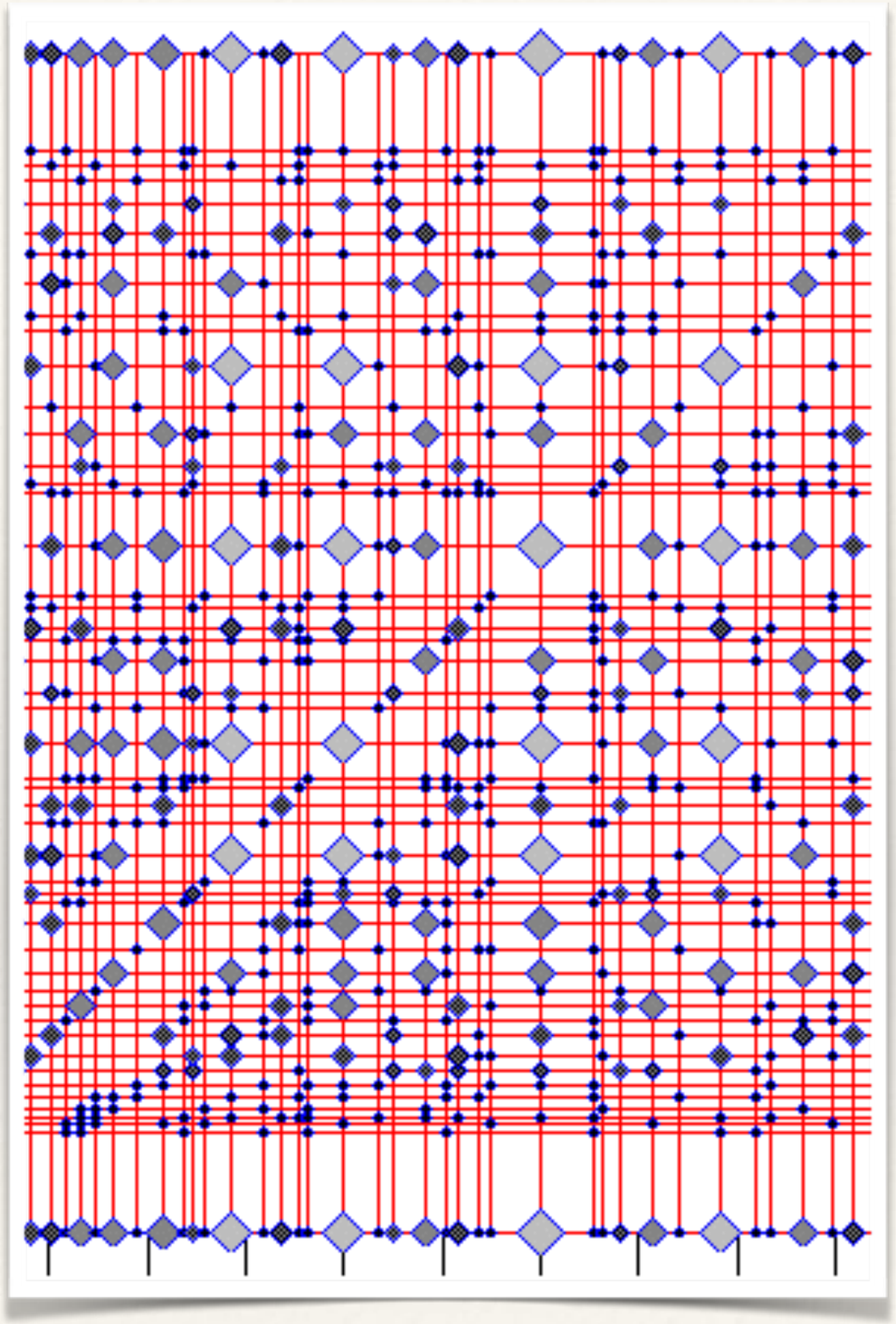
How PURE is Your Orchestra's Intonation?



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D'Addario Bowed Strings

Eastman String Instruments

www.OrchestraTeacher.net

Why do ensembles play out of tune?

- Students play out of tune because the teacher allows it!
- Students play out of tune because they don't have the aural skills to know what is correct
- Students often play out of tune because of technical deficiencies (posture, hand position)
- Students have poor tone. You can't tune a bad tone.
- "IN-**TONE**-ATION"

Why do we need to play in tune?

- We want to sound good!!
- Even a **non-musician** can still discriminate an out of tune performance!
- Establish a strong value for in tune playing
  - *"A moral premise"* - Michael Alexander

Teaching good intonation…

- You CAN do this!!
- Takes planning, practice, and a lot of patience
- Set your standards high and don't accept anything but the very best from your students
- The reward from your hard work is BEAUTY!

Prerequisites for good intonation

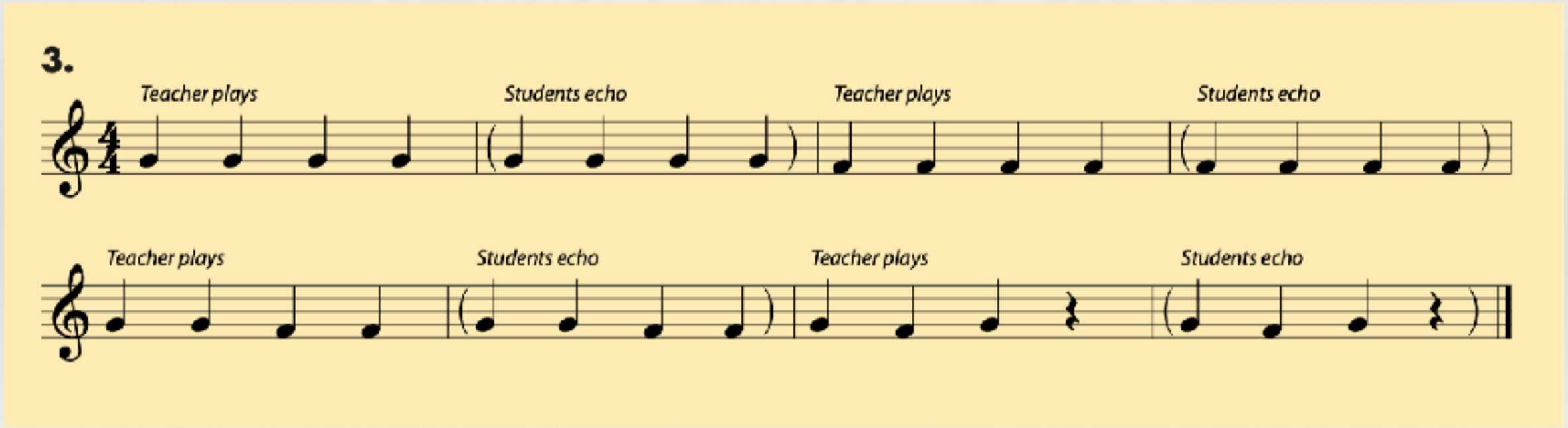
- Aural training
- Good technique
  - Posture, Hand position, Embouchure, etc.
  - Bad intonation is almost always a sign of poor technique.
- Good tone
- Good equipment

Developing Aural Skills

- Students should be able to audiate/internalize a pitch before they can play it in tune
- Spend some time each day working on aural skills. 5-10 minutes tops. Consider it an investment of your time!
  - Singing, playing echoes, pitch matching games,

Strategies for developing aural skills

- Match 4 note pitch pattens. Start simple, work your way to more difficult

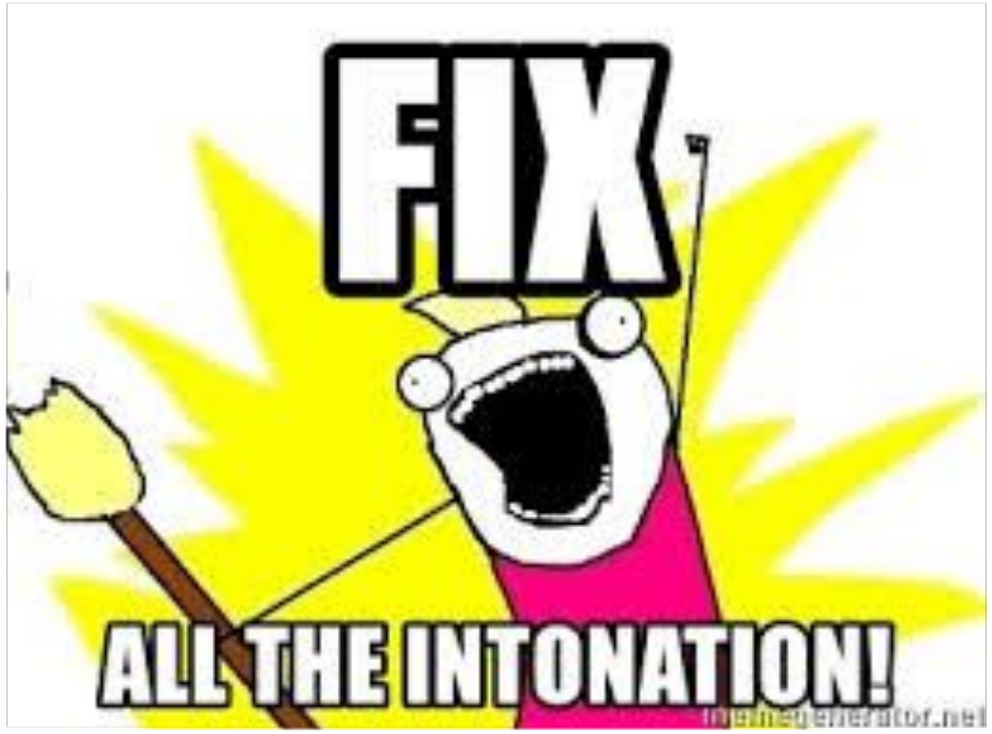


Strategies for developing aural skills

- Match 4 note pitch pattens. Start simple, work your way to more difficult
- Play scales and other exercises with sustained drones
- Have students play major melodies from their literature by ear
- Break down pieces into chords, and have students repeat the chord progressions
- Practice with accompaniments, piano or otherwise

Degrees of intonation

- In tune
- Very close (1-2 cents off)
- Out of tune
- Way out of tune
- Remember:
  - A little out of tune is **still** out of tune!
  - It only takes one person playing out of tune to make the entire section/ensemble sound bad!



"Cross Tuning" the Orchestra

- Use after tuning individual strings
- Helps students understand P5 tuning
- Allows more time for students to tune
- Allows for ***harmonic*** tuning - can be more helpful for a lot of students!
- Locks in tuning across the orchestra

Tuning Systems

- **Equal Temperament**
  - All intervals within an octave divided equally
- **Just Tuning (or Pure tuning)**
  - Based on the overtone series, uses whole number intervallic ratios (3:5, 2:1, etc.)
- **Pythagorean tuning**
  - Everything based on 3:2 ratio, raised 3rds and 7ths

Thinking "Vertically"

- Must instill a "vertical" mindset in students.
  - Rhythmic alignment
  - Harmonic alignment
- "Horizontal" intonation comes more naturally to students

Tuning Systems - When to use?

- **Equal Temperament**
  - When playing sustained notes/melodies with a piano/keyboard
- **Just Tuning (or Pure tuning)**
  - When tuning chords
- **Pythagorean tuning**
  - When playing single line melodies, scales, and arpeggios. Used most of the time.

Equal Temperament

- Equal Temperament (ET) ***approximates*** just intervals by dividing an octave (or other interval) into equal steps.
  - ET is a sacrifice to allow keyboard instruments to be more versatile
- Our ears have become desensitized due to training with ET
- ET dominates and is heard in almost all popular music

Just Tuning vs. Equal Temperament

Just tuning uses whole number interval ratios that are relative to the overtone series, as nature intended.

ET does not!

Interval	Ratio to Fundamental Just Scale	Ratio to Fundamental Equal Temperament
P1	1.0	1.0
m2	**25/24** = 1.0417	1.05946
M2	**9/8** = 1.1250	1.12246
m3	**6/5** = 1.2000	1.18921
M3	**5/4** = 1.2500	1.25992
P4	**4/3** = 1.3333	1.33483
d5	**45/32** = 1.4063	1.41421
P5	**3/2** = 1.5000	1.49831
m6	**8/5** = 1.6000	1.58740
M6	**5/3** = 1.6667	1.68179
m7	**9/5** = 1.8000	1.78180
M7	**15/8** = 1.8750	1.88775
P8	**2.0**	2.0

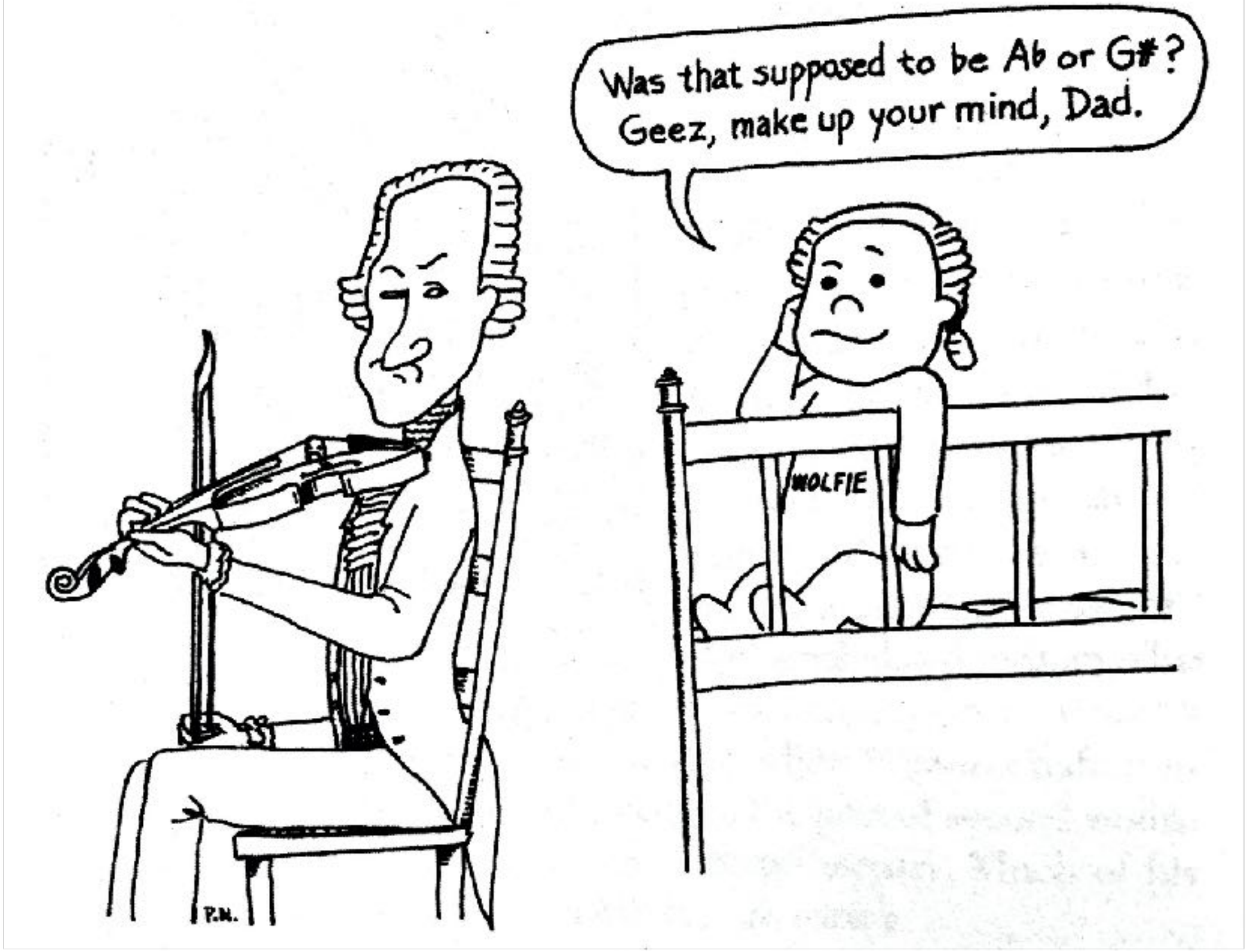
Adjustments from ET to Pure Intonation

MAJOR KEYS:

Scale Degree	1	2	3	4	5	6	7	8
Adjustment	0	+3.9	-13.7	-2.0	+2.0	-15.6	-11.7	0

MINOR KEYS:

Scale Degree	1	2	3	4	5	6	7	8
Adjustment	0	+3.9	+15.6	-2.0	+2.0	+13.7	+17.6	0



Semitone practice in the Mozart household

Cautions on using visual tuners…

- Students become visually tethered to a tuner and don't learn how to use their ears
- Tuners don't adjust to different tuning systems and only tune using Equal Temperament
- Tuners can be a fabulous teaching tool to develop an aural image
- Tuners also help student to physically manipulate pitch with fine tuners and/or pegs

Introducing the Yamaha Harmony Director

- **Yamaha HD-200 Harmony Director**
- Will play in Equal Temperament and Just Intonation
- Manual or Auto modes when in Just Intonation
- A unique tool and very practical
- Extremely customizable!
- Helps train the ears, not the eyes!

About the Harmony Director

- Harmony training, rhythm training and ensemble timing together in one device.
- Enables clear demonstration of pure temperaments
- Emulates real instruments (with necessary overtones)
- Students hear individual notes within chords, so that entire chords may be tuned.
- Allows manipulation of pitch and volume parameters of each note

Demonstration of the Yamaha HD-200 Harmony Director

Voice Section

- 10 Sounds: Flute, oboe, clarinet, sax, organ, trumpet, horn brass, strings
- Sounds can be "shaped" with setting for attack, release, and brilliance.
- Sounds can be sustained with a pedal or the "hold" button
- Octaves can be adjusted to increase or decrease the range

Harmony Section

- Voices can be transposed with a click of a button.
- WONDERFUL when working with full orchestra (unless you a master of transposing on the fly)
- Hit a button and you are playing in transposed B-flat, E-flat, or F!

Transposition & Pitch/Volume Adjustments

Effect of Timbre on Tuning

- Does timbre (tone color) impact the ability to tune accurately?
- Experiment with different timbres in your classroom
- Greer (1969) found that brass players tuned more accurately with like-timbre instruments. He found that timbres that lacked overtones (like an oscillator) posed problems with accurate tuning

A Balanced Major Chord

(opinions may vary)

- In addition to tuning, **balance** is important!
- 50% - tonic
  - (35% - lower tonic, 15% - higher tonic)
- 15% - 3rd (color chord)
- 35% - 5th

Intonation concepts to be taught:

Diatonic Intervals

Chromatic Intervals

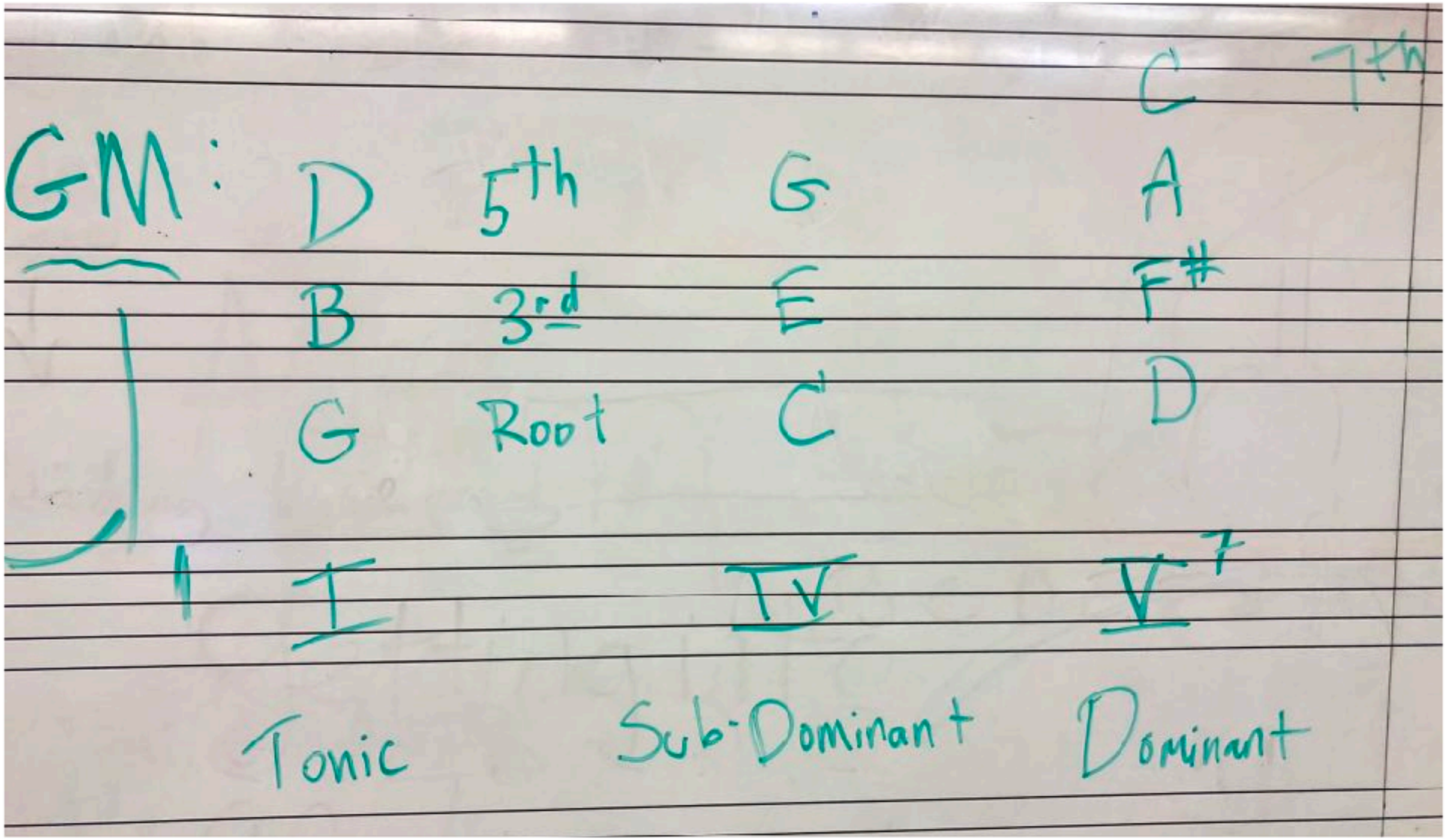
Open Fifths

Basic Harmony

Teaching Intervals

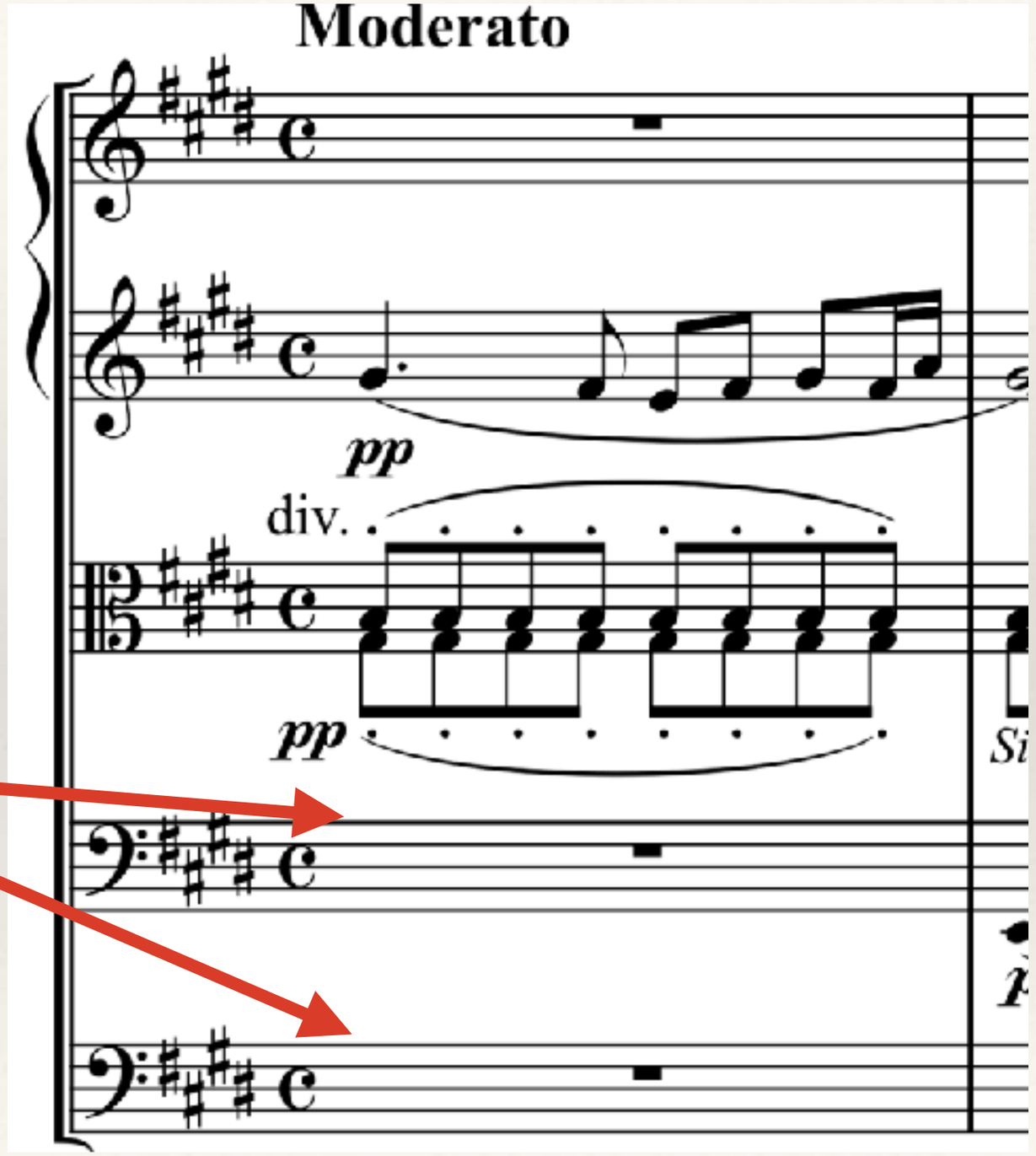
- Teach by ear, and if time, on the page
- "Interval of the week" idea
- Ask students to identify intervals within their music
  - Especially helpful with notes in higher positions
- When students begin thinking of their parts as intervals, it helps with intonation, fingering choices, etc.

Demonstrating Harmony Basics



Completing a chord

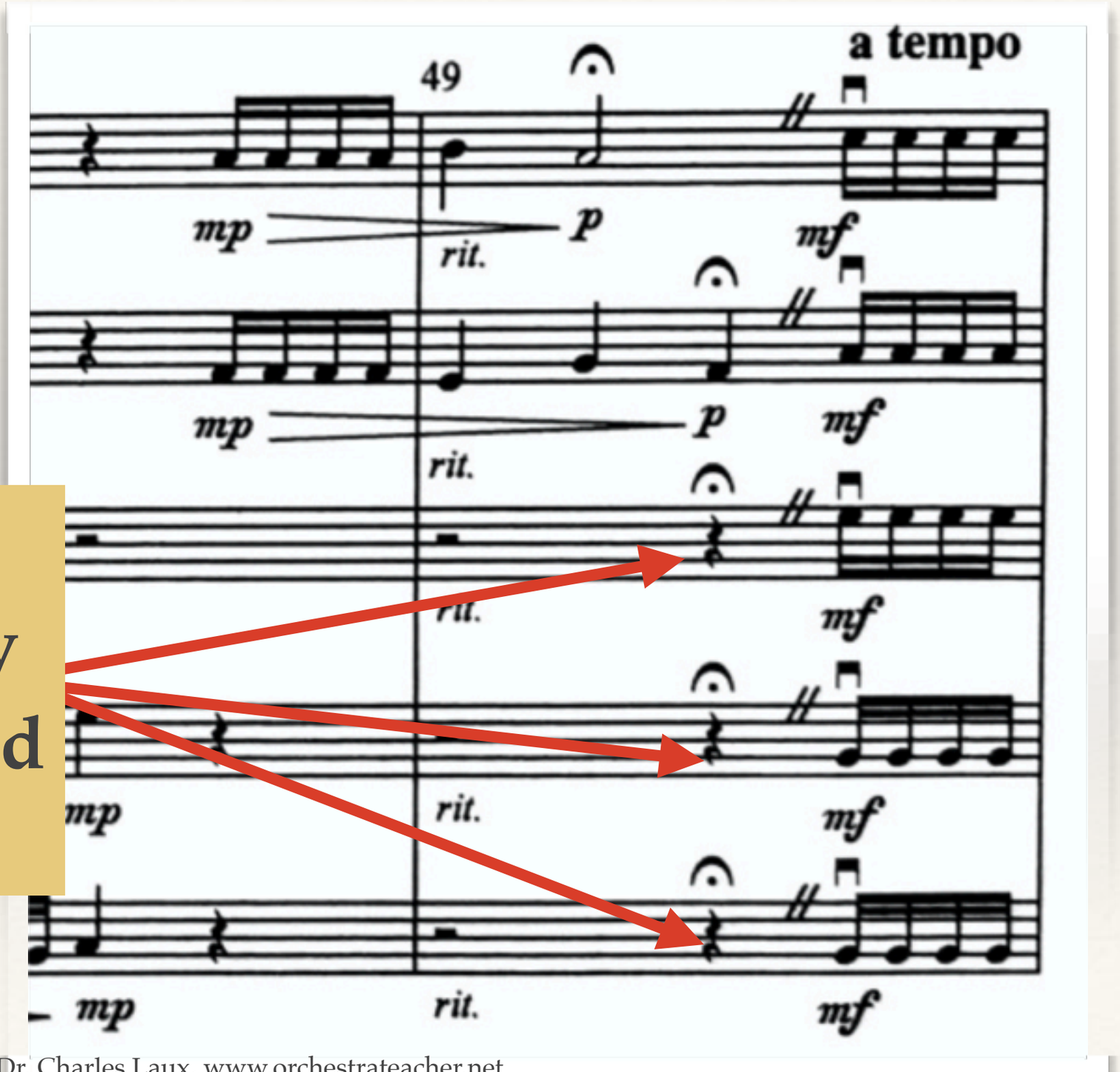
Elgar: *Serenade for Strings, I. Moderato*



Have cello/bass students play E to aid tuning the 3rd and 5th.

Completing a chord

Daniels: *Bold Venture*

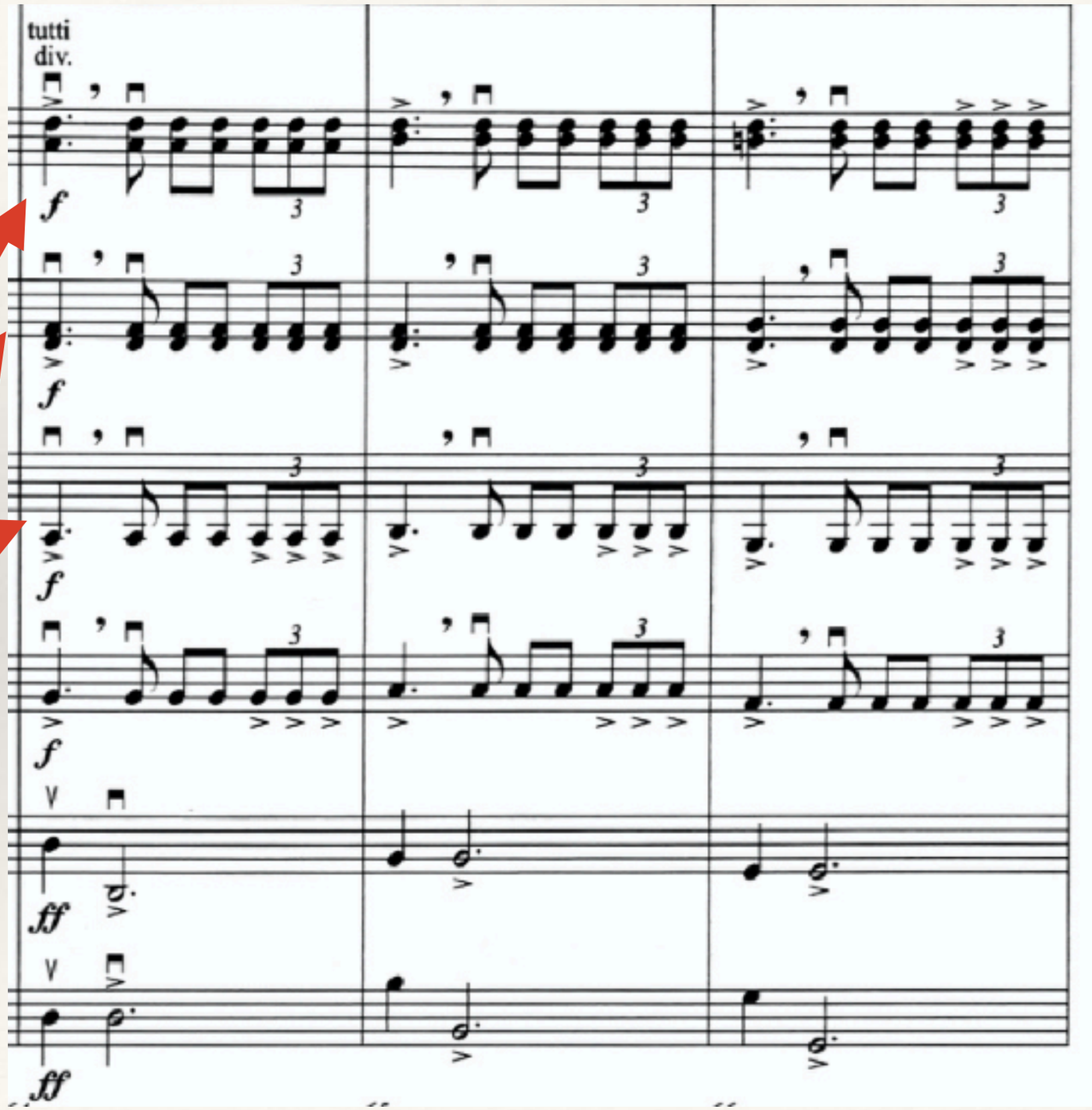


Have cello/viola/ bass students play open D string to aid tuning F# .

Rhythm impacting intonation

Newbold: *Warrior Legacy*

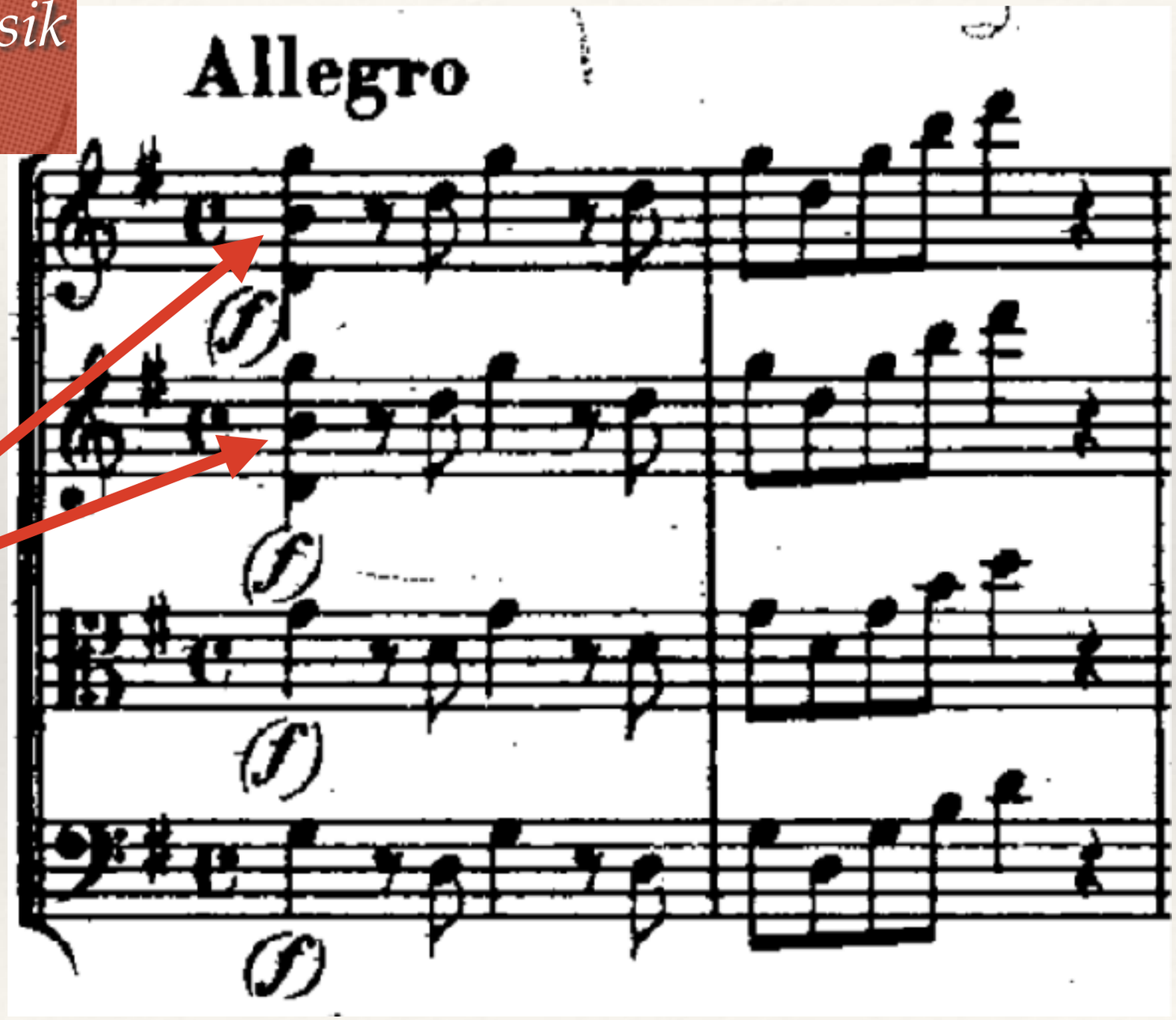
Have upper strings sustain notes instead of play the written rhythms.



Double Stops

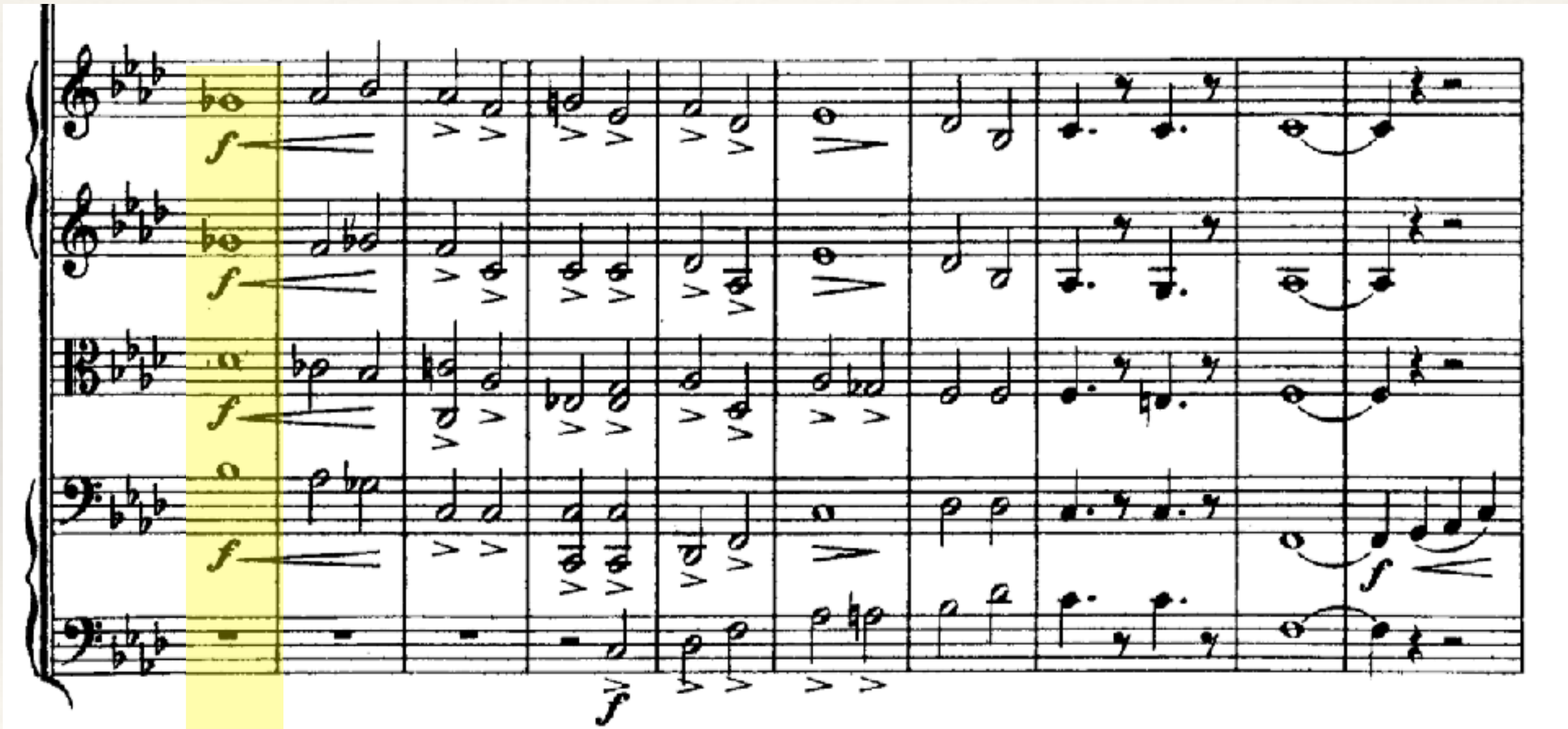
Mozart: *Eine Kleine Nachtmusik*
I. Allegro

**B must be tuned down to match with open D.
(Larger half step relationship between B and G.)**



Adjusting the 3rd in a Chord

Sibelius: *Finlandia,* Op. 26

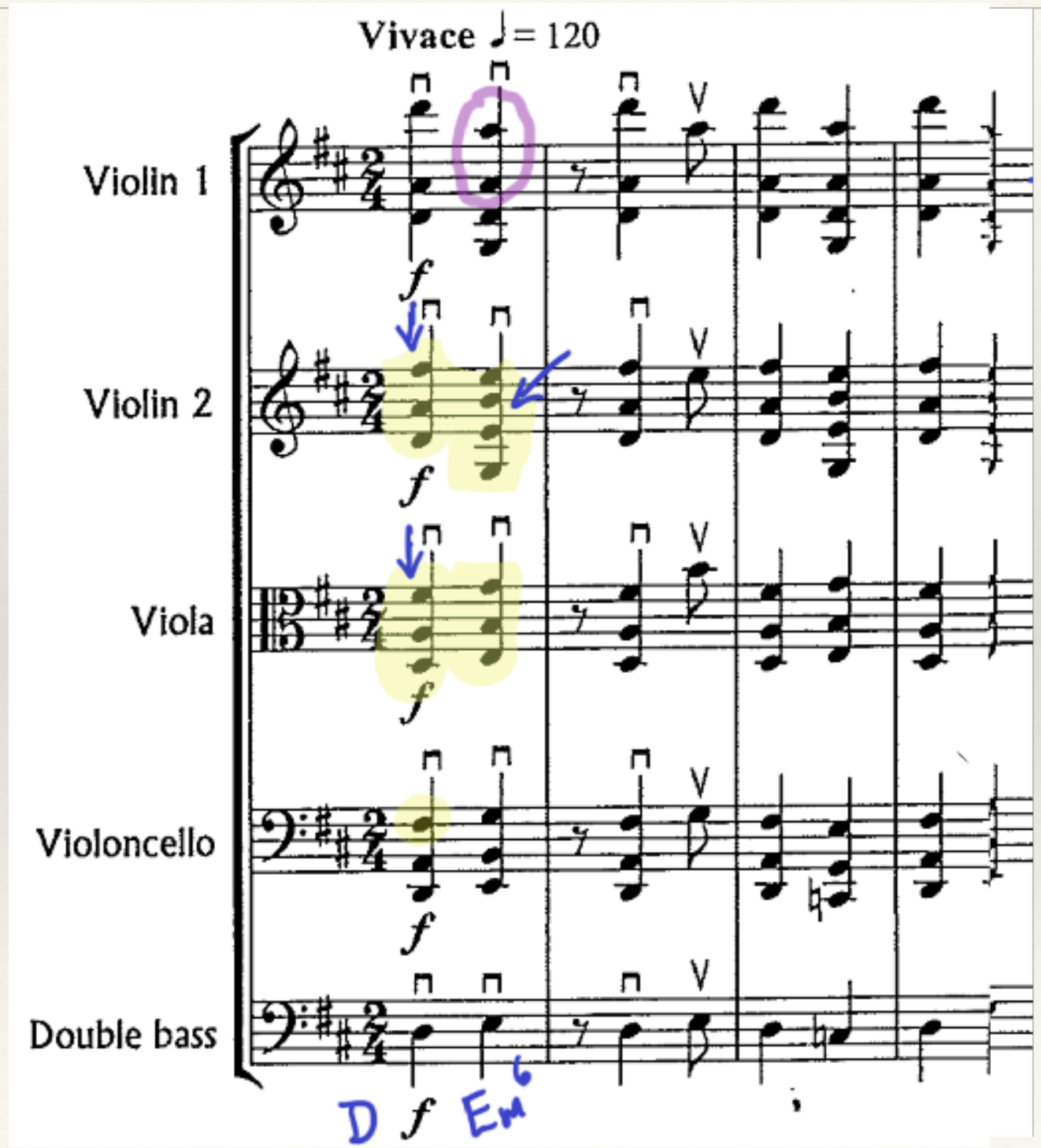


G-flat major chord, first inversion. This entrance comes after a very long period of rest!

Adjustment of fingers according to harmony

Rutter: *Suite for Strings, I. A-Roving*

1st and 2nd fingers (3rd cello) must be manipulated in order to justly tune chords. (Roots/5ths don't move.)



Tuning Apps

- Tonal Energy Tuner (iOS/Android)
  - Allows playing in Just Intonation
    - Attach compatible MIDI keyboard to iPad and play in Just Intonation
- ClearTune
- Peterson strobe tuner

References

- Duffin, R. W. (2008). How equal temperament ruined harmony (and why you should care). W. W. Norton.
- Greer, R. D. (1969). The effect of timbre on brass-wind intonation. University of Michigan).
- Laux, C. (2015). The effect of a tonic drone accompaniment on the pitch accuracy of scales played by beginner violin and viola students. (Electronic Dissertation). Retrieved from https://etd.ohiolink.edu/

Resources

- Garofalo - “Improving Intonation in Band and Orchestra Performance”
- Jagow -“Tuning for Wind Instruments”
- Fabrizio -“A Guide to the Understanding and Correction of Intonation Problems “
- https://pages.mtu.edu/~suits/scales.html
- http://violinmasterclass.com/en/masterclasses/intonation

Resources

- https://www.kylegann.com/histune.html
- https://www.kylegann.com/tuning.html

Special Thanks

YAMAHA

for use of the HD-200 Harmony Director keyboard

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Slides and more resources available at:

www.orchestrateacher.net