Bringing STEM Concepts into the String and Orchestra Classroom

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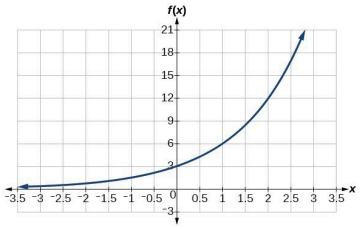
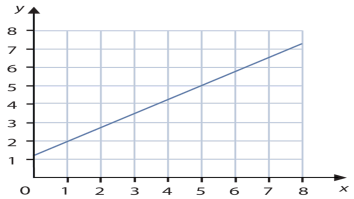
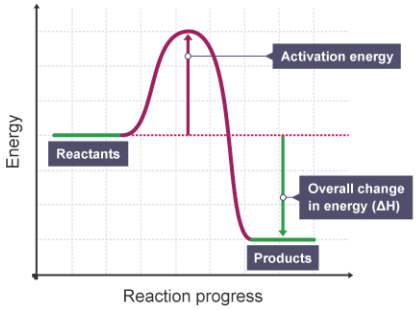
- Exponential Crescendo and Diminuendo (vs. Linear)





- Activation energy - The Lift/Land
- Holberg Suite Mvt 3 https://www.youtube.com/watch?v=GwTPfVGXY8Y

    - Activation energy can be thought of as *the minimum energy that is needed to make the reaction happen*. More specifically, the height of the potential barrier (sometimes called the energy barrier) separating two minima of potential energy (of the reactants and products of a reaction). For a chemical reaction to proceed at a reasonable rate, there should exist an appreciable number of molecules with translational energy equal to or greater than the activation energy. *It is the energy needed to "get over the hump."*



- Catalyst

- A **catalyst** is a substance that speeds up the rate of a chemical reaction without being used up in the reaction.

- Imperfect elastic collision (spicatto)
  - An **inelastic collision** is one in which part of the kinetic energy is changed to some other form of energy in the **collision**. Any macroscopic **collision** between objects will convert some of the kinetic energy into internal energy and other forms of energy, so no large scale impacts are perfectly **elastic**.

- Creating and Limiting variables (In practice)
  - Difficult techniques- 1 variable at a time 3rd position, shifting, reading in 3rd position
  - Difficult passages - create 1 variable at a time With an eye toward rhythm, then pitch, then tempo, then dynamics, etc

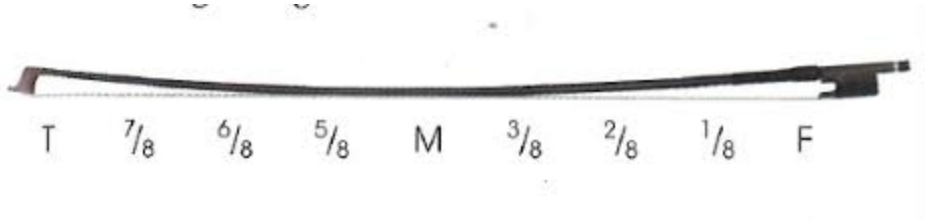
- Data and formulas
  - Fretboard Calculations, string tension, overtones, and others
  - vsl = vibrating string length (this is the basic scale length originating on the fretboard side of the nut and terminating at the leading edge of the saddle. It does not include a compensation factor.
  - c = the divisor -- I use the factor 17.817 as the constant in this formula, but others may use a different quantity.
  - i = 1... 30 or as many frets as you require.
  - L = the distance from the nut to the first fret position in millimeters.
  - L_1 = the distance between the 1st fret and the nut in millimeters.
  - L_i = the distance between the "i"th fret and the nut in millimeters.

$$vsl := \text{(put scale length in mm here)}$$
$$c := 17.817$$
$$i := 1 \ldots 30 \quad \text{(etc.)}$$
$$L_i := \frac{vsl}{c} \qquad L_i := L_1 + L_{i-1} - \frac{c-1}{c}$$

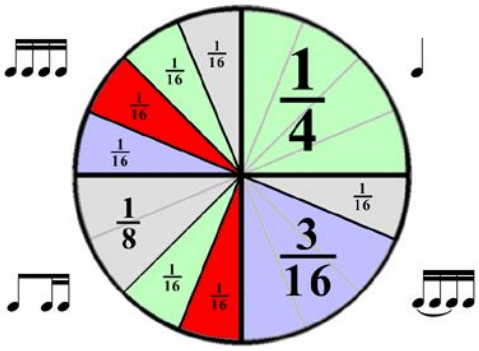
- http://www.cybozone.com/luthier/instruments/fretscale.html
- http://www.doolinguitars.com/intonation/intonation4.html
- http://liutaiomottola.com/formulae/fret.htm

Fractions

- as they apply to the bow



- and as they apply to Rhythm



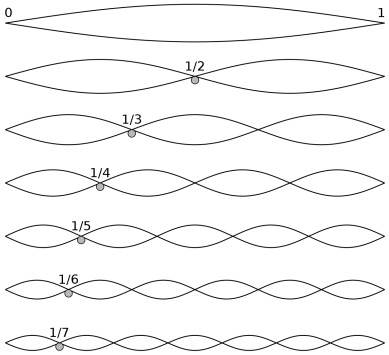
- Solve the **equation** once (writing in parts)

- Gravity: "Fight **gravity"** (Bow)

- Stable set up, three-legged stool, feet rooted to the ground

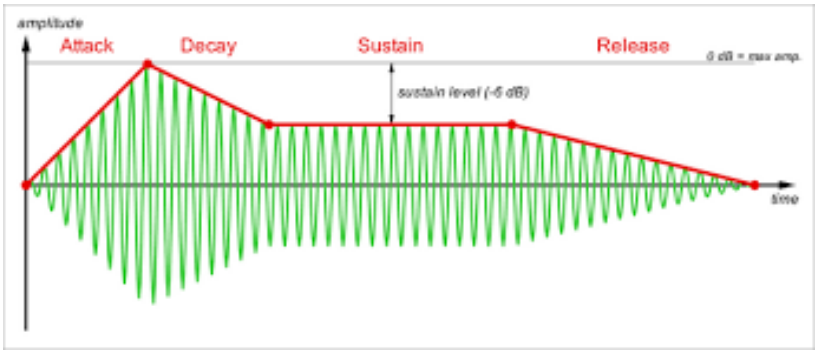
- Bowing: slow motion and the slip vibration? Slow motion video
- Helmholtz corner https://www.youtube.com/watch?v=6JeyiM0YNo4
    - Helmholtz corner
    - Stick-slip https://www.youtube.com/watch?v=FO5bq6x_Tws

- Harmonics and overtones



A2		A3		E2		E3		Bb2		Bb3	
55	A	110	A	82.5	E	165	E	58.25	Bb	116.5	Bb
110	A	220	A	165	E	330	E	116.5	Bb	233	Bb
165	E	330	E	247.5	B	495	B	174.75	F	349.5	F
220	A	440	A	330	E	660	E	233	Bb	466	Bb
275	C#	550	C#	412.5	G#	825	G#	291.25	D	582.5	D
330	E	660	E	495	B	990	B	349.5	F	699	F
385	~G	770	~G	577.5	~D	1155	~D	407.75	~Ab	815.5	~Ab
440	A	880	A	660	E	1320	E	466	Bb	932	Bb

- Transients, articulation, and envelope. *Articulation, sustain, release*



- Dynamic versus static (*passages, phrasing, technique*)
- Definition of Dynamic - more than volume
- How do we make notes dynamic? Phrases?
- Definition of Static?
- Dynamic and Static passages in music. - spotlight on and off

  - Dynamic: characterized by constant change, activity, or progress.
  - Static: stationary or fixed.

- Simple machines. (*Tuning pegs, Bow, Peg/string*)
  - any of the basic mechanical devices for applying a force, such as an inclined plane, wedge, or lever.

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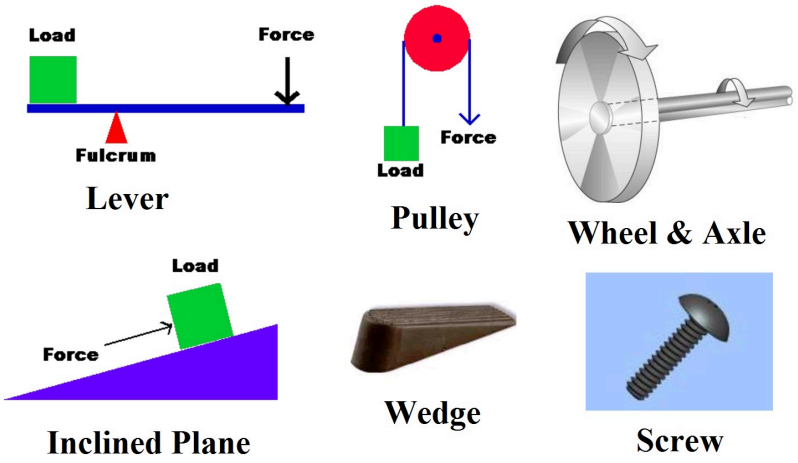
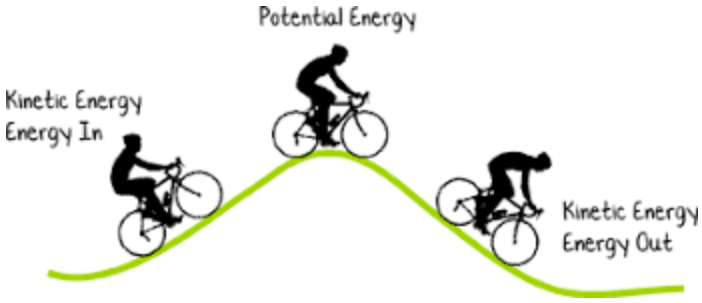
Simple Machines



Neuroscience: Brain and cognition as it applies to slow practice neural connections (*Practice)*

- "When the brain forms memories or learns a new task, it encodes the new information by tuning connections between neurons."

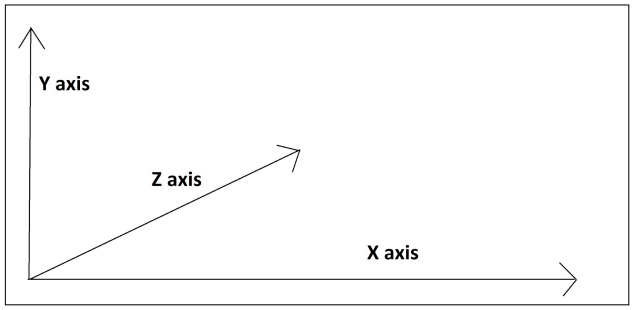
- Kinetic and potential energy. (*Slow Introduction in Symphony*)
- Haydn 104 London https://www.youtube.com/watch?v=gt0R4lBJYGY



- Kinesthesiology: is the scientific study of human or non-human body movement.

- Isometric exercise or isometrics (*4th finger strength*)
    - a type of strength training in which the joint angle and muscle length do not change during contraction (compared to concentric or eccentric contractions, called dynamic/isotonic movements). Isometrics are done in static positions, rather than being dynamic through a range of motion

- The Score as a graph:
    - X axis is rhythm
    - Y axis is pitch
    - Z axis is dynamics



- Economy of motion or “Conservation of Energy”

    - a set of rules and suggestions to improve the manual work in manufacturing and reduce fatigue and unnecessary movements by the worker, which can lead to the reduction in the work related trauma.

- Taxonomy
    - the practice and science of classification of things or concepts, including the principles that underlie such classification
    - http://ncssmstrings.blogspot.com/2017/09/ensemble-musician-taxonomy-of-musical.html