

- + Frequency ratios: unison, octave, fifth, fourth, third, etc.
- + Interval = separation of two notes on a scale
- \* Musical Scales - Pentatonic, Pythagorean, Meantone Tuning, Just, Just Diatonic, Tempered Scales
  - + whole tones, semi-tones, cents
  - + pitch standard(s)
  - + octave notation
  - + frequencies of musical notes, e.g. in tempered scale
- \* Acoustics
  - + Acoustics of auditoriums, recording studios, home listening rooms, etc.
    - o Interference, sound absorption, Sabine eqn.
    - o Reverberation & echo, spectral, octave & 1/3-octave band measurements of room/auditorium acoustics, T60, T30 measurements, etc.
    - o Electronic Sound Reinforcement
    - o Computer analysis/modeling electro-acoustics of auditoriums/studios/etc.
  - + Acoustics of loudspeaker enclosures
- Production of musical sounds by musical instruments – mimic human voice, and/or natural human rhythms (percussion instruments).
  - + Human Voice & Singing – 1<sup>st</sup> musical instrument – 1-D vibrational system.
    - o vocal chords/larynx/hyoid bone/tongue/chest-mouth-nasal cavity & formants
    - o Formants & use of formants/professional singers, Tuvan throat singing, etc.
  - + Stringed Instruments
    - o Physics of plucked & bowed vibrating strings
    - o Plucked: acoustic/classical and electric guitar(s), mandolin, ukulele, etc.
    - o Bowed: violin, viola, cello, bass
    - o Hammered: piano, hammered dulcimer
  - + Woodwind Instruments
    - o Physics of whistles, reeds & organ pipes
    - o Whistles: Whistle, recorder, flute
    - o Reed: Clarinet, oboe, bassoon, saxophone
    - o Pipe: Pipe organ, bagpipes
  - + Brass Instruments
    - o Physics of mouthpiece, bell
    - o Trumpet, trombone, French horn
  - + Percussion Instruments
    - o Physics of vibrating bars, plates, membranes
    - o Xylophone, glockenspiel, Fender-Rhodes piano
    - o Drums (all kinds), cymbals (all kinds)
    - o Musical saw
  - + Electronic Musical Instruments
    - o Electro-mechanical organs - e.g. Hammond B3
    - o Electronic organs/keyboard instruments
    - o Analog and Digital Sound Synthesizers,
    - o MIDI & MIDI instrument
    - o Computer-generated music
    - o Electronic Stringed Instruments – guitars, bass guitar, cello, mandolin..
  - + Analog & Digital Recording of Music & Sound
    - o Edison phonograph - cylinder & disk records (analog)