

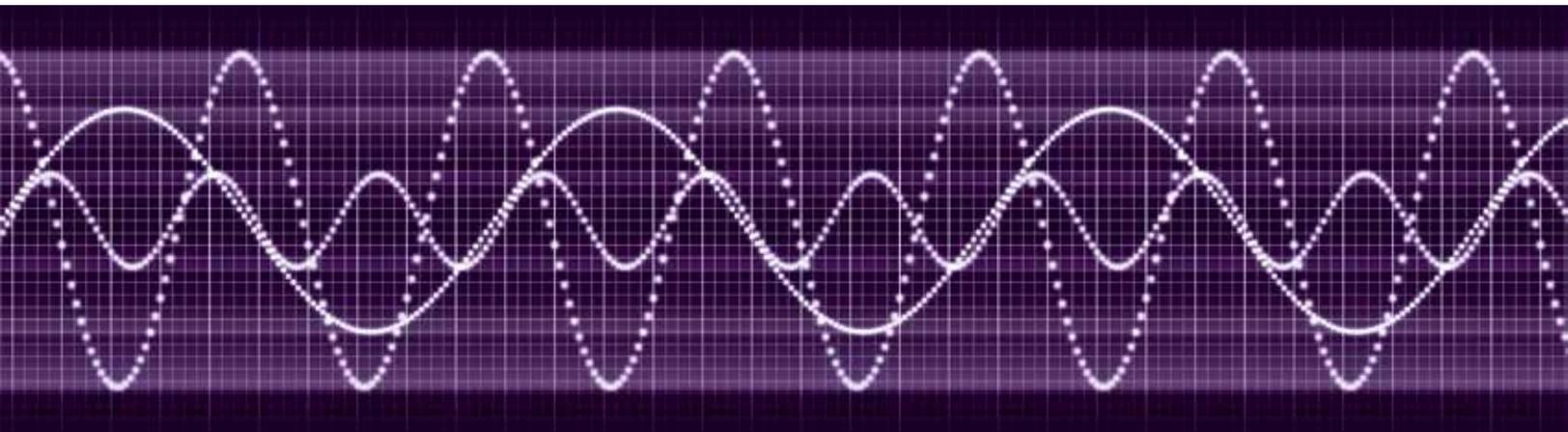


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# STRAW FLUTES



**MUSIC IS IN THE AIR!** In this STEM Gem, you will learn how young people can build a simple musical instrument using just a straw. Young people will get hands-on to discover how vibrations create sound and how the length of a straw affects pitch.



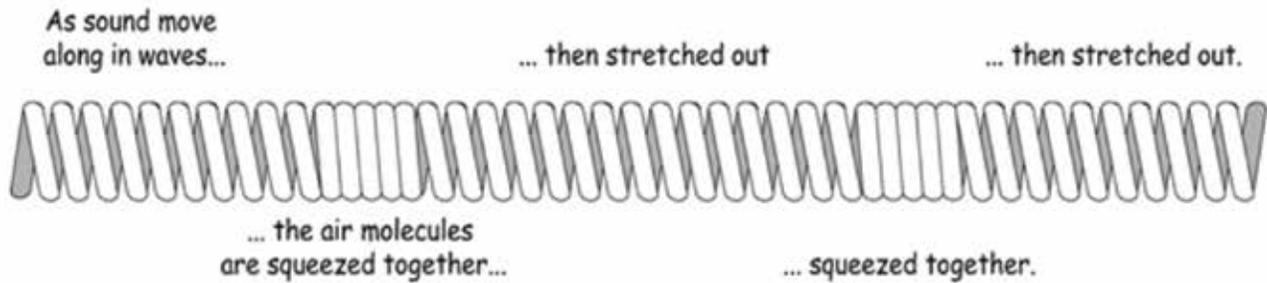
## WHAT IS SOUND?

Sound is a form of energy that is produced by vibrations. When something vibrates, it pushes and pulls on the air next to it, causing the air to vibrate and create sound waves that can transfer energy from place to place. For example, when a drum is struck, the head of the drum will vibrate back and forth moving the air next to it, creating sound waves that can be detected by our ears.

## WHAT ARE SOUND WAVES?

A sound wave is an example of a longitudinal wave. In a longitudinal wave, the movement of the medium is in the same direction as the wave. The molecules of air in a longitudinal sound wave are pushed and pulled back and forth; alternately squeezing and stretching like a spring.

## BIG IDEAS (continued...)



The atoms of air move in the same direction as the wave. When the air molecules are pushed together they create a region of high pressure called a compression. When the air is pulled apart, a region of low pressure, called a rarefaction, is created. Sound energy travels as a series of pushes and pulls that are passed along by the molecules of the medium it is traveling through. Sound waves can only travel if they have molecules to transfer the pushes and pulls. They will not travel through a vacuum.

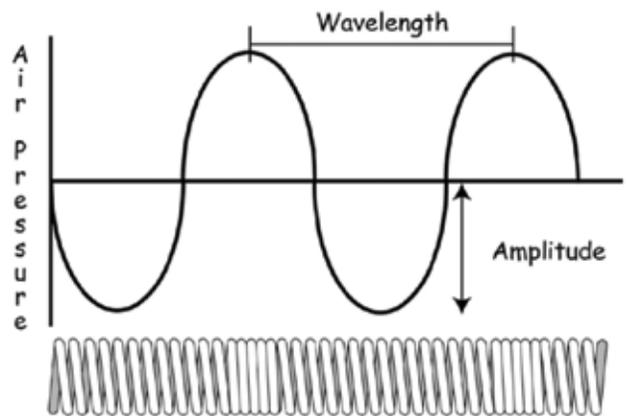
### WHAT ARE THE PROPERTIES OF A SOUND WAVE?

**SOUND WAVES** are described using various terms: wavelength, amplitude, and frequency.

**WAVELENGTH** is the length of one complete wave; compression to rarefaction and back to compression.

**FREQUENCY** is the time it takes for one complete wave to pass a point. It is the number of sound waves that pass a point in one second. A bass drum creates about 20 sound waves a second, while a whistle might produce around 10,000. The frequency of a sound determines its pitch. The higher the frequency, the higher the pitch of the sound.

**AMPLITUDE** measures the loudness of a sound. As sound waves pass through the air, the molecules of the air vibrate back and forth. The amount of air being moved determines the loudness, or amplitude, of the sound. The larger the vibration, the more the air gets moved, and the louder the sound is. Amplitude is measured in decibels; the larger the number of decibels, the louder the sound will be. Normal conversation registers about 60 decibels, an acoustic guitar is about 80 decibels, and an airplane engine is about 120 decibels.



**AMPLITUDE:** The loudness of a sound. | **COMPRESSION:** The squeezing or pressing together of something. | **FREQUENCY:** The time it takes for one complete wave to pass a point. | **PITCH:** The pitch of a sound is how the ear determines frequency. The higher the pitch of a sound, the higher its frequency. | **RAREFACTION:** A reduction of an item's density; the opposite of compression. | **VIBRATION:** A series of fast movements back and forth. | **WAVELENGTH:** The length of one complete wave.

## engage

- ② **Have your group sit silently for 30 seconds. Ask young people to describe all the sounds that they heard while being quiet?** *Young people's choice.*
- ② **Who has played a musical instrument? If so, how did your instrument make sound?** *Young people's choice.*
- ② **What creates sound?** *Young people's choice.*

## what YOU WILL NEED

### FOR THE GROUP:

- ! **A collection of different kinds of straws**
- ! **Scissors**
- ! **Cups or glasses**
- ! **A pin** *(for adult use only)*
- ! **Rulers**

## & before YOU BEGIN

**Collect the materials.** Consider gathering straws from fast food restaurants to provide a variety for the activity.

## EXPLORE & EXPERIMENT

- ① **Distribute the rulers** among young people.
- ② **Challenge young people to create a sound using the rulers.** Eventually someone will hold a ruler on the edge of a table and tap it to make a twang sound. Ask young people to describe what made the sound.
- ③ **Explain that sound was produced when the ruler was made to vibrate.** When the ruler vibrated, it pushed and pulled on the air around it. The pushes caused the air to squeeze together and the pulls caused the air to pull apart. These squeezes and pulls traveled through the air where they pushed and pulled on our ear drums, allowing our brains to interpret this movement as sound.
- ④ **Explain that all sound is caused by vibrations that travel as sound waves through the air.** The faster an object vibrates, the higher the pitch of the sound. The more air the object moves, the louder the sound.
- ⑤ **Tell young people to place a finger on each side of their throats and make a noise.** They will be able to feel the vibrations from their vocal cords. Explain that humans create sound by pushing air past a membrane in their throats, which causes it to vibrate.
- ⑥ **Hand out a straw to each young person.** Challenge him or her to make a sound using the straw.
- ⑦ **Ask young people why they cannot create much sound with the straws.** Share with them that the straw is not springy and does not vibrate very well. Blowing into it makes a sound that can also be made with just your lips. Explain that the straw needs to be changed in some way so it can vibrate.
- ⑧ **Have young people lay their straws flat on a table** and use the bottom of a cup or glass to firmly press down on one end of their straws to flatten it.

## EXPLORE & EXPERIMENT (continued...)

- 9** When young people have flattened one end, **instruct them to use the scissors to make two cuts at an angle**, forming a “V” shape, at the center of the flattened end.
- 10** **Have young people firmly grasp their straws between their lips so the “V” is in their mouths and blow hard!** Encourage them to flatten the tips of the “V” more with their teeth if no sound is heard.
- 11** When all young people are able to make a sound with their straws, **ask them what is vibrating to make the sound.**
- 12** **Explain that when they blew into the straw the two tips vibrated, causing the air in the straw to vibrate.** These vibrations traveled down to the end of the straw and reflected back. It is the air vibrating up and down the straw that made the sound.
- 13** **Have each young person choose a partner.** Instruct one partner to blow into his or her straw while the other uses scissors to cut a short piece off the opposite end of the straw. The partner will continue cutting short pieces off the end until the straw is about half of its original length. Have the partners switch roles. Be sure young people use caution when cutting the straws while their partners hold them.
- 14** **Ask the group to share their ideas about why the sound changed.** Explain that as the straw got shorter, air vibrating up and down the straw traveled a shorter distance causing more vibrations per second. This increased frequency caused the pitch of the sound to get higher as the straw got shorter.
- 15** **Invite young people to explore how sound is affected** by experimenting with straws of varying circumference and length and cutting varying angles into one end of the straws.
- 16** **Challenge young people to discover how many different sounds they can produce with the straws.** Invite them to try to make a trombone using two straws or poke a series of holes into one side of a straw and have them try to play it like a flute. Encourage young people to share their sounds and how they made them.



## make THE CONNECTION

Have young people research different musical instruments. Invite them to discover and report on the following:

- What is vibrating to make a sound?
- How are the vibrations changed to produce different notes?
- How are the vibrations amplified to produce a loud sound?

Share the following example with the group. A guitar produces sound using vibrating strings. Different notes are produced as strings of different thickness are shortened or lengthened by the player's fingers. A long, thick string produces a low note because it vibrates more slowly than a short, thin string. An acoustic guitar amplifies its sound by using a pickup that transfers the vibrations of its strings to the body of the guitar. The top of the guitar then vibrates, with the strings moving a lot of air, and makes a sound that is easy to hear.

## EXTEND & EVALUATE

**Collect a variety of empty bottles. Have young people fill each bottle with varying amounts of water. Invite young people to blow across the top of each bottle to produce a sound. Ask young people to describe how the sound is made and why it changes as the amount of water in the bottle changes.**

**Explain to young people that when you blow across the top of the bottle, air vibrates and bounces back and forth in the bottle. The tone of the sound is affected by the amount of water in the bottle. The greater the amount of water, the shorter the distance the air has to move back and forth and the higher the sound produced.**

**Challenge young people to use the straws and bottles to play a simply song, such as Jingle Bells or Happy Birthday.**