



## Vocal Vowels

### Description:

When you press the rubber bulb, a "quack" is produced in the tube. If the tube is connected to one of the voice boxes, the character of the sound changes so that there is a vowel sound rather than a "quack".

## What's Happening

1. The exhibit mimics what you do with your mouth and throat when you make the vowel sounds a, e, i, o and u. The "quacker" represents the vocal cords and the "voice boxes" are straightened out versions of the shapes of the mouth and throat openings when you produce each vowel.
2. When you squeeze the bulb, air is pushed between two flexible reeds which vibrate and produce sound waves which come out of the tube. The reeds behave like your vocal cords. When they are touching and you blow air from your lungs between them, they vibrate, alternately opening and closing, letting air pass through as a series of puffs. Because the vibration of the reeds (or your vocal cords) is complicated, the sound has a large range of frequencies in it.
3. If the sound then passes into some sort of chamber, the sound waves reflect to and fro inside. Depending on the size and shape of the chamber, some particular notes will be strengthened by reflected waves being in step with the entering waves. This is called resonance. In general, if the chambers are small, high frequencies are strengthened; if the chambers are large, the low notes are strengthened.
4. When you sing, you have to vary the tension in your vocal cords, tightening them to produce the high notes. However, quite apart from the basic frequency of the note we are speaking or singing, if there are some specific formant frequencies present, we hear a vowel sound as well.
5. There are three basic formant frequencies for each separate vowel sound and these are produced strongly by resonances in the various "chambers" of everybody's mouth and throat. You can change the shape of the mouth and throat easily by changing the position and shape of the tongue and mouth. The diagrams on the "voice boxes" of the exhibit show cross sections of the cavities which produce the required formants.

## **Incidentally**

Two examples: the three formant frequencies for "ee" are 200Hz, 2300Hz and 3200Hz; and for "oo" are 200Hz, 800Hz and 2050Hz.

These formant frequencies stay the same even though the basic note of the voice might change.

Try different squeezes, producing high and low quacks, to test this.

If the note is artificially raised, either by speeding up a tape recording or breathing helium gas, the vowels become distorted because the formant frequencies are changed.