.

DIY Instruments



Sometimes, rolling up your sleeves and recreating the wheel really is the best way to understand from the inside out what is happening, how something works, and what the science at hand really means. Patience, ingenuity, and a DIY attitude make these homemade (or "tweaked") instruments a fun and functional way to explore sound and music.

- [Build Your Own Xylophone Out of Copper Pipe](#): Math and music combine to turn ordinary copper piping into a familiar instrument. (Difficulty: 5)
- [Make Your Own Piezoelectric Pickup for Acoustic Guitar](#): Soup up your acoustic guitar for use with an

the same when you're older? (Difficulty: 3-5)

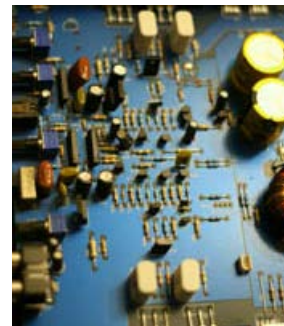
- [Movie Music](#): Consider the ways pitch, key, and tempo of background music correlate to types of movies and to how you respond to what happens on screen. (Difficulty: 5-6)
- [Can You Make a Happy Song Sad?](#): Convert various songs into different keys to explore how key relates to a listener's perception of a song. (Difficulty: 5-7)

For the Birds

Composers throughout history have borrowed melodies from birds. [Tune in to the trees outside your window and some classical tracks at the same time!](#)

Playing the "Circuit"

If you're more interested in wiring the tools that transmit, receive, or respond to music than in the theory of scales and harmony, put your circuit sense to work!



Simple circuits, resistors, diodes... it all adds up to cool sound-related fun and a hands-on look at fundamental electronics.

[Take a Musical Step Back in Time: Make Your Own Phonograph from Everyday Items](#): Use a tin can to play back sound from a vinyl record. (Difficulty: 4-6)

[Build Your Own Crystal Radio](#): Turn an oatmeal container and a germanium diode into a functional radio receiver. (Difficulty: 4-9)

[Dance Mania: Build Your Own Dance Pad!](#): Wire a dance pad to light up when stepped on. (Difficulty: 6)

[Make Your Own Low-Power AM Radio Transmitter](#): Take an inside look at how sound is broadcast. (Difficulty: 7-9)

Techno Tones

[Turn a favorite track into a ringtone](#) to explore digital audio compression, MP3 algorithms, and bit rates. Plus, you'll end up with a ringtone that's totally *you!*

amplifier by making a "pickup" out of a simple electronic buzzer.
(Difficulty: 7-9)

- [Make Your Own Electric Guitar Pickup](#): Induction, magnets, and thousands of wire wraps give your electric guitar the rock-and-roll sound you love. Wind your own pickup with a set of popsicle sticks to see how even small changes in the pickup can alter the sound. (Difficulty: 7-9)
- [Building Banjos](#): Explore the function of a banjo's "resonator." (Difficulty: 8)
- [Pluck Out & Pick New String Materials for Your Guitar](#): Guitar strings can be made out of a range of materials and come with varying degrees of "tension." Which works best with your soundboard? (Difficulty: 8-10)

From Absorption to Amplification

How loud can you go?



These two science projects let you explore both ends of the volume spectrum as you examine principles of sound absorption and amplification.

[Most Resonant Soundboard](#): test materials used to build acoustic instruments to find out which makes the best soundboard and offers the best amplification. (Difficulty: 6-10)

[Frequency-Dependent Sound Absorption](#): test various materials to determine if sound absorption changes with the frequency of sound. (Difficulty: 7)

Difficulty Level

All Science Buddies projects are ranked in terms of "Difficulty Level." **This ranking does not correlate directly with grade level.** For more information, see our [Understanding Project "Difficulty" chart](#).

Maximizing Muscle: Can You Exercise Your Brain with Music?



Have you ever considered that music might actually boost your brain? With the help of friends, family, and classmates, try out the following science projects to investigate music and multitasking. You might find that the right *track* is just what you need to rev up your next study session!

[Multitasking: Brain Drain or Boost in Efficiency?](#) (Difficulty: 7)

[Classical Music and Cognitive Tasks](#) (Difficulty: 7)

A "Sound" Career



If you think you've got to be the next guitar virtuoso or *American Idol* winner to have a career in music, think again. Check out these cool careers that build upon the science of music and sound.

- [Precision Instrument and Equipment Repairer](#)
- [Sound Engineering Technician](#)
- [Audiologist](#)

Looking for a Perfect Project for You?



Our [Topic Selection Wizard](#) can help guide you to a science project that fits your areas of interest *and* meets science fair requirements. Give it a try today!

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