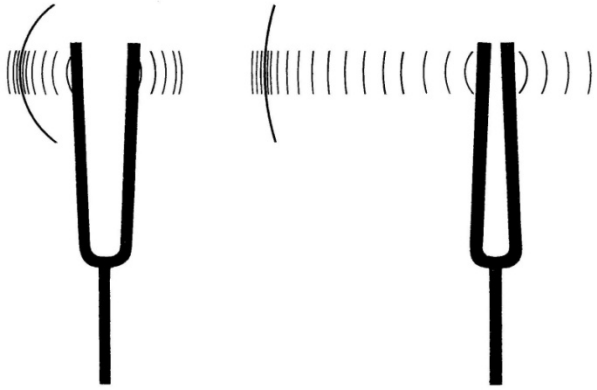
Resonance

Definition: When the vibrations produced by one object come into alignment with those of another, this is called resonance. (from Latin *resonantia* ‘echo,’ from *re-sonare* ‘re-sound’)

Whenever the vibrations of one object cause a second object to start vibrating, the second object is said to be **resonating** with the first, and its vibrations can be called **sympathetic** resonance.



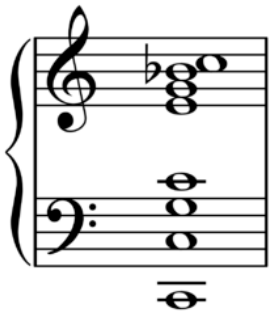
When a music instrument's body amplifies the sound of a string or vibrations from a woodwind instrument we are talking about a **Resonator**. The form of a resonator is made up of a sophisticated shape (e.g. Violin, Guitar, Harp, Trumpet, Horn, etc.).

Also the wooden body of a Piano or Grand Piano acts as a resonator.

A good resonator amplifies the sound evenly. That means all notes are reproduced with equal volume. That is why the shape of the resonator has a sophisticated form factor and is not just a cubical box.

Resonance
is very important in the physics of music. In fact, in many musical instruments, the part of the instrument that first produces vibrations is often a ***rather small***, insignificant-looking part of the instrument - a thin string, or a sliver of reed. (In the case of brass instruments, it is not a part of the instrument at all, but the players lips, that produce the original vibrations.) The largest, most obvious part of the instrument - the delicately curved body of the violin, for example, or the many brass loops of the French horn is just the main **resonator**, and this resonating part of the instrument (often called the **body** of the instrument) determines, or helps to determine, many important aspects of the instrument's sound, including tone quality, timbre, and dynamic capabilities.

Harmonics
Harmonics of a basic tone are sounds that are related higher pitch notes such as the octave, fifth above the octave, second octave, third above the second octave etc.



Each instrument produces harmonic sounds when played on its basic note. The amount of the harmonic notes determines the timbre and character of a specific instrument.

Harmonic notes will easily resonate with the basic note while ***not harmonic related notes will not resonate with the basic note***. This can easily be demonstrated on a acoustic piano with the ***Damper Pedal***.

Damper Pedal (Sustain Pedal)

If the damper pedal (right pedal) of an acoustic piano is pushed down, all strings will be free for possible sympathetic resonance. Since only tones with harmonic relationship will resonate the sound experience with the pushed right pedal will be ***fuller*** and ***richer***.

The damper pedal should not be overused since it can "melt" tones that are not harmonically related together. This does not create a pleasant sound.

Electronic pianos are usually not able to reproduce the resonance effect even if they have a right pedal. They can provide the sustain effect but without resonance of harmonic notes. However newer more expensive electronic piano have a ***resonance simulator*** built in. So they behave similarly like an acoustic piano.

Voices and Formants

The voice is the most well-known natural instrument. The ***vocal chords*** produce the vibrations, which then resonate in the ***throat, mouth, and nasal cavities***. The vocal chords are only capable of a certain range of sounds, of course, although a trained vocalist can extend this range considerably.

The resonating space of the voice, however, also has a pitch range, called the **formant**, in which it naturally resonates, so that any vibration in this range will naturally be louder than other vibrations. Like instrument sounds, a sung tone consists of a combination of vibrations, so the relationship between a sung pitch and the vocal formant greatly affects the sound of the note. Formants are a basic part of the timbre (sound-color) of every person's speaking and singing voice, and trained singers also spend much effort learning to control formant effects.