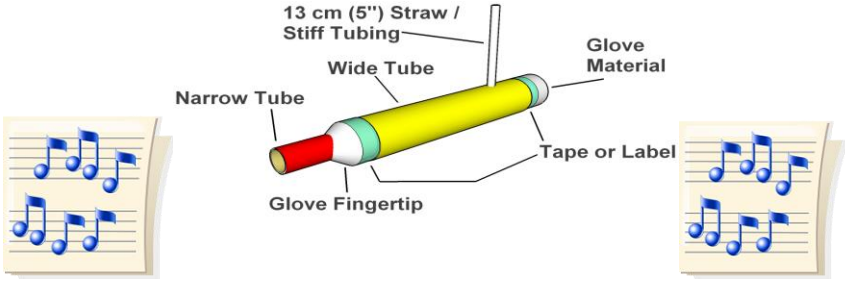
2-Tubaphones

Simple instruments with trombone-like character



Topics: Sound, Vibration, Musical Instruments

Materials List

- ✓ 1 "Wide" cardboard tube, ~3 cm (1 ¼") x 18 cm (7")
- ✓ 1 "Narrow" cardboard tube, ~2 cm (¾") x 20 cm (8")
- ✓ Piece of straw or rubber tubing, 13 cm (5") long, ~1 cm (1/2") diameter
- ✓ 1 Rubber or latex glove (**powder-free, not vinyl**)
- ✓ Tape or adhesive labels
- ✓ Craft or hot glue
- ✓ Scissors
- ✓ Optional: Drill w/ bits

This activity can be used to teach:
Next Generation Science Standards:

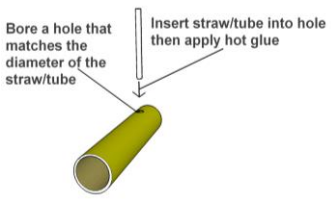
- Senses (Grade 4, Life Science 1-2)
- Sound (Grade 1, Physical Science 4-1, 4-4)
- Energy and sound (Grade 4, Physical Science 3-2, 3-4)
- Waves (Grade 4, Physical Science 4-1)
- Science & Engineering Practices (grades K-8)

Make an instrument with an adjustable pitch to explore the science of sound waves and the art of music!

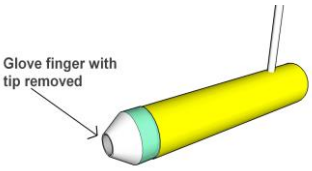
Assembly

(Safety Note: Ask about potential allergies if using latex gloves)

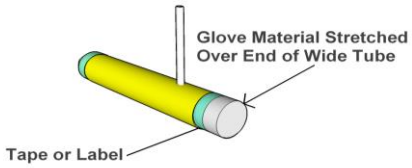
1. Using scissors or a drill, bore a hole slightly wider than the straw or rubber tube into the "wide" tube, about 7 cm (2 ¾") from an end.
2. Insert the straw or tubing piece 1-2 cm (½ - 1") into the hole made in step 1. Apply craft glue or hot glue around the insertion point to form an airtight seal.



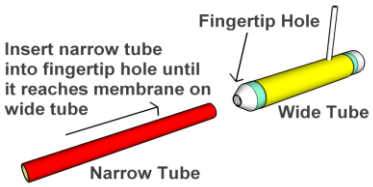
3. Cut off a finger or thumb from a rubber or latex glove at the point where the finger/thumb meets the palm of the glove.
4. Stretch the "mouth" of the cut finger/thumb approximately 2 cm (~1") over the end of the wide tube opposite the end with the straw/tubing. Apply a piece of tape or label to secure the rubber/latex to the tube.
5. Poke or cut a 1 cm (~½") diameter hole into the tip of the finger/thumb (shown at right).



6. Cut a piece of rubber/latex from the palm of the remaining glove material about 7 ½ cm (3") in diameter. Stretch this piece over the open end of the wide tube until tight, forming a membrane. Apply tape or a label to secure to the tube (see illustration below).



7. Insert the narrow tube into the wide tube through the fingertip hole from step 6 until the narrow tube touches the membrane on the other end.



Inspired by an activity developed by Fran Holland, written by Eric Welker (RAFT)

8. If needed, apply tape or labels to form an airtight seal between the two tubes at the end of the fingertip.

To Do and Notice

1. Make sure that the narrow tube is touching the membrane on the wide tube.
2. Blow into the 13 cm (5") straw/tubing material "mouthpiece" to create a tone. If there is no audible tone, push the narrow tube further into the wide tube until a tone is heard.
3. Change the pitch of the tone by stretching and un-stretching the membrane (pulling and pushing on the narrow tube). Note which tube positions create high pitch and low pitch tones.

The Science Behind the Activity

When the narrow tube is pressed firmly against the membrane on the inside of the wide tube, the tension in the membrane pushes against the narrow tube, forming an airtight seal. Since the other end of the instrument is also sealed, an airtight chamber is formed. When one blows into the "mouthpiece" the chamber fills with air. The air pressure inside the chamber increases and overcomes the tension in the membrane and pushes the membrane away from the end of the narrow tube. The air escapes through the opening of the narrow tube and out the other end of the instrument, thus decreasing the air pressure in the chamber and allowing the tension in the membrane to reform the seal with the narrow tube. With continual blowing, this pattern of increasing and decreasing pressure causes the membrane to vibrate back and forth at a specific rate. The rate is called frequency (or pitch) and is measured in cycles per second (hertz).

When the force on the membrane applied through the narrow tube increases, the tension (force) applied by the membrane against the tube also increases. The increased tension in the membrane material prevents it from moving easily, meaning that it does not allow as much air can escape per second, causing the air pressure to build up in the chamber. To reduce its pressure, the air must vibrate the membrane more cycles per second, thus increasing the frequency of vibration and creating a tone with higher pitch.

Taking it Further

- Use a longer narrow tube, put 3 - 4 holes into the protruding end, and then cover one or two holes while blowing into the straw.
- Vary the lengths and diameters of the tubes used.
- Explore other wind instruments with RAFT Ideas Sheets ***Glove-a-Phone***, ***Finger-Phone***, and ***Straw Noisemakers***.
- Investigate sound waves with RAFT Ideas Sheets ***Sound String*** and ***Making Waves***.

Web Resources (Visit www.raft.net/raft-idea?isid=521 for more resources!)

- More information on sound and frequency - http://www.school-for-champions.com/science/sound.htm and http://en.wikipedia.org/wiki/Frequency
- Sound wave exploration - http://illuminations.nctm.org/ActivityDetail.aspx?ID=37