Sizing up Sound -- STRAW'N & STRING'N

Summary

Students will learn about sound waves and frequency. Also they will learn to tell the differences between high and low pitches.

Materials

Pop Toob
Craft sticks
12" jumbo drinking straw
Jumbo straw and Super Jumbo straw for each student
Low temp glue guns
Hand-held hole punch
Scissors
Rulers
Plastic trays
Pegboard pieces
Nylon fishing line (30# or thicker)
Four eyebolts (each)
Eight washers (each)
Four wing nuts (each)

Additional Resources

Books

- *Experimenting with Sound*
  , by Alan Ward; ISBN 0-7910-1511-4
- *Focus on Sound*
  , by Barbara Taylor; ISBN 1-56924-038-8
- *Light, Sound & Electricity*
  , The Usborne Internet-Linked Library of Science; ISBN 0-439-44147-1
- *Light, Sound, and Waves*
  by Robert Gardner; ISBN 0-7660-2126-2
- *Physical Science Activities for Grades 2-8*
  , by Marvin Tolman & James Morton; ISBN 0-13-669797-6
- *Primarily Physics: Investigations in Sound, Light, and Heat Energy*
  , AIMS Activities, ISBN 1-881431-46-0
- *Sound, Noise & Music*
  , by Mick Seller; ISBN 1-57335-149-0
- *Sound Science*
  , by Etta Kaner; ISBN 0=201-56758-X
- *Sound, Student Activity Book*
  , National Science Resource Center; ISBN 0-89278-745-7

Videos

- *Breaking the Silence: An Introduction to Sound, Live Action Video*
  , (Rainbow Educational Media, 1-800-331-4047, http://www.rainbowedumedia.com/); Product ID: RB814
- *Heat, by Bill Nye*
  (Disney Educational Publications, 1-800-295-5010, http://dep.disney.go.com/educational/index);

Product ID: 68A71VL00

- *Heat, Temperature and Energy, Live Action Video*
, (Rainbow Educational Media, 1-800-331-4047, http://www.rainbowmedia.com/); Product ID: RB8229
- *Sound,by Bill Nye*
(Disney Educational Publications, 1-800-295-5010, http://dep.disney.go.com/educational/index); VHS Product ID: 68A99VL00, DVD Product ID:77A34VL00

Additional Media

Sound, Science Court, Tom Snyder Productions, 80 Coolidge Hill Road, Watertown, MA, 1-800-342-0236, http://www.tomsnyder.com ; #XSCI SND U 01

Background for Teachers

Sound is a form of energy when vibrations (rapid back and forth movements) travel through a medium. Three things are necessary for the creation of sound: (1) a source of energy or disturbance, (2) vibrations, and (3) a medium for the vibrations to travel. The source of energy could be plucking the string of a guitar, blowing across a reed, or hitting a drum. This disturbance causes the string, the reed, or the drumhead to vibrate rapidly. When the drum is hit, the drumhead vibrates and creates a disturbance in the molecules in the air near it. When the drumhead moves to the right it pushes the air molecules into each other, causing them to become compressed (like a slinky). When it vibrates to the left, the molecules of air move farther apart, creating a rarefaction (the particles are farther apart). These vibrations travel through the air, one particle bumping into another like dominoes, until they reach the ear. Sound, unlike heat and light, cannot travel through space because space has no medium for it to travel.

Sound waves (longitudinal waves) like all waves have four basic properties: amplitude, wavelength, frequency, and speed. Amplitude in a longitudinal wave is a measure of how compressed or rarified the medium becomes. High-energy vibrations (hitting the drum harder) cause the molecules to become more compressed. The greater the amplitude of the wave (intensity) the louder the sound is. Frequency is the number of complete waves (vibrations) that pass a given point in a certain amount of time or how fast the medium is vibrating. The pitch (highness or lowness of a sound) that is heard depends on the frequency of the sound wave. Sound waves of high frequency have a high pitch, while sound waves of low frequency have a low pitch. The frequency of a vibration of a drumhead depends on the material used, the size of the drumhead, and how tight it is. A tighter or smaller drumhead would create a higher pitch than a looser or larger drumhead. A guitar string that is tighter, thinner, or shorter will have a higher pitch than one that is looser, thicker, or longer. Therefore, size makes a difference in sound. If the shape and material used in two instruments are the same, then the larger instrument will vibrate with a lower frequency and create a lower pitch than the smaller instrument.

Intended Learning Outcomes

1. Use Science Process and Thinking Skills.
2. Manifest Scientific Attitudes and Interests.
3. Understand Science Concepts and Principles.

Instructional Procedures

Invitation to Learn

Discuss the following questions with the students, Does size really matter? What are the advantages and disadvantages of being tall or short? Does size make a difference in sound? Play with the PopToob and ask the students to observe and be ready to share their observations. After a minute or two, have the students share what they observed and heard. Tell them that today they are going to play around with sound and discover if size really does matter.

Instructional Procedures

Activity #1 STRAW'N -- That's the Last Straw!

Straw Whistle

Lay a ruler alongside the 12 inch jumbo straw and use the pencil to measure and mark the straw in the following lengths: a three inch piece, two and a half inch piece, two inch piece, one and a half inch piece, one inch piece, and a spare piece. Put an X on the spare piece so you can distinguish it from the rest. Cut the spare piece off the straw on the mark you have measured. Set the remaining straw aside.

Flatten one end of the spare piece and use the scissors to cut two sides off the flattened piece to create a sharp point like an arrow.

Place the pointed end between your lips and blow. If you can not get a sound, try flattening the straw more with your teeth and releasing it slowly as you blow or pull the straw in or out of your mouth as you blow.

Straw Panpipe

Cut the remaining 12 inch jumbo straw on the marks you have measured. You should have five pieces.

Flatten one end of each piece of straw and bend it over about one-fourth inch to seal off the straw. Staple the bent over end so no air can pass through the straw. Test each piece by blowing into the straw.

Lay the ruler alongside the craft stick and make small marks every half inch.

Lay one end of each piece of straw against the top edge of the craft stick. Line them up (each piece on a different half inch mark) from longest to shortest, as shown. Use the glue gun to make a dot of glue on five of the marks you will use and press a piece carefully into each dot of glue.

Blow across the top of each straw and listen to the sound. How does the length of the straw affect its pitch? Which straw makes the lowest pitch? Which straw makes the highest pitch? Why? Move your instrument back and forth as you blow across. How does the sound change as you move from the longest straw to the shortest?

Play a tune with your instrument. Write a code showing how to play the tune. Try to play a tune written by someone else.

Strawmbone

Take the smaller Jumbo straw and cut the tip into a point like an arrow.

Slide the smaller straw into the wider Super Jumbo straw. Blow on the smaller straw and slide the wider straw up and down the smaller straw. How does the sound change as the straw becomes longer?

Strawzophone

Slide the wider straw off the smaller straw and flatten the wider straw. Use the hole punch to make three holes starting two inches from the top. Make sure you only punch a half hole in the form of a C as shown. Unflatten the straw and you should have three round finger holes. (See illustration.)

Cut the top of the straw into a point like an arrow. Blow into the straw with no holes covered. Now, cover one hole at a time and blow into the straw? What happened? Why?

Allow the kids to play and experiment with the straws. Discuss what they have discovered.

Activity #2 -- STRING'N -- Pegboard Harp

Pass out the following items to each member of the group (Have them place the small items in the plastic tray to keep them from getting lost.): one plastic tray, one pegboard, four eyebolts, eight washers, and four wing nuts. (The pegboard should have four strings already attached: one tied to the last hole in the board, one tied two holes in from the end, one tied four holes in,

and one tied six holes from the end.)
Place one washer on an eyebolt and put it through the hole at the opposite end of the first tied string. The washer should be on the top surface of the pegboard.
Secure the end of the eyebolt on the underside of the pegboard with another washer and a wing nut.
Tie the loose end of the string to the eyebolt. (Be careful when tying the strings on the eyebolts because you will have to untie the knots you put in the strings.)
Repeat steps two to four with the remaining strings. All eyebolts should run flush left down the pegboard as shown in the illustration.
Turn the eyebolts to tighten or loosen the strings. Loosen the wing nut on the bottom before tightening the string. It will be easier to turn the eyebolt to tighten the string and won't cut the string.
Pluck one of the strings and listen to the pitch (the highness or lowness of the note). Now, tighten the string and pluck the string again.

- When you turned the eyebolt, what happened to the string?
- What happened to the pitch when you tightened the string?
- How do you think the sound would change if you stretched the string tight? Loosened it?
- How many different pitches can the string make?

Pluck the strings on your harp.

- Why does each string make a different pitch?
- How does the pitch change when you change the tension of the strings?
- Which strings have the highest pitch?
- What might you do to produce a high pitch from a long string?

Tighten or loosen the strings until you have four different notes. Try to play a tune on the harp.

Extensions

Curriculum Extensions/Adaptations/Integration

Extend the sound unit into the arts core by creating a rhythm band from instruments created by class members and performing.
Create bottle xylophones from bottles filled with differing amounts of water that play a tune by tapping the bottles or by blowing across the tops.
Create a panpipe by filling bullet shells with differing amounts of water and then play a tune by blowing across the tops.

Family Connections

Keep a log of all the sounds you hear in your home during an hour time span.
Tell a short story to your family and use sound effects.
Have students design and construct a telephone using string and test to it to find answers to questions such as:

- How long can the string be and still be heard?
- Is it possible to cross strings from two sets and have a "conference call"?
- Do metal cans or plastic cups work best?
- Does yarn, string, or fishing line work the best?
- Does it matter if the line is loose or tight?
- Do high-pitched sounds or low-pitched sounds carry farther?

Assessment Plan

Assign the students to use what they have learned to design and construct a multi-pitch instrument.
Have the students place cluster pictures of instruments in order from lowest to highest pitch.

Have the students write an essay on three ways that they could change a string on a guitar to create a lower pitch and then explain which of the three ways would be the easiest change.
Have students place items (identical except for size) in the order of highest to lowest pitch.

Bibliography

NSTA Publications, (1984). Understanding play. *Science and children*, National Science Teachers Association, Arlington.
Wonder, inquiry, curiosity, and mental challenge are all important to the developing young scientist. A review of educational and psychological research suggests that play and science are complimentary in their aspect of problem solving. Research studies have shown that children who play with and manipulate a wide variety of toys and games are flexible in strategies to solve problems.
Kluger, B., (1999). *Inquiry thoughts, views, and strategies*, for the K-5 classroom. Arlington: National Science Foundation.
Good science inquiry involves learning through direct interaction with materials and phenomena.

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