Squawk! Learn how you can change sound waves with just a piece of paper and a pair of scissors. Physics never sounded so fun(ny)! Credit: George Retseck

Key concepts

Physics
Frequency
Sound waves
Pitch

Introduction

Did you know that not all animals use their ears to hear sounds? Snakes, for example, perceive sound waves through their jawbones! And many insects perceive sound waves through their antennae. Although these methods of detecting sound might be different, they all respond to the same thing that our ears do, which is sound waves in the environment. In this activity, you will generate some impressive sound waves from very simple materials and observe how these sound waves are generated. Get ready to make some noise!

Background

Sound reaches our ears in the form of sound waves. Similar to an ocean wave, sound waves are created by vibrations or movement in a given medium. When the wave is in the ocean, the medium is the water. In the case of sound waves, the medium that the waves travel through is the air around us. Just like an ocean wave can originate from someone jumping into the water, a sound wave originates from a vibrating object, such as a tuning fork or guitar string.

When someone jumps into the ocean they displace the water around them and cause water molecules to bump into each other. Those water molecules bump into other water molecules, and the wave is propagated through the water. In a similar manner, when a guitar string is plucked the string vibrates, disturbing the air particles all around it. These air particles bump into air particles around them, propagating the sound wave through the air. These particles vibrate at the same frequency (or rate) as the vibration of the guitar string.

Sound waves with different frequencies sound different to our ears. We perceive higher-frequency sound waves as higher-pitched sounds. Similarly, lower-frequency sound waves have a lower perceived pitch. In this activity you will be creating an instrument and using it to explore the properties of sound waves.

Materials

- Piece of paper
- Pair of scissors
- Ruler

Preparation

Use your scissors to cut a three-inch by eight-and-a-half-inch rectangle from your paper.

Fold your rectangle in half lengthwise so that the shorter ends are touching. Make a strong crease.

With your rectangle folded, fold each end back up to the middle crease, in the opposite direction of your original fold. Your paper should have three folds so that it's in the shape of a "W" when viewed from the side.

Turn your paper around so that your first fold is facing toward you.

Holding the paper folded, use your scissors to cut a small triangle (one-quarter inch to one-half inch at the base) at the center of the fold. If you open the paper up, it should look like a small diamond.

Procedure

Keeping the paper folded, turn it around so that the cutout is on the side facing away from you.

Hold the paper horizontally so that it looks a little like a paper mouth.

Gently press the two lips of the paper mouth to your own lips. Hold it in place by pressing your pointer or middle fingers into the top crease, and your thumbs into the bottom crease.

Keeping your lips parted, forcefully blow out (don't purse your lips, keep them relaxed).

If you don't hear a sound right away, try opening your mouth slightly wider, and open your paper mouth slightly wider as well.

Try slightly different configurations until you get a strong squawk—you'll know it when you hear it!

Practice your squawking while making observations. *What do you notice about the paper when you're squawking? Does it move? How would you describe the movement?*

Find the smallest possible gap you can have between the lips of your paper mouth while still getting a sound. Listen to the sound. *What does it sound like?*

Find the largest possible gap you can have between the lips of your paper mouth while still getting a sound. Listen to the sound. *How does the sound differ when the gap is smaller compared to when it is wider? Does one sound lower or higher than the other?*

Extra: Test different-sized triangle cutouts. How does the size of the cutout affect the sound and performance of your squawker?

Observations and results

In this activity you created a lot of noise while exploring the physics of sound! You should have observed that as your paper squawked it also vibrated gently in your hand. This tells you something about the sound that you're generating with your squawker. As you blow into it, you cause the paper to vibrate. Those vibrations generate sound waves, and when those sound waves reach our ears we perceive them as a distinct squawking sound.

When you made the gap smaller in your squawker you should have noticed that the sound became higher pitched. Because you were forcing the same amount of air through a smaller space, you caused the paper to vibrate more quickly. Our ears perceive those faster vibrations as a higher-pitched sound. This is similar to how the thinner strings on a guitar make a higher-pitched sound—because they can vibrate faster and therefore produce higher-frequency sound waves.

When you made the gap in your paper squawker larger you should have noticed that the sound became lower. In this case you were increasing the space while blowing the same amount of air, and the resulting vibrations of the paper were slower. These slower vibrations create lower-frequency sound waves, which our ears perceive as lower-pitched sounds.

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