# Sound Science!
# Activity 1: Experimenting with Sound Waves

**What you need**

- Metal wrench with closed loop on one end, or metal utensil (preferably a spoon)
- String
- Table or desk

Follow the steps below to make a model that explores how sound waves travel through different substances.

**Preparation**

1. Cut a 3-foot length of string.
2. Find the mid-point of the string and tie it through the closed loop end of the wrench, creating two equal length (approximately 1.5 feet long) attached to the wrench.
    a. Alternatively, if using a metal utensil, find the mid-point of the string and tie it around the utensil handle. You may need to secure it with tape. There should be two equal lengths of string attached to the utensil.
3. Grab the two equal lengths of string; the wrench or utensil will hang in the center. Wrap the string a few times around each index finger, but leave plenty of string loose so that the wrench or utensil hangs & swings.

**What to do**

1. Lightly swing the wrench or utensil to bump it against a table or desk. Observe what you hear.
2. Press your index fingers, with string wrapped around, against the tragus of each ear (i.e., plugging your ears). The wrench or utensil should be hanging under your chin. Then bend over and lightly swing the wrench or utensil to bump it against the table or desk. Observe how the sound is louder and deeper in tone; you may even notice vibrations in your jaw!


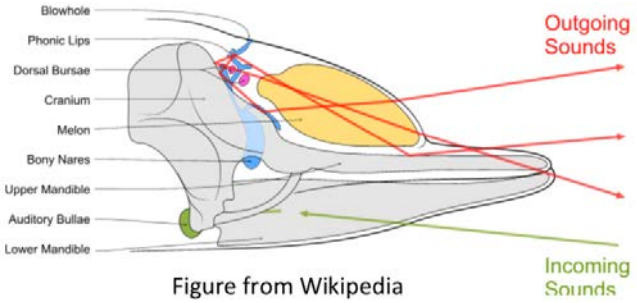

Figure from Wikipedia

**What is happening?**

Hitting the wrench or utensil against the table causes it to vibrate. These vibrations (sound waves) are conducted up the string, through your fingers, through the bones of your skill and into the inner ear. Because the sounds are traveling through solids (instead of through air like the first observation), the sounds are louder and deeper. This is similar to how cetaceans hear underwater. In toothed whales, instead of sound coming in through an ear canal, sound comes in through fatty tissues in the jaw. The fatty tissues in the whale's jaw are attached to an "acoustic funnel," where the ear bones vibrate and translate sounds to the fluid-filled inner ear.

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## Activity 2: Water Glass Xylophone

**What you need:**

- 4 or more glass cups (e.g., water glasses)
- Metal utensil, such as a spoon
- Water in a pitcher or other container that enables controlled pouring
- Towel for easy clean-up in case of a spill
- Optional: Food coloring – a different color for each glass cup

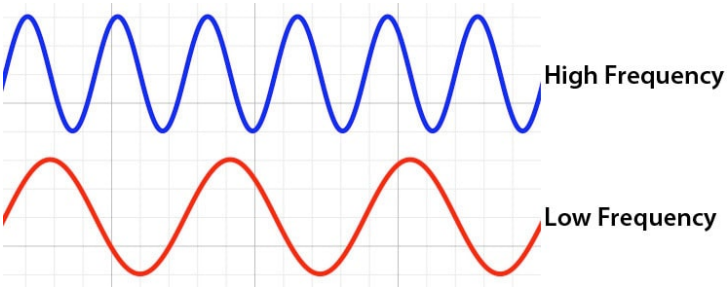
Follow the steps below to learn about how different pitches are produced and have fun playing your own homemade xylophone!

**Preparation**

1. Gather your supplies. Have an adult help you place the glass cups on a table and space them out so that they don't touch each other. (We don't want any to fall and break!) Also, keep the towel handy in case water spills.
2. Pour water into each glass cup: start with one being nearly full and then reduce the amount of water in each one as you go down the line of cups.
3. Optional: Add a different color of food coloring to each glass cup to create a rainbow xylophone!

**What to do**

1. Take your spoon or other utensil and tap each glass to hear the sound (pitch) produced.
2. Compare the pitch produced when you tap the glass cup with the most water vs. the pitch produced when you tape the glass cup with the least water.
3. Have fun creating music on your water glass xylophone! Get creative and try using different objects (wooden spoon, plastic spoon, etc.) to compare the quality of the sounds.




**What is happening?**

Each glass cup, with its differing amount of water, produces a unique pitch. And pitch is the quality that allows us to classify a sound as high or low. Pitch is determined by the frequency of sound wave vibrations. The frequency of vibrations is related to how quickly the sound wave can make a "round trip" through the object it is traveling through. If there's less water, it takes less time for it to make the round trip, and thus the pitch increases. By altering the amount of water, we alter the material and the weight of each glass. That changes the natural frequency of each glass and so each glass vibrates at a different frequency and creates a different note.

# Sound Science!
# Activity 3: Straw Pan Flute

**What you need:**

- 9 or more straws (can be paper or plastic straws)
- Scissors
- Clear tape

Follow the steps below to learn how length can affect the pitch of sound waves and make your own straw pan flute musical instrument!

**Preparation**

- Gather your supplies. Be sure to have adult supervision when using scissors.

**What to do**

1. Line up the straws side-by-side so that all of the ends are aligned.
2. Using the scissors, cut the straws at an angle on one side. Each straw should be a different length.
3. Using the clear tape, tape the straws together to create a straw pan flute!
4. Now, blow through the straws. Which straws make higher or lower pitches?

**What is happening?**

Sound is produced by the vibration of air blowing across the open holes of the straws. The way a sound wave is received by your ear is known as its pitch. The wave that creates it is measured in frequency, or the number of sound waves that hit your ear in a certain amount of time. A high-pitched sound is made by a high-frequency wave and a low-pitched sound is made by a low-frequency wave.

The different lengths of each straw vibrate with different frequencies, creating different pitches of sound. Air blowing through the shorter straws moves quickly in one end and out the other. These vibrations move quickly and have a high frequency, which produces a high pitch. Similarly, the same amount of air moving through a longer straw takes longer to come out the other end. These vibrations move more slowly, have a low frequency, and produce a low pitch. As the length of the straw is reduced, the note produced has a higher pitch. This is because the column of air that vibrates gets shorter as you blow through the shorter straws.

Dogs and many other animals can hear pitches that are too high for our ears. Whales sometimes create pitches that are way too low for human ears, but whales can hear them just fine for hundreds of miles across the ocean!

Modified from "Saturday Science: Straw Flute" by The Children's Museum of Indianapolis