A Pedagogical Guide and Argument for Using the Harmonic Series in Teaching Beginning and Intermediate Level Horn Students

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A PEDAGOGICAL GUIDE AND ARGUMENT FOR USING THE HARMONIC SERIES IN TEACHING BEGINNING AND INTERMEDIATE LEVEL HORN STUDENTS

by

Patrick James Richards

Abstract of a Dissertation
Submitted to the Graduate School of The University of Southern Mississippi in Partial Fulfillment of the Requirements for the Degree of Doctor of Musical Arts

May 2012
ABSTRACT

A PEDAGOGICAL GUIDE AND ARGUMENT FOR USING THE HARMONIC SERIES IN TEACHING BEGINNING AND INTERMEDIATE LEVEL HORN STUDENTS

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An awareness of the harmonic series and its attributes is a crucial part of learning how to play the horn well, not to mention how the instrument works. Numerous undergraduates enter their career as music majors without understanding this important concept. This implies that students are not learning the harmonic series earlier in their development. Horn method books that instruct the student to use one harmonic series at a time often do not explicitly define the harmonic series, or the exercises are too difficult for developing horn students. Collecting existing and developing original exercises and other teaching tools will provide a useful resource for teachers to help make this concept comprehensible for younger players.
The University of Southern Mississippi

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Patrick James Richards

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May 2012
# TABLE OF CONTENTS

ABSTRACT ............................................................................................................................ ii

LIST OF ILLUSTRATIONS .................................................................................................... iv

CHAPTER

I. INTRODUCTION ................................................................................................................. 1

II. REVIEW OF METHOD BOOKS AND SURVEY RESULTS ........................................... 6
   Review of Method Books
   Survey Results

III. ORIGINAL EXERCISES AND SUGGESTED METHODS ........................................... 17
   35 Études for Introducing the Harmonic Series to the Beginning or Intermediate Horn Student

IV. TECHNIQUES FOR TEACHING THE HARMONIC SERIES .................................. 45
   Private Lesson Setting
   Sectional/Group Lesson Setting
   Full Band Setting

V. TRANSPOSITION AND THE HORN ................................................................................. 54

APPENDIXES ....................................................................................................................... 62

REFERENCES ...................................................................................................................... 64
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Range for Exercises in Scientific Pitch Notation</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Sounding pitch and horn pitch</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>F Harmonic series</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>Diagram of Russian nesting dolls within largest doll</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>Diagram of Russian nesting dolls separated</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>Diagram of target for partial target practice</td>
<td>58</td>
</tr>
<tr>
<td>7</td>
<td>Diagram of partial jumping floor chart</td>
<td>51</td>
</tr>
<tr>
<td>8</td>
<td>Harmonic Series to the 16(^{th}) Partial</td>
<td>54</td>
</tr>
<tr>
<td>9</td>
<td>Quoniam tu solus Sanctus, from Johann Sebastian Bach’s Mass in B minor</td>
<td>55</td>
</tr>
<tr>
<td>10</td>
<td>Transposition for music written for horn in F</td>
<td>56</td>
</tr>
<tr>
<td>11</td>
<td>Transposition for music written for horn in D</td>
<td>56</td>
</tr>
<tr>
<td>12</td>
<td>Example given in chapter 14 of the Dauprat</td>
<td>57</td>
</tr>
<tr>
<td>13</td>
<td>No valves (harmonic series for horn in F)</td>
<td>57</td>
</tr>
<tr>
<td>14</td>
<td>Second valve (harmonic series for horn in E)</td>
<td>58</td>
</tr>
<tr>
<td>15</td>
<td>First valve (harmonic series for horn in E-flat)</td>
<td>58</td>
</tr>
<tr>
<td>16</td>
<td>First and second valve (harmonic series for horn in D)</td>
<td>58</td>
</tr>
<tr>
<td>17</td>
<td>Second and third valves (harmonic series for horn in D-flat)</td>
<td>58</td>
</tr>
<tr>
<td>18</td>
<td>First, and third valves (harmonic series for horn in C)</td>
<td>59</td>
</tr>
<tr>
<td>19</td>
<td>First, second, and third valves (harmonic series for horn in B)</td>
<td>59</td>
</tr>
<tr>
<td>20</td>
<td>Thumb valve (harmonic series for horn in B-flat)</td>
<td>59</td>
</tr>
</tbody>
</table>
21. Thumb and second valves (harmonic series for horn in A).......................... 60
22. Thumb and first valves (harmonic series for horn in A-flat)...................... 60
23. Thumb, first and second valve (harmonic series for horn in G)............... 60
24. Thumb, second and third valve (harmonic series for horn in F-sharp)....... 60
CHAPTER I
INTRODUCTION

In the United States, most hornists begin learning the instrument in their junior high or middle school band. The method books used for these ensembles often do not address the concept of the harmonic series, but rather display a chromatic fingering chart to explain how to locate pitches. Thus, the student associates each note with a fingering rather than its location on the harmonic series. While this may be convenient for someone trying to teach several different instruments simultaneously, when used alone it can impede the student’s understanding of the horn. Offering a perspective that addresses the concept of the harmonic series to students soon after they have conquered the basics of tone production helps them more thoroughly understand how to play the horn well.

Whether they take private lessons or not, young students’ first experience with a musical instrument is with a keyboard instrument such as the piano. Here, they learn that on the piano, one key stroke produces just one pitch. However, when the student learns a brass instrument such as the horn they discover that one fingering has the potential to produce multiple pitches, some of them diatonically or chromatically adjacent to each other. This makes playing the correct pitch significantly more complicated than simply using the correct fingering. Accurate pitch production on the horn requires the player to hear the pitch in their head through audiation (the act of hearing music when sound is not present), then using a combination of appropriate air speed and embouchure setting to produce the pitch. Finding the correct partial is similar to finding a location on a map.

Without an informed awareness of the harmonic series, the student is guessing which partial they are going to produce - similar to driving through an unknown city
trying to find an address with no map. By teaching the harmonic series earlier in the
student’s development, the student can begin learning the instrument with a more solid
understanding of how the horn works. This is the best way to improve pitch accuracy and
enhance their playing overall. This document will explore various ways one can use the
harmonic series to help students develop audiation skills, pitch accuracy, control of the
air stream, good tone and intonation and technical facility through illustrations, analogies,
and modified as well as original exercises.

The relationship between the horn and the harmonic series has existed since the
horn was first sounded. When composers began notating music for the instrument, it
consisted of a single tube and could play just one harmonic series. More information
about the significant relationship between the natural horn and the harmonic series can be
found in Chapter V.

The invention of valves and the standardization of the three valve system made it
possible for the horn player to play any chromatic note without changing crooks or using
hand horn technique. As the valve horn became more standard, composers began writing
for “horn in F”. It was at this point also that hornists began training their audiation skills
to the idiosyncrasies of the transposing instrument. For example, modern hornists
(possibly excluding those with absolute pitch, see a third space C), audiate a third space
C, and the listener hears a concert F. However, every time modern hornists change
fingerings they move to a different crook or combination of crooks and thus, to a
different partial on a different harmonic series. As a result, hornists have become more
concerned with using the correct fingering to access the correct partial on the most
convenient harmonic series.
Despite the addition of valves, the harmonic series has remained an integral part of horn pedagogy, notably in the natural horn exercises featured in Fred Teuber’s *Progressive Studies in Flexibility and Range Development for French Horn* (Teuber 1984). However, it is most often reserved for more advanced students (typically in high school or college), who have to fill in this fundamental aspect of horn playing after they have been conditioned to rely on fingerings as the primary vehicle for pitch selection and production. This document will explore different ideas and techniques for introducing this concept earlier in the student’s development by collecting the opinions of collegiate instructors, reviewing publications, and using that information to inspire original exercises that present a different perspective of learning the instrument that more specifically involves the harmonic series.

The document will be divided into four chapters, including this introduction as chapter one. The second chapter will evaluate publications and methods for using the harmonic series as a teaching tool. In addition, it will include the results of a survey that invited responses from two hundred and sixty-three horn instructors at schools accredited by the National Association of Schools of Music (NASM) and a review of texts and methods targeted toward developing horn players. The publications reviewed in this document will consist primarily of texts directed toward the typical developing horn player. A list of these texts will be included in Appendix B. The survey of horn instructors was conducted via email. Instructors were asked questions about how they teach the harmonic series, what tools they use, and at what level they think it is appropriate to begin teaching the harmonic series. The results of this survey will be examined to identify trends in methodology and texts used throughout the United States.
Those texts will also be addressed to adapt that content for the less advanced, developing horn player, but will not be reviewed with the same amount of criticism as those texts already designed for the developing horn player.

Chapter III is a collection of exercises targeted toward developing horn players that employs melodic études designed using one harmonic series per exercise. The original exercises included in the document are designed to enhance learning how to play the instrument by re-framing fundamental skills with an awareness of the harmonic series. Some differences between these exercises and those found in more advanced methods include a limited range, basic time signatures and simple rhythms. The range of these exercises will be limited from C3 to G5 in written notation for horn in F using scientific pitch notation (C4 being middle C; C5 being third space C with all notes in-between labeled with the note name and 4 such as D4, E4, F4 etc.)

![Figure 1. Range for exercises in scientific pitch notation.](image)

The meters will be limited to 4/4, 3/4, and 6/8, and to rhythmic values no shorter than a sixteenth note nor longer than a whole note. The limitations placed on these exercises are not meant to restrict the player’s development in these areas but rather to help them focus on the physical aspects of horn playing and understanding the concept of the harmonic series. Where appropriate, dynamics and tempi are assigned to emphasize the goal of
each exercise. The player is specifically instructed on how to use their air, embouchure setting and audiation skills to navigate the harmonic series through both technical exercises and melodic exercises. These techniques are specifically highlighted in the technical exercises, then the student is given an opportunity to put the techniques to use in a melodic exercise. The melodic exercise provides a contextual experience that resembles how the student might use these techniques in learning a performance piece. These exercises are designed to be used as a separate resource and the tools and techniques described in it will hopefully encourage horn teachers to integrate the harmonic series to establish a more comprehensive foundation for developing horn players. Chapter IV is an exploration of different scenarios and situations where one might use to teach the harmonic series.

The input of horn instructors throughout the United States suggest that the harmonic series is an important part of learning the horn. Several publications have included natural horn exercises and some describe the harmonic series and its role in horn playing at length, also suggesting its importance. This document is specifically using the concept of the harmonic series specifically targeted toward helping developing hornists use concept of the harmonic series to develop the skills necessary to play the instrument well.
CHAPTER II

REVIEW OF METHOD BOOKS AND SURVEY RESULTS

This chapter will be divided into two parts. The first is a collection of reviews of publications targeted toward developing horn players and concerning how they incorporate the harmonic series in each text. The second part will discuss the results of a nationwide survey of horn instructors at schools accredited by the National Association of Schools of Music. The survey included questions on how these teachers incorporate the concept of the harmonic series in their teaching. See Appendix A for the survey as it was presented to each participant.

The method books selected for this review are listed in the References section. The books that contained material related to teaching the harmonic series are described and listed in alphabetical order. The purpose of each review is to find material in the book that lends itself toward discussion about the harmonic series and to present ways for using that material to highlight certain topics related to the harmonic series. Each book will be ranked by the following criteria: the specificity of the authors’ intent for the student to use one harmonic series at a time (1 being least specific and 5 being the most specific), and the appropriateness of the études for horn players in the first few years of study (1 being the least appropriate and 5 being the most appropriate).

Presenting études to students in a way that brings certain playing issues to the forefront is one of the more creative aspects of teaching private lessons. Of course this practice has been going on for as long as we have had these études and exercises. It is also quite likely that the following examples have already been used to demonstrate any number of horn playing elements, including the concept of the harmonic series. By
presenting these beginner level études in a way that includes information about the harmonic series, teachers can help students have a more complete understanding of how we play the horn from the start.

**Review of Method Books**

Belfrage, Bengt: *Method for Beginners on the French Horn* (Belfrage)

Authors’ intent to have the student use one harmonic series per exercise - 5

Appropriate for students in first few years of study - 4

Part One of Belfrage’s method consists of 17 lessons. The first five lessons use only partials found in the F harmonic series. In these first five, Belfrage adds a new partial with each lesson from C4 to C5. In lesson six, Belfrage introduces the E harmonic series by instructing the student to press the second valve and play the partials learned in the first five lessons. In lessons seven through ten, he introduces the E-flat, D, and D-flat harmonic series in the same way.

By introducing pitches one harmonic series at a time, Belfrage encourages the student to think about using all appropriate physical aspects of horn playing as they move from note to note. Introducing the pitches in this way discourages the student from relying on changing fingerings to change notes.

Of all the books reviewed, the overall concept behind part one of Belfrage’s method bears the most resemblance to the thesis of this document. Introducing pitches by order of partials on one harmonic series is unusual within the canon of beginning method books. However Belfrage only presents four partials of the harmonic series. He also does not include the seventh partial (B-flat on the F harmonic series). In this respect, Belfrage’s method is similar to Farkas’s, where he presents major arpeggios and indicates
the player to only use one valve combination at a time. Belfrage does this with an illustration of a horn indicating what valve is to be pressed and “0 = valve not pressed down” (Belfrage 7) or, in lesson VI, “Press down the 2nd valve” (Belfrage 14).

King, Jeff and Richard Williams: *Foundations for Superior Performance Warm-Ups & Technique for Band* (King and Williams)

Authors’ intent to have the student use one harmonic series per exercise - 3

Appropriate for students in first few years of study - 5

On pages six through nine, King and Williams include interval exercises grouped into *Warm-Up Sets*. Each set includes interval drills using one fingering for each drill. The fingerings are indicated beneath each drill. Here, the authors’ indicate the player is to use one harmonic series at a time on the B-flat side of the instrument (the first fingering indicated is thumb (T) - Open). Using the B-flat side of the horn in this way is unusual in method books published in the early part of the twentieth century. These would begin the student on the F side of the horn and introduce the B-flat side later, if at all. This book, published in 1997, certainly does not fall into that category. The purposes of band method books being what they are, the authors needed to adapt all instruments around concert pitches. If following the method book rigidly, the first note all band members would learn would be concert F (written C for horn). The standard fingering for third space C is thumb-open. In order for the horns to be playing the same pitch as the ensemble and to reinforce standard fingerings, the authors chose to begin with this harmonic series. Due to the use of natural horn exercises on the B-flat side of the horn, this example is quite telling regarding the differences between learning the instrument in the late 20\textsuperscript{th}/early 21\textsuperscript{st} century and even the early part of the 20\textsuperscript{th} century.
Kinyon, John: *Breeze-Easy Method for French Horn Book Two* (Kinyon)

Author’s intent to have the student use one harmonic series per exercise - 5

Appropriate for students in first few years of study - 5

Kinyon includes several warm-ups using one harmonic series at a time. Here the same options are available as in the previous étude such as harmonic series and partial identification. The simplicity of these étude allows the conversation to shift to what the student is physically doing to move from one partial to the next partial. When using these études in private lessons, teachers should ask, “If you are not moving your fingers, then how are you changing notes? Are you changing your air? Are you changing your embouchure?” These questions should be followed by asking what the student is doing to make these changes. This also gives an opportunity to isolate any unusual physical issues the student might have. When working on more complex literature, the teacher can often find something more obvious to discuss such as rhythm, tone or pitch accuracy. These issues can distract the teacher from discussing more fundamental aspects of horn playing. Even if the student is doing everything correctly, by asking the student these questions and drawing attention to these aspects of horn playing it can help them to understand the importance of an embouchure that works or how to use air more efficiently.

Pearson, Bruce: *Best in Class* (Pearson)

Author’s intent to have the student use one harmonic series per exercise - 3

Appropriate for students in first few years of study - 4

The popular band method book *Best in Class* by Bruce Pearson includes special pages intended for hornists to work with on their own. It is often the case in the first few lessons with any student that they will not have an étude book specific to their own
instrument but a band method book such as *Best in Class*. In these first few lessons these special pages can come in handy for teaching the student about the harmonic series. In volume one of the *Best in Class* series, pages 4-A through 7-A provide several short and easy note introduction exercises. The first five notes the student learns in this book are C4 to G4. Here, as with the *Rubank* exercises, the student is only working with two harmonic series; the F harmonic series and the E-flat harmonic series. To help the student make this association, teachers can display both harmonic series for the student and have them choose which notes are playable on which harmonic series. Then, have the student label the appropriate partial with the appropriate note.

Pearson, Bruce: *Standard of Excellence* (Pearson)

Author’s intent to have the student use one harmonic series per exercise - 3

Appropriate for students in first few years of study - 5

Book one of Pearson’s *Standard of Excellence* series includes several short études that are very appropriate for introducing the harmonic series. These particular études have an indication of “For French Horns Only.” They use only one or two different fingerings and thus only one or two harmonic series, making it easier to have the student focus on moving between the two. As with the *Best in Class* exercises, showing both harmonic series to the students and guiding them to match each pitch with its corresponding harmonic series will help reinforce the concept.

Skornicka, J.E. (editor) *Rubank Elementary Method for French Horn* (Skornicka)

Author’s intent to have the student use one harmonic series per exercise - 3

Appropriate for students in first few years of study - 5
In Skornicka’s *Rubank Elementary Method for French Horn*, you can use lesson 6 on page 8 to clearly demonstrate how one moves between harmonic series, particularly in number 8, where the student can play the exercise using only two fingerings, no valves and 1st valve (both on F horn). Show the student both sets of harmonic series he or she will be using. Have the student look at the first two bars and find the partials for G and E. Then have them find the partials for F and D. Guide them to the realization that the two sets of partials are the same, just on different harmonic series.

To demonstrate the difference between this area of the harmonic series and the upper octave of the harmonic series, first show the student where the notes would be on the F harmonic series, then play the étude for the student up an octave, on the open F horn. Then, play the étude using the first valve. If you want to challenge the student further, ask them why this is possible on the upper octave but not the lower octave.

**Survey Results**

Method books about the horn are practically useless without a qualified instructor to guide the student through them. Many of the finest pedagogues and professors have composed and published their own methods, giving students some insight into how they teach the horn. While these texts have been vital to the canon of literature on the horn, few of them are targeted toward players at the beginner and developing levels. The goal of this survey is to collect the thoughts and opinions of horn instructors from across the United States about how they teach the harmonic series. The results for each question will be condensed and presented in this chapter. The survey in its entirety can be found in Appendix B.
1. When do you think it is appropriate to begin teaching the harmonic series to horn players?

This question is the most important in the survey. This document is the attempt to answer it; arguing the benefits of introducing the harmonic series earlier in a student’s development. 57% of the participants in the survey chose “beginner level”: 35% chose “intermediate level” (junior high-seventh or eighth grade) 13.2% chose “high school”, 7.9% chose “post-secondary” and 5.3% chose “other”. Those who chose “other” were asked to specify; most responded that it would depend on the student. This suggests that the main argument of the document (the concept of the harmonic series should be taught at the beginning to intermediate level of a horn student’s development) is supported by the opinions of a significant number of horn instructors in the U.S.

2. In the previous question (When do you think it is appropriate to begin teaching the harmonic series to horn players?) Why did you choose this level?

While the answers to this question were quite varied, the majority of responses associated with choosing the beginner level pertain to learning the fundamental aspects of playing the horn (embouchure shifts, air speed, etc.) and understanding how playing a brass instrument works. Those who chose the intermediate level explained that it should be introduced after students have learned the basics of the instrument. Those who chose the high school level tended to suggest that teaching too much about the harmonic series would cause students to over-think every aspect of sound production or that students would not be intellectually mature enough to understand the concept until this age.
3. When teaching the harmonic series, do you use a published resource? If so, what do you use?

Thirteen different texts were mentioned in response to this question. The text most frequently mentioned was Philip Farkas’s *The Art of French Horn Playing*, also referred to as “the Farkas.” While the number of different publications is great, the majority of participants (72%) indicated that they did not use a published resource when teaching the harmonic series. Of the 72% that did not use a published resource, 19 participants (26% of all participants) stated that they used their own written materials to teach the harmonic series. Some responses indicate that the participant considered the question to limit the term “published resource” to only allow for printed examples of the harmonic series. Others explained how they use the harmonic series as a way to introduce other aspects of horn playing such as transposition and music written for the pre-valve horn.

Questions four and five asked participants to rate how often they discussed the harmonic series in private lessons and in a master-class setting.

4. How often do you discuss the harmonic series in lessons with your students? Participants were asked to choose between never, rarely, occasionally, frequently or in every lesson. Out of 76 participants one (approximately 1.3%) replied with “rarely”, 19 (25%) replied “occasionally”, 40 (approximately 52.6%) replied with “frequently” and 16 (approximately 21%) replied with “in every lesson.”

5. Do you discuss the harmonic series when you give master-classes? If so, how often?
Out of 76 participants, three (approximately 4%) responded with “rarely,” 15 (approximately 20%) with “occasionally,” 43 (approximately 56%) with “frequently,” eight (approximately 10%) with “in every lesson” and seven (approximately 9%) with “not applicable.”

6. How well do you think your students understand the concept of the harmonic series after you teach it to them?

Out of 76 participants, 22 (approximately 29%) responded with “somewhat,” 41 (approximately 53.9%) with “almost completely,” and 13 (approximately 17%) with “completely.”

The responses for these questions demonstrate how the topic of the harmonic series is already prevalent in teaching at the college level. More than half of participants who responded to each question said they discussed the harmonic series frequently in both lessons and master-classes.

Questions seven, eight, and nine are related to teaching using the harmonic series through different learning styles.

7. Do you use any specific aural learning techniques for teaching the harmonic series? If so, please describe.

This question had 70 replies. Of the 70 replies, 12 (approximately 17%) replied that they did not use any specific aural learning techniques for teaching the harmonic series. The other 58 replies (approximately 83%) could be divided into those that use the horn and those that do not. Among responses that included the horn the most frequent responses, 11 (approximately 16%), pertained to demonstrating the partials of the harmonic series and having students imitate that demonstration. This is the most direct
and obvious way of using an aural technique to teach the harmonic series in its most basic form. Other responses describe more specific aspects of the harmonic series beyond the basic series of partials, such as playing works that originally were intended to be played on natural horn using one harmonic series. This technique helps students understand the context in which the horn was originally played before the invention of the valve in the early nineteenth century. The responses that did not include playing the horn mostly involved singing the partials with or without solfèze syllables. This would be very useful for associating the distance between partials with intervals with which the student may already be familiar.

8. Do you use any visual learning techniques for teaching the harmonic series? If so, please describe.

Out of 65 respondents, 14 (approximately 21.5 %) said they did not use any visual learning techniques for teaching the harmonic series. 21 respondents (approximately 32 %) said that they used the harmonic series written out using musical notation to teach the harmonic series. This is the most direct visual method for teaching this concept. The remaining responses 30 (approximately 46 %) included using three-dimensional objects such as nesting dolls to demonstrate how each partial is part of one harmonic series. Other visual aids mentioned included lengths of string or tubes to demonstrate how the different lengths determine different harmonic series.

9. Do you use any specific kinesthetic learning techniques for teaching the harmonic series? If so, please describe.

Out of 67 responders, 25 (approximately 37%) said they did not use any specific kinesthetic learning techniques. The other responses 42 (approximately 63%) from those
who said they did use kinesthetic related techniques to teach the harmonic series can be divided into those that use the act of playing the horn (36 or approximately 85% of respondents that use kinesthetic learning techniques - approximately 54% of the total) and those that do not require the horn (6 or approximately 14% of respondents that use kinesthetic learning techniques - approximately 9% of the total). Many of the responses that involved playing the horn discussed how the student would feel as she moved from partial to partial. There were many references to the bump or popping that one feels as they move to an adjacent partial. Responses that did not include the horn referred to exercises where the student would jump from a measured series of floor tiles to resemble the amount of work one needs to do to move from partial to partial in the lower part of the harmonic series. This also illustrates how little work the student needs to do to move from partial to partial in the upper part of the harmonic series.

This survey shows that instructors at the college level consider the harmonic series as a significant part of teaching the horn. The techniques used to teach this concept can be adapted for younger, less experienced students. The techniques that use the concept of the harmonic series to approach other aspects of playing the horn are also adaptable. Awareness of this concept can help bridge concepts of horn playing such as embouchure dexterity and accuracy in the upper register.
CHAPTER III

ORIGINAL EXERCISES AND SUGGESTED METHODS FOR INTRODUCING THE HARMONIC SERIES

The following collection of exercises are based on the information gathered in chapter two and specifically the natural horn exercises in Teuber’s *Progressive Studies in Flexibility and Range Development for French Horn*. They are meant to be used as a supplement to any horn teaching method for beginning to intermediate horn players. Their purpose is to offer the student some insight into the harmonic series and its relationship to how we play the instrument. These exercises are organized by individual harmonic series. Different harmonic series will be introduced and illustrated in full. In other texts, authors have simply displayed the F harmonic series with an explanation that the same set of intervals is applicable to other harmonic series simply by depressing a valve or combination of valves. In these exercises, each different harmonic series will be presented on the staff to help students who learn better through visual media. The exercises will be divided into groups designated by the different harmonic series. The first group will be written using the F harmonic series; the second group with the E harmonic series and so on until all possible combinations on the F horn are exhausted (F, E, E-flat, D, D-flat, C, and B). All exercises can also be transposed simply by using a different valve combination. This can be a good introduction to the traditional method of transposition. The fundamental of each harmonic series is also called the first partial in the tradition of brass pedagogy. The 4th partial of each exercise will be indicated with a diamond shaped note-head, to illustrate how the same partial moves when changing...
harmonic series. Writing out the pitches and their corresponding partial can help reinforce the student’s understanding of the correlation between the two.

35 Études for Introducing the Harmonic Series to the Beginning or Intermediate Horn Player

Music written for the horn is transposed. That means when you play a C on the horn, it sounds like an F on the piano. We call the pitch you play on the piano “concert pitch” and the pitch you play on the horn “horn pitch.” If you played a C on the horn and an F on the piano, they would sound like the same pitch.

Figure 4. Sounding pitch and horn pitch.

Here is what we call the F harmonic series. We call it this because the concert pitch that the harmonic series begins on is F. The horn pitch is C.

Figure 5. F Harmonic series.
Exercise No. 1

One of the tools we use to move from one partial of a harmonic series to a higher partial is to increase our air speed. Play the following two notes, G and C, focusing only on changing your air speed. Play the two notes again maintaining the same air speed and only changing your embouchure. Which one do you think is more efficient?

When moving from the middle C (C4) to third space C (C5). Think of saying Tah-Yee using the back part of your tongue. Then, do the opposite to play the descending octave leap (Tee-Yah). Just remember to keep your embouchure set. Do not say Tah-Yee or Tee-Yah with your lips; just your tongue. A good way to determine how fast is to imagine blowing twice as fast to play a partial one octave higher. When playing the middle C, imagine a subdivision of sixteenth notes in your head. Increase your air speed on the final sixteenth note of the measure. Try to maintain the same dynamic level for the both octaves.
Remember to use the syllables Tee and Yah when playing the descending octave. Here, instead of increasing your air speed to change the pitch, imagine your air becoming warmer and thicker. When playing the middle C your air should be slower.

Exercise No. 2

Play each measure separately from the others. The goal is to memorize how it feels to move from partial to partial. Be sure to keep your air moving throughout each measure.

\[ J = 48 \text{ beats per minute} \]
Exercise No. 3

In the previous exercise, you practiced using the different physical aspects to move from partial to partial. Here, you have to play partials that are not next to each other on the harmonic series. You will need to hear the next pitch in your head before you play it. Teachers could also use this exercise to discuss hearing wide intervals such as the major 6th, perfect 5th, tritone, and perfect 4th.

$\dot{r} = 96$
Exercise No.4

As in the previous exercise, you will need to make sure you are hearing the interval correctly. Take the mouthpiece off your lips during each rest. This forces you to remember the embouchure setting for that partial. When you play this exercise, think about how it feels to play the first four bars. How does it feel to play bars 5 through 12? What did you have to do differently to move between these partials?

\( j = 80 \text{ beats per minute} \)
Exercise No. 5

When playing this melody ask yourself these questions. Write in the answers to each question to remind you of what works best for you.

How much do I have to change my air speed to move from partial to partial?
What did I have to do physically to move from note to note?
How and when did I change my embouchure setting?

\[ j = 80 \text{ beats per minute} \]
B (concert F-sharp) harmonic Series

Play all exercises on F horn (no thumb valve), second valve

Exercise No. 1

When playing this exercises, try to maintain the airstream through each phrase. What intervals are prominent in each phrase?

\( j = 140 \) beats per minute
Exercise No. 2

Hold all notes out for full value and do not diminuendo on the whole notes unless indicated. Do not let your dynamic get louder than forte. Notice the difference in the air and the embouchure setting required for the first half of the exercise and the second half of the exercise.

\[ \text{♩} = 120 \text{ beats per minute} \]

Exercise No. 3

As in Exercise No. 1, notice how you use your air in the different registers. In the last two bars, note how it feels to shift between the two registers

\[ \text{♩} = 88 \text{ beats per minute} \]
Exercise No. 4-a

Remember to play every note with second valve on the F horn (no thumb valve).

This exercise has a C-sharp (ninth partial on the E harmonic series) which usually is played with thumb, second and third valve. For this exercise you will have to use your air and embouchure to find the note.

\( \text{♩ = 104 beats per minute} \)

Exercise No. 4-b

This is the same exercise as 4-a, with the slur shifted from beats two and three to beats three and one. Note the difference between the shift in air speed to move between the wide intervals and the smaller intervals.

\( \text{♩ = 104 beats per minute} \)
Exercise No. 5

This exercise features the seventh partial (A4). While the standard fingering for this note is thumb, first and second, for these exercises you need to play all notes on the second valve of the F horn.

\( \text{♩} = 96 \text{ beats per minute} \)
B-flat (Concert E-flat) Harmonic Series

Play all exercises using only on the F horn using the first valve.

Exercise No. 1

Take the mouthpiece off of your lips during each rest. During each rest try to hear the next pitch before playing it.

\( j = 140 \)
Exercise No. 2

This exercise includes the seventh partial (A-flat on the B-flat harmonic series).

Do not use the traditional fingering (thumb, second, and third) to play the A-flat.

Remember that all notes must be played on first valve on the F horn.

\[ J = 108 \]

Exercise No. 3

Feel how close the adjacent (one step away from each other) partials are in bars 5 through 7. In this section, focus on feeling the point where the partial changes.

\[ J = 88 \text{ beats per minute} \]
Exercise No. 4

As in Exercise No. 3, try to remember how it feels to move between the adjacent partials. There are no slurs in this exercise, so you must remember the setting for each partial while performing a clean and clear articulation.

\[= 88 \text{ beats per minute}\]

Exercise No. 5

The goal of this exercise is to move quickly between partials. Keep the air moving through each phrase. Begin slowly, then increase the tempo as you become more familiar with the exercise.

\[= 76 \text{ beats per minute}\]
A (Concert D) Harmonic Series

Play all of these exercises on the F horn using the first and second valves.

Exercise No.1

When playing this exercise, remember to apply the same technique used to play the octaves in the first set of exercises.

\( \text{♩} = 120 \text{ beats per minute} \)
Exercise No. 2

Try to keep each four-bar phrase connected with a constant air stream. Make sure to play the G (7th partial) in bars three and six. This might take a few attempts to find it. It will probably sound strange but do not attempt to adjust the pitch with your hand or embouchure.

\[ j = 120 \text{ beats per minute} \]

Exercise No. 3

Follow the phrase marking to the downbeat of each bar. Try not to breathe until the end of bar four.

\[ j = 88 \text{ beats per minute} \]
Exercise No. 4

In this exercise, look for where you are playing partials that are next to each other on the harmonic series and where you are skipping partials on the harmonic series.

\[ \text{\textit{J} = 88 \text{ beats per minute}} \]

Exercise No. 5

Make sure to play the seventh (G), ninth (B) and eleventh (D#) partials using the first and second valve combination only.

\[ \text{\textit{J} = 88 \text{ beats per minute}} \]
A-flat (Concert D-flat) Harmonic Series

Play all exercises on valves two and three.

Exercise No. 1

Take the mouthpiece off your lips between during each rest. Try to hear the next pitch while resting.

\( \text{\textbf{\textit{J}} = 120 \text{ beats per minute}} \)
Exercise No. 2

Make sure to play the seventh (G-flat 4), ninth (B-flat 4), and 11th (D-flat 5) partials on the second and third valve combination only.

$J = 88$ beats per minute

Exercise No. 3

$J = 88$ beats per minute
Exercise No. 4

This exercise contains several octave leaps. Apply the principles you learned in the first set of exercises.

\( \text{♩}\) = 120 beats per minute

Exercise No. 5

Try to make the eighth notes in bars five through seven as smooth as possible. Remember to feel the exact point where the partial changes.

\( \text{♩}\) = 88 beats per minute
Play all exercises on the F horn, first and third valve.

Exercise No. 1

This exercise features wide intervals such as the octave, perfect 4th and perfect 5th, triadic arpeggios, and adjacent intervals. Notice the difference in how you move from partial to partial for each. What techniques give you the best results when moving between the large intervals? What about the small intervals?

$\text{♩}= 132$ beats per minute
Exercise No. 2

When playing this exercise, imagine one stream of air for each four-bar phrase. How will you use this airstream to move from partial to partial? How will you use it to crescendo? How will you use it to diminuendo?

\[ j = 96 \text{ beats per minute} \]

Exercise No. 3

For this exercise, focus on feeling the difference between playing the adjacent partials and the arpeggiated partials.

\[ j = 96 \text{ beats per minute} \]
Exercise No. 4

Play each phrase as smoothly as possible. Be careful to play each pitch accurately, especially in bars one and five.

\[ J = 96 \text{ beats per minute} \]

Exercise No. 5

Keep your air stream constant for the octave leap in bar seven.

\[ J = 88 \text{ beats per minute} \]
F-sharp (Concert B) Harmonic Series

Play all exercises on the F horn valves one, two, and three.

Exercise No. 1

$J = 120$ beats per minute

Take the mouthpiece off the lips during the rests.
Exercise No. 2

In this exercise, try to only breathe every four bars. Make sure to take a full breath before you play.

$\text{j = 88 beats per minute}$
Exercise No. 3

This exercise sits mostly in the middle and lower registers. What physical changes do you need to make to play in these registers comfortably? Are they effective? To play in these registers, try moving your jaw forward and imagine using a slow, thick air stream.

\( \text{\textit{\textbf{j}} = 88 \text{ beats per minute}} \)
Exercise No. 4

Make sure you are playing the seventh partial (E4) in bars three and five. It will be tempting to play the eighth partial instead.

$\textbf{l}$ = 96 beats per minute
Exercise No. 5

This exercise is quite fast. Start practicing it slowly, then increase your speed as it becomes more familiar. The eighth notes in bars three and five should be played very smoothly and without much physical change.

♩ = 88 beats per minute
CHAPTER IV

TECHNIQUES FOR TEACHING THE HARMONIC SERIES

In the past few decades, increased special attention has been paid to how students learn. Howard Gardner’s multiple intelligences and Neil Fleming’s learning modality theory are two of the most well-known. Gardner’s multiple intelligences (MI) theory defines intelligence as “the capacity to solve problems or to fashion products that are valued in one or more cultural setting (Gardner).” His theory lists seven different kinds of intelligence: linguistic, logical-mathematical, musical, bodily-kinesthetic, spatial, interpersonal and intrapersonal. Fleming’s theory developed from previous research done by Richard Bandler and John Grinder on neuro-linguistic programming and suggests students may have an individual preference for one of the following as a means for acquiring information; visual (seeing the material), auditory, (hearing the material) reading/writing and kinesthetic/tactile (movement and or touch) (VARK) (Bandler). Both these theories promote using different techniques for teaching based on the various ways that children learn. I believe most educators would agree with me that it is preferable to teach using a variety of methods, hoping one works better than the other for a given student. These theories were used in organizing the following scenarios and activities.

Here are some examples of scenarios in which one might find an opportunity to use the harmonic series using literature appropriate for a developing horn player. They are divided into three categories; private lessons, group lessons or sectionals, and full band activities. Under the first two categories, I will present three different activities, each favoring one of the different learning styles.
Private Lesson Setting

*Russian Nesting Dolls-Visual*

The act of looking at the harmonic series written on the staff is the simplest way to teach the harmonic series to young students. However, to make the experience more memorable it could help to use three-dimensional objects. One interesting way to approach this concept would be to present the student with a set of nesting dolls (several different sized dolls that fit inside one another.) This can help present several concepts. When all of the dolls are inside the larger doll, this can represent to the student that when you are hearing the fundamental (first harmonic) you are hearing all of the harmonics at once. This also can represent the harmonic series in its entirety. The dolls inside each other represent one length of tubing, or one fingering on the horn. When using this one fingering, the student has the potential to hit all of partials of the harmonic series, just like shooting a gun through all the dolls. For a more specific description of the harmonic series, you can remove the dolls from the largest doll and space them according to the intervallic distance on the harmonic series. This could be used with any amount of participants.
Figure 4. Diagram of Russian nesting dolls within largest doll.

Figure 5. Diagram of Russian nesting dolls separated.
Lyrics for Partials-Auditory

The most obvious method for teaching the harmonic series to students with an auditory learning preference is to play the series on the horn. Adding an element of novelty to the series of partials can help make the intervallic distance between the partials more memorable. If the student is familiar with solfège, you can have the student use these syllables. However, this could get complicated with some of the accidentals assigned to the seventh, eleventh, thirteenth, fourteenth and fifteenth partials. Teaching some of these chromatic solfège syllables would have significant merit, especially if the student is planning on majoring in music in college. To make the student feel more involved in learning the harmonic series, have the student write down sixteen monosyllabic words and assign them to each partial. Have the student sing a small excerpt of a natural horn étude or exercise using their lyrics. This also encourages students to develop their own techniques to learn new music and become more independent as a musician.

Partial Jumping-Kinesthetic

In the low register, moving to an adjacent partial requires more physical changes than moving to an adjacent partial in the upper register. To illustrate this concept, create some sort of diagram on the floor or ground that depicts the distance between partials.

![Diagram of partial jumping floor chart.](image-url)
The purpose of this activity is to show the student that moving from partial to partial in the low register may require more physical work, while moving from partial to partial in the upper register requires more dexterity. If outdoors you can use sidewalk chalk on concrete but this activity works just as well indoors. You can use masking tape on the floor.

Sectionals/Group Lesson Setting

Many young players’ only chance for this type of idiosyncratic instruction is in a sectional rehearsal led by their band director or a hired instructor within a school ensemble. Here are some activities an instructor could use with a group of horn players to illustrate how we play the horn using the harmonic series.

Partial Target Practice—Visual

The learning objective of this game is to illustrate the increasing difficulty of hitting the desired partial as the harmonic series gets higher. For this game you need some sort of target equipment. In most cases, you will need to use a relatively safe version such as one that uses suction cup darts. If you wish, you may re-label the different areas of the target to represent partials of the harmonic series. A more elaborate and specific version of the game would probably require you to design and construct your own target to provide all sixteen partials of our standard harmonic series. By labeling the larger outer area of the target the space between the first and second partial and the increasingly smaller areas of the inner part of the target in the same order as the partials in the harmonic series, you are demonstrating the difficulty of hitting the correct partial in the upper part of the harmonic series. This would be a good opportunity to coax the
student toward understanding the amount of skill and concentration that is necessary to hit the smaller target areas or upper partials as opposed to lower partials. Here too, one should emphasize what is necessary to play the correct partial on the horn; good audiation skills, proper air usage, and embouchure setting rather than tension, excessive mouthpiece pressure, and air flow restriction. Some may find that their schedules do not allow time to do these sorts of activities. To them I would suggest making time for these kinds of exercises when there is some down time (half-days, the Friday before a lengthy school break, etc.) This would be much more educationally advantageous than watching a video, or leaving the students to their own nefarious devices. Playing these games serves a number of purposes, the least of which being to fill time. It has also been my experience that an unorthodox teaching method such as a well-planned game can help students remember material significantly better than simply telling students something.
Figure 7. Diagram of Target for Partial Target Practice. The note names are listed above and the partial numbers below.

Funnel Horn-Auditory

You can make this activity more memorable by using a natural horn or creating a natural horn out of a garden hose, funnel and some tape. This helps illustrate the concept of using one harmonic series at a time. It also makes it easier to demonstrate the length of the hose and how it determines which harmonic series you can play. The flexibility of the garden hose makes it convenient to demonstrate just how long the tubing needs to be to play the same harmonic series as the F horn (12 feet). Typical garden hoses come in four sizes 1/2 inch, 5/8 inch, 3/4 inch and 1 inch. Use a smaller diameter to demonstrate small bore instruments like the horn and trumpet, larger for euphoniums and tubas. If
possible, you might consider constructing the horn with a student or smaller group of students to make the experience more significant. This would especially be beneficial for students with a tactile learning preference. The novel timbre of the garden hose horn can help make the concept of the harmonic series more memorable for students.

**Full Band Setting**

The visual activities used for private lessons and sectionals could also be used in a full band setting. When discussing the harmonic series with the entire band, you may want to consolidate different learning styles into one presentation.

To involve the entire band, or at least the brass section, present a diagram of the length of tubing on each instrument. Then associate the tubing lengths with each instruments’ appropriate harmonic series. Here you, could incorporate the funnel horn activity by creating several funnel horns with tubing lengths that correspond to the different instruments (12 feet for horn, nine feet for trombone, four feet and eight inches for the B-flat trumpet, 18 feet for the B-flat Tuba.) Have a representative from each section attempt to demonstrate the harmonic series for their instrument on the funnel horn.

*Harmonic Series Catch-Kinesthetic*

To illustrate the distance between partials, you might want to put down the horns, and pick up a ball. Have students distance themselves according to partial distance. Use whatever equation you find appropriate. If you have ample space, you might use one foot to equal a whole step. Let the students come to the realization that it requires more work to move from partials on the lower part of the harmonic series than it does in the upper
part of the harmonic series. Have the students line up in different harmonic series next to each other to demonstrate how we switch partials between different harmonic series. While his sort of activity is best suited for music camps or band camps, it can be easily adapted for small indoor spaces and is a good way to incorporate musical knowledge with recreation.

Summary and Conclusion

The goal of this document is to express the significance of understanding the harmonic series as it applies to horn playing at the beginning and intermediate levels as well as to provide teachers with the pedagogical resources to do this. In the first chapter, the historical significance of the harmonic series in playing the horn as the instrument developed from the natural to the valved horn was presented. In chapter two the focus shifted to the use of the harmonic series in published method books designed for young players and collected thoughts on how the concept is taught at colleges and universities around the United States. The information collected in chapter two was used to develop original short exercises using one harmonic series at a time that are also appropriate for younger players. In the fourth chapter, the data presented in chapter two influenced the suggestions for teaching the concept of the harmonic series in various situations and through different learning styles. The document presents alternative methods to help the young horn student more thoroughly understand this complex instrument. This understanding helps transform the student’s view of the horn from a frustrating and perplexing mechanism into an intricate vehicle used for creating beautiful music.
CHAPTER V

TRANSPOSITION AND THE HORN

Composers typically write for the horn using partials in the upper part of the harmonic series in the third and sometimes fourth octave. Most of these partials are diatonically or chromatically adjacent, making it considerably more difficult for the player to play the correct partial.

Figure 8. Harmonic series to the 16th partial.

Examples of this can be found throughout the repertoire from early works such as the Quoniam from J.S. Bach’s B minor Mass (see Fig. 9) to the horn concertos of W.A. Mozart.
Horn in D

![Musical notation](image)

*Figure 9. XI. Quoniam tu solus Sanctus, from Johann Sebastian Bach’s Mass in B minor. This would have been played on natural horn and thus one harmonic series. Note the proximity of the partials in measures seven and ten.*

Before the invention of the valve in the early nineteenth century, an awareness of the harmonic series was much more significant to the horn player. Without the ability to access a different harmonic series by pressing a lever, the hornist was limited to playing the partials of only one harmonic series. He was required to interpret written pitches as partials. Thus, a printed third space C would be interpreted as the eighth partial on whatever harmonic series the player was using. The following examples show the written pitch, the modern transposition and the concert pitch (pitch that would match a keyboard or other non-transposing instrument) and the partial number. The excerpt from Bach’s Mass in B Minor is written for horn in D, thus the modern hornist would need to use the transposition in figure 11.
Figure 10. Transposition for music written for horn in F (majority of works written after the beginning of the twentieth century.)

Figure 11. Transposition for music written for horn in D (*Quoniam* example)

The harmonic series used would be determined by the length of the horn. The hornist would change the length of the horn by attaching a different crook, or additional tubing. Each crook would be assigned a different harmonic series or key in concert pitch such as E-flat or D. Thus, the written third space C would be heard as an E-flat if the player was using the E-flat crook and would be heard as an F on an F crook. For either one, the hornist would look at the music, see the third space C and understand it was necessary to adjust his embouchure and air speed to produce the eighth partial of whatever key the composer indicated. The most notable and comprehensive treatise from this era of horn playing is François Dauprat’s *Method pour Cor Alto et Cor Basse*, (Dauprat 1994) originally printed in the 1820s. The exercises found in this book help to illustrate the reliance horn players placed on their knowledge of the harmonic series to play the instrument. This is particularly evident in chapter fourteen where Dauprat presents a scale on the instrument as a harmonic series rather than the diatonic major or minor scale.
that is standard today. As he notes on page 30, “The easiest scale for the horn, the most natural, and that which is most often used, is, as shown here, the scale of C Major. Players continue to refer to C Major no matter what crook is in the horn” (Dauprat 30).

Figure 12. Example given in chapter fourteen of the Dauprat.

Modern hornists must do this transposition in their mind rather than changing crooks; the hornist must play pitches in intervals lower or higher than the written pitch, depending on what key is indicated on the page. For example, if the score indicates horn in E-flat, the hornist, who reads modern music in F, would read all pitches one full step lower than they appear on the staff.

With the invention of valves and the standardization of the three valve system, the hornist could access seven harmonic series on the single F horn and twelve harmonic series on the double F/B-flat horn by using an assortment of valve combinations. In brass pedagogy, the fundamental is also called the first partial.

Figure 13. No valves (harmonic series for horn in F).
Figure 14. Second valve (harmonic series for horn in E).

Figure 15. First valve (harmonic series for horn in E-flat).

Figure 16. First and second valves or third valve (harmonic series for horn in D).

Figure 17. Second and third valves (harmonic series for horn in D-flat).
Figure 18. First and third valves (harmonic series for horn in C).

Figure 19. First, second and third valves (harmonic series for horn in B)

Figure 20. Thumb valve (harmonic series for horn in B-flat)
Figure 21. Thumb and second valves (harmonic series for horn in A)

Figure 22. Thumb and first valves (harmonic series for horn in A-flat)

Figure 23. Thumb, first and second valves (harmonic series for horn in G)

Figure 24. Thumb, second, and third valves (harmonic series for horn in F-sharp)
On the surface, it would appear that the invention of the valve would have rendered obsolete texts such as the Dauprat. However, one can find homages to Dauprat’s work in several later published method books for advanced players. For example, exercises similar to those in the Dauprat book can be found in more contemporary texts such as Philip Farkas’s *The Art of French Horn Playing* (Farkas) and Fred Teuber’s *Progressive Studies in Flexibility and Range Development for French Horn* (Teuber) both written for the modern valve horn. These two texts include natural horn exercises in which the student uses one valve combination throughout the exercise. By doing this, the student uses one harmonic series, and must rely on the combination of air speed and embouchure movement to access the correct partials. Of these two examples, Teuber presents a more specific relationship between natural horn exercises and the harmonic series. Teuber’s book includes melodic exercises in addition to the series of arpeggios and interval drills found in the Farkas and other similar texts, and provides a more contextual setting similar to a work the student might perform. In his introduction to these exercises, Teuber emphasizes that they are “a direct approach to the problem of pitch-proximity on the instrument (Teuber 29).” This approach reinforces the relationship between audiation and pitch production. Overlooking this relationship is the trap most young unguided horn players fall into when they assume that they can play correct notes simply by blowing and depressing the right lever. Learning to use a combination of audiation, embouchure setting and air speed to navigate between partials is a more reliable strategy for playing correct notes than relying on fingerings alone.
APPENDIX A

SURVEY AS PRESENTED TO PARTICIPANTS

Strategies and Techniques for Teaching the Harmonic Series

1. When do you think it is appropriate to begin teaching the harmonic series to horn players?
   - [ ] Beginner Level
   - [ ] Intermediate (junior high/7th 8th grade)
   - [ ] High School
   - [ ] Post Secondary
   - [ ] Other (please specify)

2. In the previous question, why did you choose this level?

3. When teaching the harmonic series, do you use a published resource? If so what do you use?

4. How often do you discuss the harmonic series in lessons with your students?
   - [ ] Never
   - [ ] Rarely
   - [ ] Occasionally
   - [ ] Frequently
   - [ ] In every lesson

5. Do you discuss the harmonic series when you give master-classes? If so, how often?
   - [ ] Never
   - [ ] Rarely
   - [ ] Occasionally
   - [ ] Frequently
   - [ ] In every lesson
   - [ ] N/A

6. How well do you think your students understand the concept of the harmonic series after you have tried to teach it to them?
   - [ ] Not at all
   - [ ] Somewhat
   - [ ] Almost completely
   - [ ] Completely
   - [ ] N/A

7. Do you use any specific aural learning techniques for teaching the harmonic series? If so, please describe.
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<th>Strategies and Techniques for Teaching the Harmonic Series</th>
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<td><strong>8. Do you use any specific visual learning techniques for teaching the harmonic series? If so, please describe.</strong></td>
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<tr>
<td><strong>9. Do you use any specific kinesthetic learning techniques for teaching the harmonic series? If so, please describe.</strong></td>
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<td><strong>10. Please enter your name and address to receive the $100 Amazon.com gift card should your name be selected during the drawing.</strong></td>
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REFERENCES


