The Curiosity Guide

Subject: Sound

Investigation: 01

Season 1 Ep. 2 (#102)

Visible Sound

Description:

We're used to hearing sound, but there's a way to SEE sound too.

Materials:

- Computer with free downloaded tone generator software
- Sound cable
- Amplifier or speaker
- Shallow metal pan
- Cornstarch
- Water
- Food coloring
- Towel

Procedure:

1) Search and download free Tone Generator software on a computer
2) Connect the computer to a large speaker with a cable
3) Fill a metal pan with 1-2 centimeters of water
4) Place the pan of water on the speaker
5) Select a frequency on the tone generator software (perhaps starting around 150 hertz)
6) Adjust the level up or down and observe the wave patterns in the water
7) Keep a towel on hand as some frequencies and amplitude level can splash a great deal

My results:

Explanation: To make Ooblek, combine 1 part water with 1½ to 2 parts cornstarch. Ooblek is a non-Newtonian fluid (or colloid) that behaves both like a liquid and a solid. When combining the ingredients, put the water in the pan first and add cornstarch mixing with your hands until the consistency is gooey without puddling. You may elect to add drops of food coloring to add to the visual interest and mixing of colors. Place the pan of Ooblek on the speaker and repeat the demonstration. As the energy moves through the substance, the Ooblek will flow like a liquid with certain frequencies and amplification, but with increasing intensity and force, it behaves like a solid.

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Turning Fork in Water

Description:
Here's a different way to see sound waves.

Materials:

- Tuning fork
- Clear glass of water
- Rubber mallet

Procedure:

1) Lay down a rubber mallet on a table
2) Holding the handle of a tuning fork, strike the tines against the rubber
3) By standing the handle on a table top the sound can be amplified
4) Strike it again and carefully invert the tuning fork so the tines are placed just inside the glass of water
5) Note and discuss the splashing water

My results:

Explanation:

Tines of a tuning fork vibrate so quickly that it is difficult to see, however by placing the tines in the water the energy transfer is very apparent. Forks with a vibration rate of 126 times per second causes a good splash, however forks that are smaller with vibration periods of 256 or 512 are ideal and have even bigger splashes.

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Ping Pong Energy

Description:
Learn how to make energy move from one object to another.

Materials:
Tuning fork (256 or 512 vibrations per second are very effective)
Rubber mallet
Ping-pong ball
String (12 inches long)
Tape
Piece of paper

Procedure:
1) Tape a ping-pong ball to a length of string 12 inches long
2) Lay down a rubber mallet on a table
3) Holding the handle of a tuning fork, strike the tines against the rubber
4) Hold the sting so that the ping-pong ball is suspended and still
5) Move the tuning fork in so that it barely touches the ball
6) Observe the large energy transfer as the ball ricochets away
7) Then place the tuning fork up to a piece of paper held on one end

My Results:

Explanation:
The rapid vibration of the tines will transfer energy to the ball demonstrating the effect of the vibration. Placing the fork against a sheet of paper also makes the vibration sound more apparent producing a buzzing sound.

Rubber Band Boogie

Description:

Vibration can cause sound, but it also is motion that you can transfer to something else.

Materials:

- Board 10-12 inches long
- Nails (3 inch or longer)
- Hammer
- Rubber band
- Paper strips

Procedure:

1) Drive two long nails into the same flat side of the board about 2 inches from each end
2) Stretch a rubber band around the nails
3) Drape several paper strips at various points long the rubber band
4) Pluck the rubber band and observe

My results:

Explanation:

When the rubber band is plucked, the paper strips bounce around allowing us to observe that vibration is motion and that the energy is transferred into nearby molecules as well.

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Space Phones

Description:
Different kinds of sound waves cause different things to happen.

Materials:
Space phones (made from a long coil spring and two at tached cones or purchased online; a slinky works well to demonstrate the waves too)

Procedure:

1) Use the space phones by stretching them out in the room and demonstrate longitudinal and transverse waves
2) Hold one end of the space phones or slinky, then pull and release the other end to show longitudinal wave motion
3) Observe how the wave travels
4) Then slap down on one end of the phones to demonstrate the up and down transverse wave
5) Notice that the vibration is amplified by the cones on the end to produce amazing sounds

My results:

Explanation:

There are two kinds of sound waves, transverse and longitudinal, which can be demonstrated using a long coil spring or slinky. Transverse waves move in a side to side or up and down motion and look like a typical water wave with peaks and valleys, while the longitudinal wave is a repeated push-pull motion running in a linear line. Holding one end of a slinky and pulling the other end and releasing it shows a series of compressed coils with space in between the next series of compressed coils and the energy is transferred that way. The cones on either end of the coiled spring transfer and amplify the sound vibrations. By stretching out the spring and speaking into the cones, it is possible to demonstrate that sound travels through solids as well as air or water. It is logical to describe how using light waves in fiber optics or radio waves for WiFi devices is even more efficient for long distance communication.

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Tin Can Telephone

Description:

Hear how sound can move through solids.

Materials:

- 2 open soup cans with
- String (10-12 feet long)
- 2 buttons

Procedure:

1) Prepare two soup cans by drilling a small hole in the ends of each
2) Thread a 12 foot long string through the holes so that the closed ends are towards each other
3) Fasten a button inside each can to the ends of the string to prevent them from pulling out
4) Stretch the can tight holding the cans by the side
5) One person speaks into the can while the other listens to their can opening

My results:

Explanation:

This is intended to demonstrate that sound can travel through solids. So long as the string is tight the molecules (which are closer together in a solid) easily transfer the energy from one end of the string to the other. The cans then carry the sound as well and amplify the sound. If done well, it is possible to hear when the cans are 50 meters apart. If you make a second pair, the two strings can be looped and pulled tight so that three people can hear one person speak. It is logical to describe how using light waves in fiber optics or radio waves for WiFi devices is even more efficient for long distance communication.

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Tube Telephone

Description:

You can hear sound, but you can also hear how sound sounds when it is concentrated.

Materials:

2 funnels
Surgical tubing or rubber hose (cut in various lengths)

Procedure:

1) Slide each end of a length of surgical tubing onto two funnel (using friction only)
2) Have one person whisper into the funnel while another listens to their funnel

My results:

Explanation:

Sound clearly travels through air, however the waves lose energy and weaken in open air and over a great distance the vibration is lost. We have all experienced how noises seem to go away (a car driving by us on the sidewalk for example). However, by trapping the sound in a tube the vibration remains stronger allowing us to hear much softer sounds over a greater distance. This is precisely how a stethoscope works or a speaking tube on a ship. If power were to go out on a ship it is still easy for the captain to contact the men in the engine room using a speaking tube. Another interesting aspect to note is that the tube does not need to be straight or tight in order to work. It is logical to describe how using light waves in fiber optics or radio waves for WiFi devices are even more efficient for long distance communication.

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Magic Spoons

Description:

Some things sound different than you might imagine.

Materials:

- Spoons
- String (18-24 inches long)
- Tape
- Table

Procedure:

1) Tie or secure with tape a spoon to the center of the length of string
2) Repeatedly wrap each end of the string around both index fingers
3) Plug both ears with your index fingers so that the string is suspending the spoon in front of you
4) Swing the hanging spoon so that it strikes a table or have another per son strike it with a second spoon
5) Discuss what is heard and compare the sound to how it sounds through the air

My results:

Explanation:

It is important to clarify that for sound to be produced the vibration must move through some kind of medium like the air, water, or the ground. In air, sound travels at 1,120 feet, or 340 meters, per second. Sound travels four times faster in a liquid like water than in the air because the molecules are closer and can transfer the energy more readily and faster still through a solid. Examples of people listening to solids include Native Americans placing an ear to the ground to hear buffalo movement, a railroad worker listening to the rail to hear if a train is coming, the transfer of a Morse code signal on a telegraph line, or an auto mechanic who uses a screwdriver on the engine to listen to the timing. Sound generally travels quite well in a solid and does so more loudly as more of the energy is transferred through the spoon, the string, and your fingers. Finally, place an ear on the table and gently scratch another part of the table. You will easily hear the sound through the table.

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Singing Glasses

Description:

Make beautiful sound through vibration.

Materials:

- Several wine glasses
- Water
- Vinegar
- Paper towel

Procedure:

1) Pour different amounts of water into the wine glasses (starting with one half full is helpful)
2) Dip your index finger in vinegar and make sure that it is clean (removing oils)
3) Dry with a clean paper towel
4) Dip your finger in water a second time and gently place your finger on the lip of the glass
5) While applying light pressure, continue to gently rub in a circular motion around the top of the glass
6) Discuss the emitted sound
7) Experiment with various amounts of water in the glasses and the amount of applied pressure

My results:

Explanation:

The action of your finger on the edge of the cup begins to emit a vibration through the glass as the molecules begin to transfer the energy and the glass resonates. The pitch or frequency will change depending on the amount of water in the glass and changing the amount of pressure applied will alter the amplitude or volume.

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WKAR

Double Reed Straw

Description:
You can demonstrate how vibrations make sounds, and make music at the same time.

Materials:
Straw
Scissors
Drinking glass

Procedure:
1) Tightly flatten the last inch of a straw by pinching it between your thumb and finger or using the edge of a drinking glass (as flat as possible is preferable)
2) Use scissors to cut the end corners of the flat portion of the straw (making tapered corners with a blunt flat end)
3) Place the cut end of the straw in our mouth and close your lips around it
4) Blow, be patient, adjust the straws position, and enjoy the sound
1) Cut the straw shorter and the pitch goes up as well

My Results:

Explanation:
When blowing into the straw the cut ends of the straw begin to vibrate sending vibrations through the channel of air in the straw and creating sound. This double reed system is precisely how the oboe works, as does the bassoon and English horn. By shortening the length of the straw, the air chamber is reduced and the pitch changes.

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Make a Cymatic Demonstrator

Description:
See how different sounds cause different vibrations.

Materials:

PVC "Y" reducer 4 x 4 and with 2 1/2 inch leg
2 1/2 diameter PVC pipe (about 36 inches long)
Large round black balloon
Salt (or white sand or sugar)
Rubber bands
Duct tape
Scissors
Shallow tray

Procedure:

1) Cut PVC pipe to 36 inches long
2) Cut the neck off of the black balloon
3) Stretch the cut balloon over the opening of the 4 x 4 Y so that the 2 1/2" leg is also facing up
4) Secure the balloon on the pipe with duct tape or rubber bands
5) Place the Y on a shallow stray
6) Slide and twist in the length of PVC pipe into the Y so that is secure
7) Hold it balanced
8) Lightly sprinkle the balloon surface with salt
9) Take a deep breath and hum into the opening of the long tube
10) Observe the vibration and salt patterns - experiment with lower and higher pitches

My Results:

Explanation:
Cymatics is the process of making sound and its vibrations visible. Historically, this has been done many ways with the most notable being the bowing (with a violin bow) along the edge of a flat metal plate covered with salt. The vibration moves through the solid molecules in patterns that are demonstrated with the salt formations. Here, the sound is traveled through the air in the tube first which maintains more of the sound energy than if done through the open air, and then is transferred into the solid balloon membrane. Experimenting with higher pitches (higher frequencies) yield different and more complex patterns and results.

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