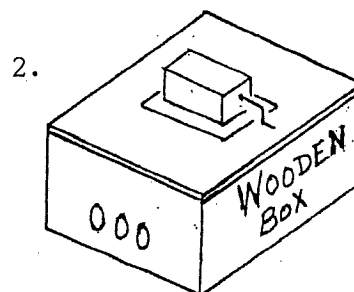
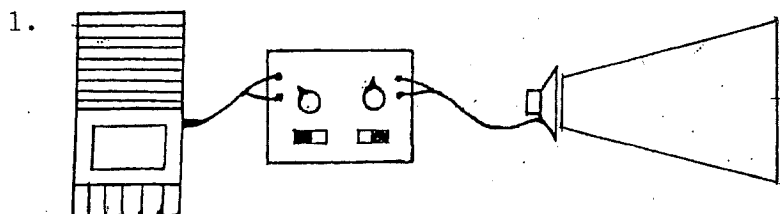


Sound and loudness - The topic of sound is difficult to teach (and learn) because the terms used to describe it are so technical. An example is intensity and loudness. Although they are related, they have different meanings. Let's stay with loudness which is about the human ear's perception of hearing sounds.

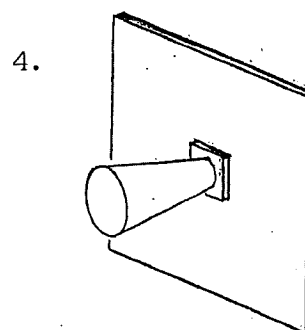
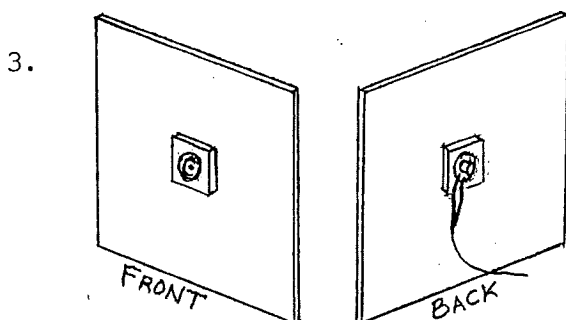
Since the beginning of time, we humans have been manipulating the loudness of sound, usually to make it louder. (It has almost reached the ridiculous level today via electronic amplification.) Thus, during the introduction of sound, it's reasonable to begin with several simple, natural ways we first learned to make sound louder, to amplify it, and these ways are still used today the world over.

Early on, people learned to cup their hands around their mouths when they shouted over long distances. Before long, they learned to use the horn and the conical megaphone instead. These cone-shaped devices still exist everywhere because they are necessary "impedance reducers" or mechanisms that allow sound to "flow" more efficiently from the source into the air for dispersal. The following set-up (1.) will show this clearly. It requires a tape player with an earphone jack, an amplifier, a 2" speaker, and a small, 5" dia. large end megaphone. (Any of these pieces may be altered as you see fit.) First, hold the operating speaker up in the air for the students to hear. It will be faint. Then place the speaker on the small diameter end of the megaphone. A dramatic increase in loudness will occur.



Especially when musical instruments were developed and "forced vibrations" were better understood, sound boards came into use, a simple way to greatly increase the loudness of sound. The piano remains the prime example or user of the sound board. However, one of the most delightful musical devices ever created to use forced vibrations is the music box (2.). Hand-cranked mechanisms with different tunes are still available, especially for special holidays. First, play the device in the air for the students. It will be very faint. While continuing to play it, press it down firmly on the plywood panel (bottom) of a wooden box. A very dramatic and delightful, loud sound will be heard and without any assist from electricity!

Another dramatic, "loudness" demonstration is possible if a hole is cut in the center of a large panel of cardboard, masonite, or plywood (3.). A good size for the panel is 16" square with a 1 15/16" dia. hole in the center for a 2" speaker. The hole is made slightly smaller than the speaker. "Centering" guides 3 1/4" square with approximately 2" dia. holes could be added to each side for improved presentation. Start the demonstration with the speaker being played in the air. Then press the operating speaker against the back edge of the hole in the panel. It is not certain what is causing the increase in loudness. It is believed, however, that forced vibration may be the major contributor. Regardless, the increase is dramatic and partially explains why speakers are attached to, or mounted on, panels.

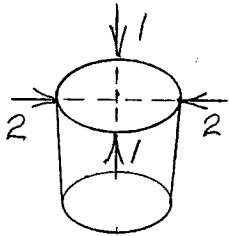


One more experiment to try is placing (combining) the megaphone on the front of the panel while the speaker is playing on the back of the panel (4.). A slight increase in loudness may be noted.

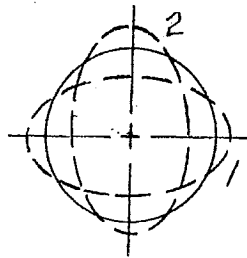
Addendum: Loudness also plays an important part, a dramatic part, in two other important demonstrations on sound: the "singing rod" and the "singing drinking glass". The "singing rod" is described in "Measuring the speed of sound (in air and an alum. rod)". The greater the diameter (cross-sectional area) of the rod, the louder the sound can become. Students are amazed at the results created by "singing rods".

The "singing drinking glass" is an idea that goes back before Ben Franklin's time. He so admired the idea that he invented a musical instrument that uses the concept. The "singing drinking glass" is closely related to the bell and vibrates much the same way to make its sound. In its simplest mode, the bell and the glass rim vibrate in a "cross" pattern which is easy to show students with a quart-sized plastic container (5.). To actually make a drinking "sing", choose a glass with a fairly thin rim like a large wine glass or a brandy sniffer ~~GLASS~~ (6.). With the glass about half full of water and holding the base firmly down on the table-top, wet your clean index finger slightly and begin to rub the top but ever so slightly inside the rim. Slowly speed up the rotation around the rim and add pressure to the rubbing. It requires some practice and a certain "feel" to get it right. Keep wetting your finger just enough to create the friction needed to keep the glass "singing" and to increase its loudness. Note the bell-like sound or "ring" that is produced. Of course, different depths of water and different-sized glasses (rims) will generate different frequencies. There is a long history of sets of glasses that are made into musical instruments and played to make music; it continues today. With some imagination and several glasses tuned to different notes, students could generate some simple songs to share.

5.



Alternately squeeze 1, then squeeze 2.



Top view of result: a flexing (vibrating) "cross" pattern.

6.

