Resonance.

The human voice, as well as most other sound generators, produces sound waves at many different frequencies simultaneously. By manipulating the shape of the room in which the sound is generated and through which it travels, the strength of the different frequencies can be modified by using principles of resonance.

Two examples:

1. When walking or humming in a cave, or any small hard-surfaced room, your voice will often sound 'pale' or dampened; except when you are humming a certain pitch. At this pitch, your voice will be violently amplified, because this pitch contains a frequency which 'fits' the size and shape of the room. Vibrations which fit the space they are in resonate. Since there is a liberal use of plaster surfaces in the older buildings around campus, you should be able to find this sort of room, and if it's a small room, you'll probably be able to hum a note which resonates to some part of the room. (Later in the semester, you may be able to predict the note from the size and shape of the room.)

2. If you tap a glass – or better yet, a crystal vase – it will emit a sound at a certain frequency. As you fill the glass with water, the frequency of the sound will change. This is (partially) because the air space inside the glass constitutes a room with certain resonant characteristics; i.e., on frequency of the sound wave created by tapping on the glass is amplified while the others are dampened. As you fill the glass with water, the shape and size of the air space in the glass changes, changing the resonant frequency.

The vocal tract, i.e. mouth, pharynx, and nasal passage, constitutes an air space whose shape and size changes at will, and whose resonant characteristics change as well. For example, the tongue, which acts as the floor of the mouth, can be raised, lowered, and curled up to change the shape the air space in the mouth. This results in a manipulation of the frequency of the sound waves which come out of the mouth. Since your friends, who are not in your mouth, can hear these differences, they can figure out what's going on in your mouth.

To get at these frequency differences, we can plot sound frequencies over time. Such a graph is called a spectrogram.