Oregon State University
Precollege Programs

Envision, Believe, Succeed

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Singers and Sound Waves

LaCuKnoS Language Booster

DESCRIPTION

Have you ever seen a cartoon where an opera singer sings a loud, high note and wine glasses, eyeglasses and even light bulbs shatter and break? Do you think this can happen in real life? Is it possible for sound waves to break glass? Believe it or not, the answer is yes. Every solid object has a sound frequency that can cause it to vibrate. Wine glasses vibrate easily because of their hollow shape. This is why they make a ringing sound when they are tapped together. If a person sings the same musical note as that ringing note from the glass, the sound of the voice vibrates the air molecules around the glass, and this causes the glass to start vibrating as well. If the person sings the correct note loudly enough, the glass will vibrate so much that it shatters. Here's a video that shows this in action. Sound waves are invisible, but they can be powerful! In this activity, you will use models to demonstrate and explain two important characteristics of sound waves: the ***frequency*** (how many waves reach your ears each second) and the ***amplitude*** (the height and energy of a wave).

Talk with your partner about these questions, then write your answers...

1
Have you ever played a musical instrument that needs to be tuned? Did you ever tune it? How did you do it?

2
Why is it important for a musician to know how to tune their instrument?

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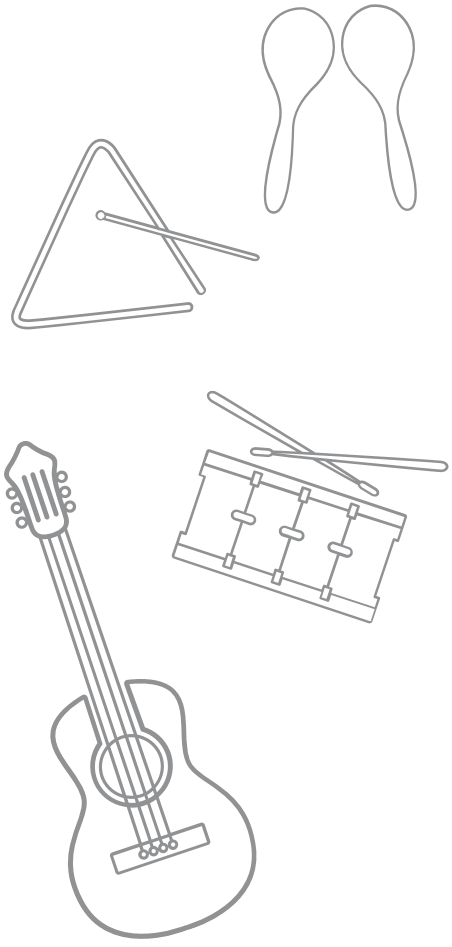
Exploring Sound Waves with Simple Instruments

LaCuKnoS Science Investigation

Materials

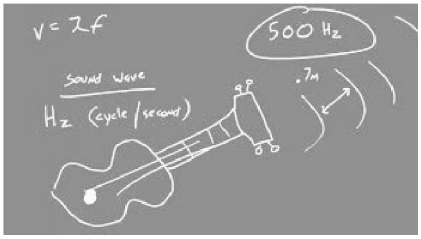
- One-string guitar (prepared by your teacher)
- Hanging hanger (prepared by your teacher)

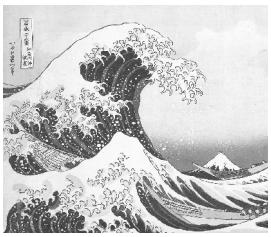


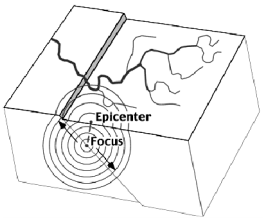
DESCRIPTION

In this activity we are all going to be musicians as we explore two simple instruments as a way to better understand sound waves and their characteristics. A wave is a change that moves through a substance. The substance can be a gas (like air), or a liquid (like water), or a solid (like the ground). Examples of common waves include sound waves, ocean waves and earthquake waves. In this activity, we will be exploring sound waves.

In your investigation group, you will explore sound waves using two different models: The one-string guitar and the hanging hanger. In both cases your challenge is the same: to adjust the instrument so that you can play a note with a higher sound (high pitch) and with a lower sound (low pitch).







PROCEDURE

For the one-string guitar:

1. Have one person hold the cup to their ear.
2. The second person will hold the end of the guitar string, pull it tight, and pluck it with their finger.
3. The first person should describe what they hear.
4. The second person should then change something about how they hold and pluck the string.
5. The first person should describe what they hear again. Did the sound change? How?
6. The second person should continue to change things about how they hold and pluck the string until they can produce a higher sound and a lower sound.

Take turns listening and plucking the string and make sure everyone in your group has a chance and is able to produce and to hear a higher and lower pitch sound. Describe what you did and what you heard.

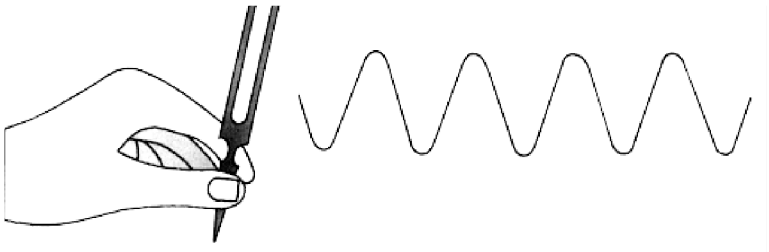
PROCEDURE

So far, you have been changing one characteristic of the wave (high or low pitch). Now, describe how you can change the sound of the 1-string guitar to make it loud or quiet.

For the hanging hanger:

1. Have one person hold the cup to their ear. Make sure the string is hanging down without touching anything.
2. The second person will use a pencil or pen to tap the metal of the hanger.
3. The first person should describe what they hear.
4. Next, think about what you can change to produce a higher pitch sound and a lower pitch sound. Remember what you changed for the one-string guitar.

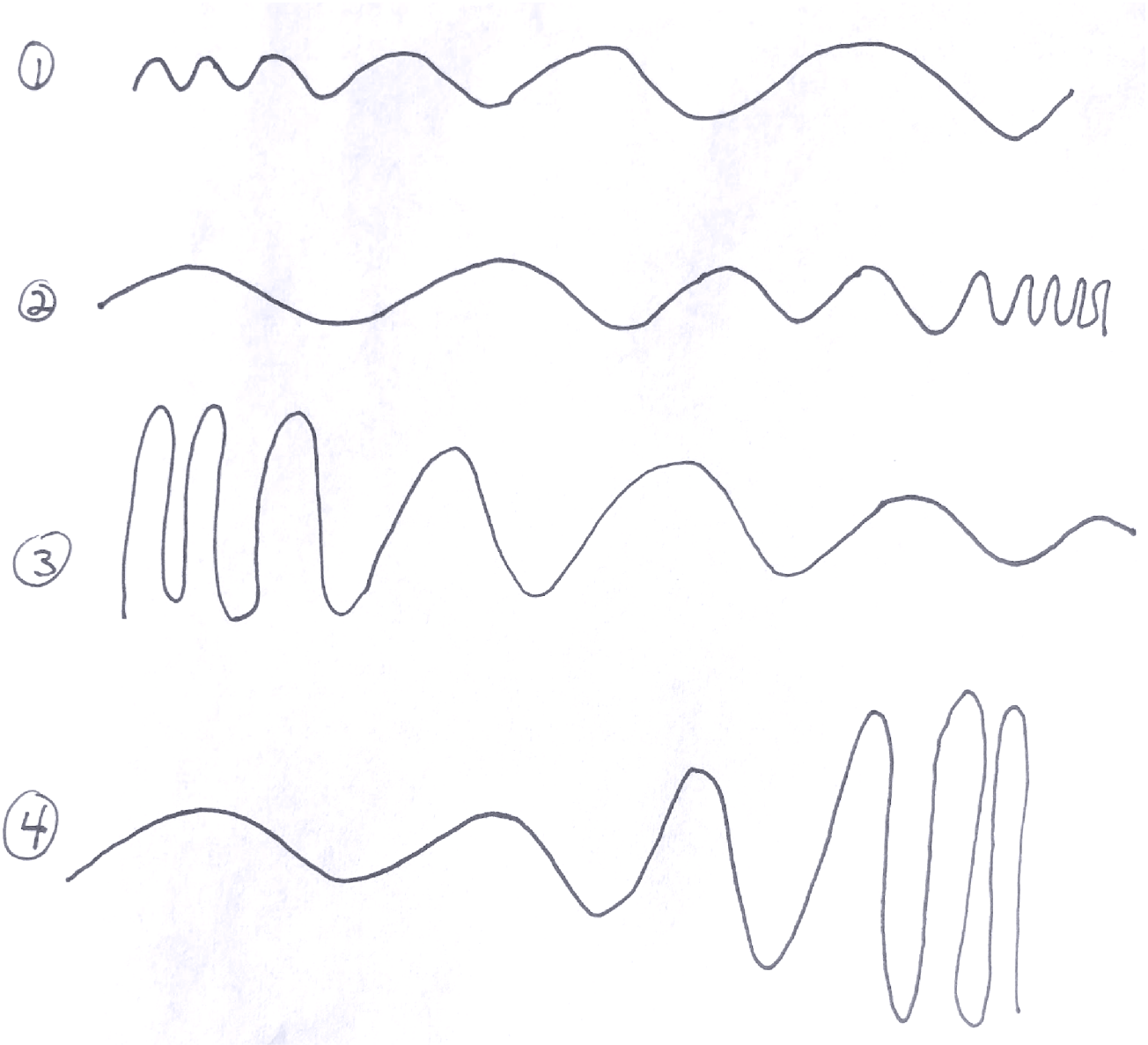
Write down the changes you tried to make and how the sound changed. Make sure everyone in the group has a chance to participate.



The two important properties of sound waves (and other types of waves as well) are called ***amplitude*** and ***frequency***. The amplitude is how powerful the wave is. You can think of the amplitude as the height of a wave. The taller the wave, the more powerful it is. This is true for ocean waves, and it is also true for sound waves. A more powerful sound wave is louder and is represented as a taller wave. The other important property of a wave is frequency. Frequency is how many waves reach a point (like your ear) in a certain period of time. You can think of frequency as the speed of the wave or how fast it moves. For sound waves, the frequency describes if the sound you hear is high pitch or low pitch. Waves that have a high frequency are very close together, with many waves reaching your ear every second and have a high-pitched sound. Waves that have a low frequency are wide and spread out, with few waves reaching your ear every second.

Applying what we have learned

Now that we have explored sound waves and some of their important properties, it's time to apply what we have learned. In the beginning of this activity, we talked about how a singer could break a glass with their voice. The last part of our activity is to practice singing what some sound waves should sound like based on what they look like. Look at the next page and you will see drawings of four different waves. Using your singing voice, we will sing the sounds that these waves would make. Remember to think about the amplitude of the wave (how loud) and the frequency of the wave (how fast, which also determines how high or low the sound is). Hopefully, no glass will break!



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Sound Waves

LaCuKnoS Investigation Summary

NGSS SEP: Developing and Using Models

Describe the two main concepts that the musical instrument models helped us learn about.	How did the musical instrument models help you to understand the concepts?	What is one limitation of these models (something the model did not help you understand)?

How would you describe to a family member what you learned today about sound waves?

How would you describe to your science teacher what you learned today about sound waves?

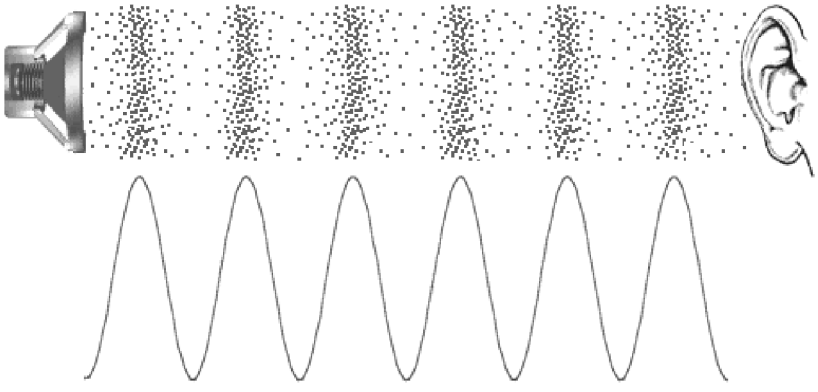
Sound Waves

LaCuKnoS Concept Cards

Sound Wave/Onda Acústica

The pressure caused by the vibration of matter, such as air or water. The vibration transfers energy.
Every noise you hear is the result of a ***sound wave*** *traveling to your ear.*

La presión causada por la vibración de la materia, como el aire o el agua. La vibración transfiere energía.
Cada ruido que escuchas es el resultado de una ***onda de sonido*** *viajando a tu oído.*



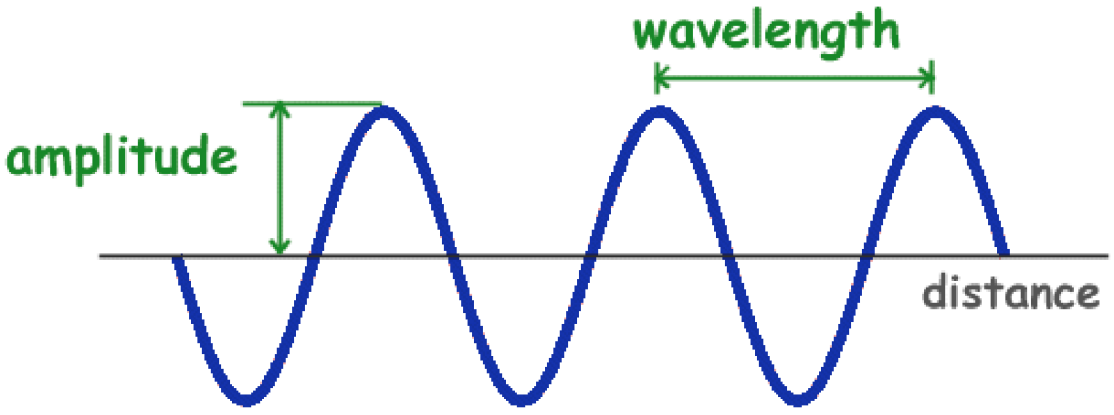
Sound Waves

LaCuKnoS Concept Cards

Amplitude/Amplitud

The height of a wave from the center line to the top of the crest.

La altura de una onda desde la línea central hasta la parte superior de la cresta.



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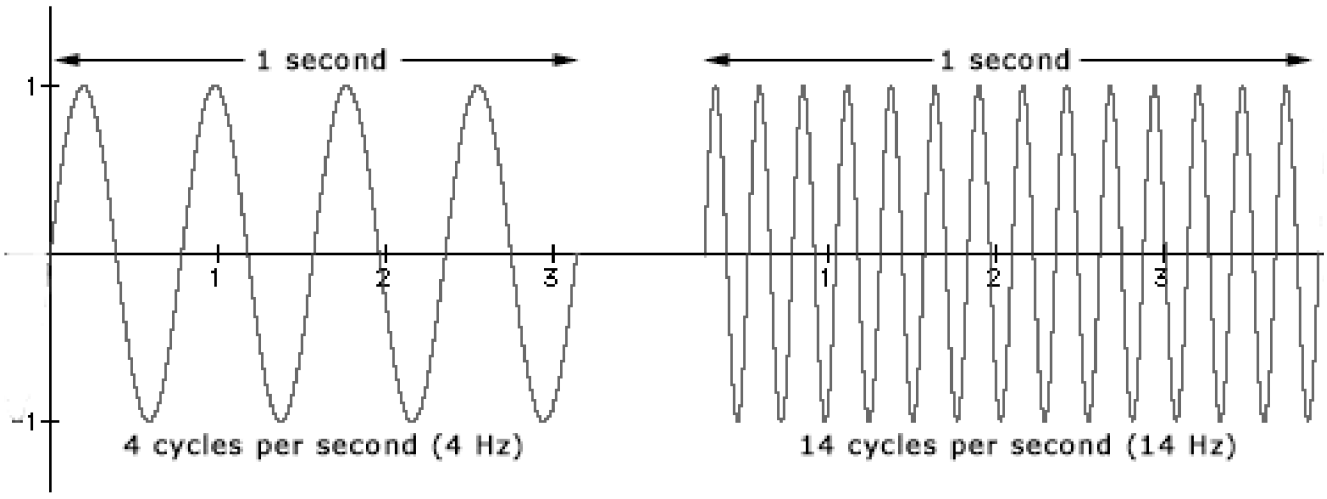
Sound Waves

LaCuKnoS Concept Cards

Frequency/Frequencia

Frequency is the number of sound waves produced in a second. It is measured in Hertz (Hz).
*Dogs can hear sound **frequencies** that humans cannot.*

La frecuencia es la cantidad de ondas sonoras producidas en un segundo. Se mide en hercios (Hz).
*Los perros pueden escuchar **frecuencias** de sonido que los humanos no pueden.*



Sound Waves

LaCuKnoS Concept Cards

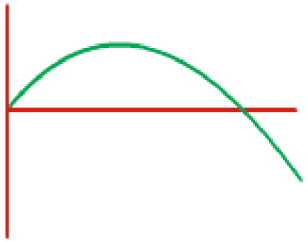
Pitch/Tono

The measurement of how high or low the frequency of a sound wave is (how fast the sound wave oscillates or moves up and down to complete a cycle). The faster the sound wave oscillates the higher pitch it will have and vice versa.

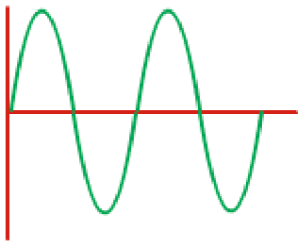
*On a guitar a big heavy string will vibrate slowly and create a low sound or **pitch**. A thinner lighter string will vibrate faster and create a high sound or **pitch**.*

La medida de qué tan alta o baja es la frecuencia de una onda de sonido (qué tan rápido oscila la onda de sonido o se mueve hacia arriba y hacia abajo para completar un ciclo). Cuanto más rápido oscila la onda de sonido, mayor tono tendrá y viceversa.

*En una guitarra, una cuerda grande y pesada vibrará lentamente y creará un sonido o **tono** bajo. Una cuerda más delgada y ligera vibrará más rápido y creará un sonido o **tono** alto.*



Lower Pitch



Higher Pitch