

## Physics 105 Assignment: Instrument Design:

Every musical instrument may be thought of as having three fundamental components.

1. One needs a source of vibration that can be frequency controlled, usually through positive feed back of some resonant vibration.

Examples:

Violin: Bow slides across string with stick-slip friction at a frequency determined by the fundamental standing wave resonance due to the length, mass, and tension the string.

Guitar: Picked string vibrates with frequency determined by the fundamental standing wave resonance due to the length, mass, and tension of the string.

Trombone: Lips vibrating in mouthpiece with frequency determined by standing wave resonances due to speed of sound in air and effective length of open tube.

Saxophone: Reed opening and closing according to pressure vibration feedback at frequency determined by open holes in the tube.

2. One needs a means to transfer the energy of these vibrations to a resonating device that can accentuate the vibrating source.

Examples:

Guitar and violin: Bridge transfers vibrations to top plate which resonates and transfers some energy to sound box air cavity.

Saxophone and trombone: The resonating tube sets up standing waves in the air column which builds up to a large standing wave amplitude.

3.: One needs a means to transfer this energy efficiently to the air as sound.

Examples:

Violin and Guitar: Vibrating top plate efficiently transfers energy to air vibrations. Air resonances in sound box are transmitted to the air through the sound hole or F-holes.

Saxophone and trombone: The standing wave resonances radiate from the bell and from the open holes into the air efficiently since they are already large air vibrations.

**Now write a short essay about your proposed instrument. Try to answer the question: How will your instrument meet each of the above requirements as efficiently as possible? You are allowed to change your mind as your ideas develop, both in what instrument you choose and how you answer the above question.**