Dividing Time

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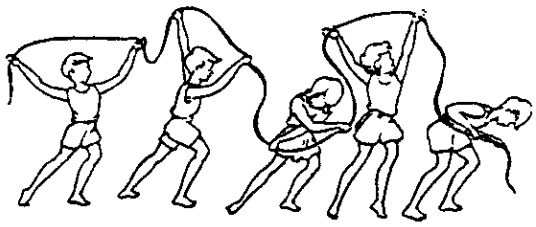
Dividing Space:

A participatory workshop using music & movement to study increment, ratio & proportion



presented by

Terry L. Boyarsky

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INTRODUCTION

Welcome and Warm-up

Topic/Rationale/Purpose

Learning through music and rhythmic movement draws on students' kinesthetic intelligence, deepens understanding and retention. Joyful, energetic, collaborative activities are powerful motivators for learning. The purpose of this participatory workshop is to introduce ways of using music and movement to deepen students' understanding of increment, ratio and proportion.

Goals of the Workshop

At the end of this workshop, you will know:

- How to work with circles and parts of circles.
- Ways to help students recognize clockwise and counter clockwise.
- How musical structure, form and note values relate to whole, half and quarter.
- The difference between increment, ratio and proportion.

At the end of this workshop, you will be able to:

- Lead students in musical and rhythmic activates related to numbers and shapes.
- Create rhythms to analyze and use for studying math problems.
- Identify and facilitate elements of good listening and teamwork.
- Help students experience how spatial movement connects to written symbols.

Overview of the Workshop

Participants will experiment with organizational principles of music and improvise with some elements of rhythm. We will take a new look at concepts such as increment, ratio and proportion by playing rhythm and movement games that embody these mathematical relationships. We will study circles – as found in dances, songs, clocks, and floor patterns – and represent them with diagrams, formulae and symbols.

LEARNING ACTIVITY #1 – *Increments*

Ohio Standards addressed in math, music and literacy:

Mathematics Standards (Grade 5):

- *Numbers, Number Sense and Operations: show how fractions are equal.*
- *Measurement: Geometry and Spatial Sense: Identifying, classifying and analyzing one-, two- and three-dimensional objects.*

Music Standards (Grade 5):

- *Analyzing and Responding: Analyze a piece of music using music vocabulary.*
- *Connections, Relationships and Applications: Interpret music through dance, drama and visual art.*

Cleveland Literacy System Tie-In (Grade 5):

- *Acquisition of Vocabulary*
- *Communication: Oral and Visual: Demonstrate active listening strategies*

The Process:

Activity outcomes:

Students will:

1. Identify, define, track, measure, and predict incremental change.
2. Diagram and measure ratios in choreography and music.
3. Verify and chart the movement of time.
4. Interpret a song by creating and performing choreography to it.

Activity steps for moving by increments, using the song, "How Time Flies:"

1. **Arithmetic progression**: Counting beats in increments (1 2 3 4 5 6 7 8 . . .).

2. Define **Increment**: *"a small positive or negative change in the value of a variable."*

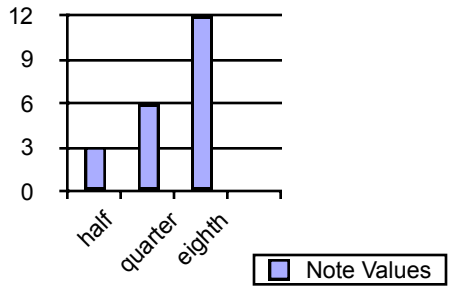
3. **Steady beat**: Form circles of 12 people; tap a steady beat. Then pass beat around the circle, one per person. Experiment with Quick Reaction to change from clockwise to counterclockwise (CW, CCW). Go twice as slow; go twice as fast.

4. **Clock:** With your right arm, draw a large circle in front of you (refer to a clock face). Indicate each "hour" of the clock, one "hour" per beat; then smooth it out.

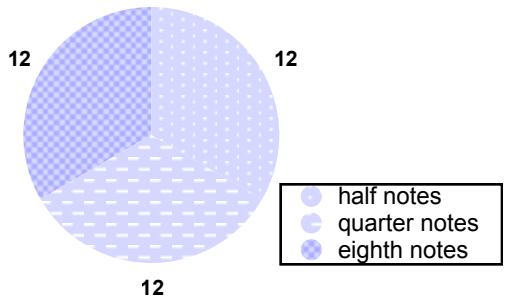
5. **Quick Reaction:** In 12 beats, get from this end of the room to the other end. In 12 beats, go from lying down to standing up. In 12 beats, go from standing straight up to a twisted position. In 12 beats, go from begin alone to making a shape with two others. In 12 beats, as a group create an "X" (a square, an "O"). Count the beats in different ways: saying the numbers out loud, playing a drum, follow the chromatic scale on a piano.

6. **Sing:** "How Time Flies." Discover three speeds of beat (eighth, quarter, half). Tap the quickest beat (eighth notes, 12 per phrase). Walk the medium tempo (quarter note, 6 per phrase) changing direction for each phrase. Sway each beat for the slowest beat (half note, 3 per phrase). How much "time" goes by?

7. **Count:** How many eighth notes in the entire song? Quarter notes? Half notes?



8. **Draw** a pie chart showing how many parts of the song and what kind of beat is predominant for each part.



9. **Reflection questions for students:** What is an increment? How does one measure incremental change in music? math? How does this game relate to the clapping game we did in the beginning? What did you learn by graphing the different beats? Which is harder - to create or perform choreography? Can you think of incremental phenomenon in your daily life?

Possible assessment tools:

°Draw a bar graph showing how many eighth/quarter/half notes are in the song.

°Use half, quarter, and eighth notes to create and perform a new 12-beat rhythm.

Reflection on the activity

°What are the problem-solving skills used in this lesson?

°What strategies were used to teach clockwise and counter clockwise?

°How does spatial awareness relate to the written symbol?

°How did the movement activities help you work with fractions and circles?

LEARNING ACTIVITY #2 – *Ratios*

Ohio Standards addressed in math, music and literacy:

Mathematics Standards (Grade 5):

- *Mathematics/Number/Number Sense and Operations/Number and Number Systems: Use models and visual representation to develop concept of ratio as part-to-part and part-to-whole.*
- *Mathematics/Mathematical Processes: Applying problem-solving and reasoning skills and communicating mathematical ideas.*

Music Standards (Grade 5):

- *Analyzing and Responding: Identify terms related to form (e.g. DC al Fine, DC al Segno, repeat signs, first and second endings)*
- *Analyzing and Responding: Evaluate and describe individual and group performances.*
- *Creative Expression and Communication: Read, write and perform patterns using sixteenth notes through whole notes including dotted half note and syncopated rhythms.*

Cleveland Literacy System Tie-In (Grade 5):

- *Reading Applications: Analyze the difference between fact and opinion.*
- *Communication: Oral and Visual: Use clear diction, pitch, tempo and tone, and adjust volume and tempo to stress important ideas.*

The Process:

Activity outcomes:

Students will:

1. Learn and perform a rhythmic body percussion composition.
2. Analyze part-to-part, and part-to-whole ratios in the above piece.
3. Design a performance by layering rhythms, creating forms, and communicating with musical vocabulary.

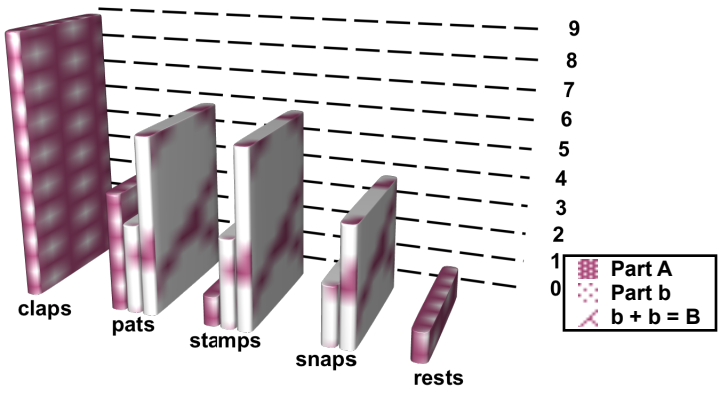
Activity steps for learning about ratios using a body percussion piece:

1. Define **Ratio**: *"The relation between two quantities expressed as the quotient of one divided by the other: The ratio of 7 to 4 is written 7:4 or 7/4.*"

2. **Body percussion piece:** Teach the first part by modeling and echoes.

3. **Phrases:** How many parts (phrases) are in the piece? How many parts do you know so far? (Three out of four, or ¾). Record part-to-whole ratios in fractions.

4. **Beats:** Diagram or chart the form of the piece measured by time (beats).How many claps, pats, stamps, snaps and rests are in each section? In the entire piece? Create an algebraic formula: 3 (A) + 2 (b+b) = X



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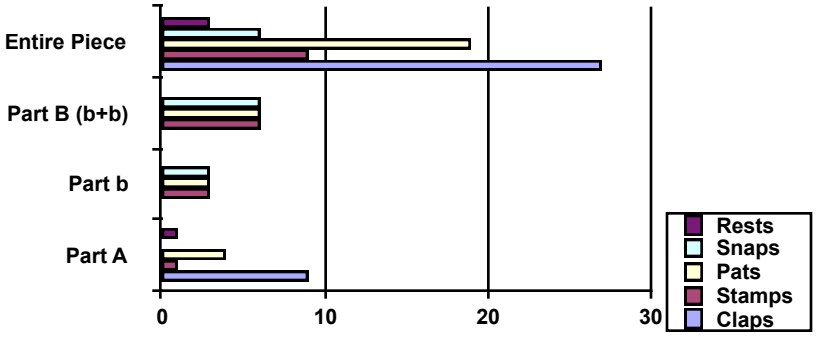
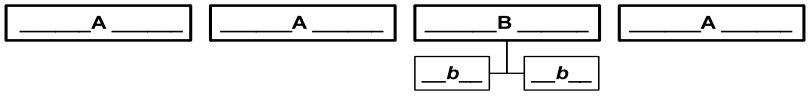


5. **Musical Terminology**: Divide class into groups to perform. Decide which group performs which part. Create a performance assigning different musical values (loud/soft and high/low) to various parts of the piece, based on the structure. Use musical terms and abbreviations such as: *forte, piano, mezzo forte, mezzo piano, crescendo, diminuendo, largo, andante, allegro, vivace.*

6. **Form**: Chart form of piece (A A B A). Use musical indications such as: *Da Capo, repeat, tutti, solo.* Make artistic decisions about dynamics, tempo, form and orchestration. Perform several different ways. Compare each version.



7. **Rhythmic Notation**: Identify and notate quarter, eighth and sixteenth notes. Introduce rests and accents. Discuss syncopation. Find each of these in the piece.

8. **Reflection questions for students:** What is the form of this piece? What is the difference between body percussion and note value? Explain how to measure a part of the whole. Where do you find ratios in everyday life?

Possible assessment tools:

°Assess performance of body percussion piece for fluency, and rhythmic accuracy.

°Diagram form and notate rhythms for a different piece of music.

°Create a new piece and perform with a partner. Notate the body percussion piece with your own symbols. Use repeat signs, accents, rests, 1st & 2nd endings.

Reflection on the activity

°How could you adapt this activity to other areas of the math curriculum?

°How does this relate to literacy?

°Are there parts of this piece that we could use for other math problems?

LEARNING ACTIVITY #3 - *Proportions*

Ohio Standards addressed in math, music and literacy:

Mathematics Standards (Grade 5):

- *Patterns, Functions and Algebra: representing patterns and relationships using tables, graphs and symbols, and using them to solve problems.*
- *Data Analysis and Probability: Organizing and interpreting results through data collection to answer questions, solve problems, show relationship and make predictions.*

Music Standards (Grade 5):

- *Creative Expression and Communication: Improvise melodies in a call-and-response setting.*
- *Analyzing and Responding: Identify dynamics, tempo, meter and tonality in various pieces of music aurally.*

Cleveland Literacy System Tie-In (Grade 5):

- *Phonemic Awareness, Word Recognition and Fluency*
- *Reading Applications: Analyze information found in maps, charts, tables, graphs and diagrams.*

The Process:

Activity outcomes:

Students will:

1. Collect data to generate charts showing rhythmic and mathematical relationships.
2. Measure rhythms and notate rhythmic patterns.
3. Make musical and mathematical predictions based on previous experience.
4. Compose and perform a rhythm with specific mathematical parameters.

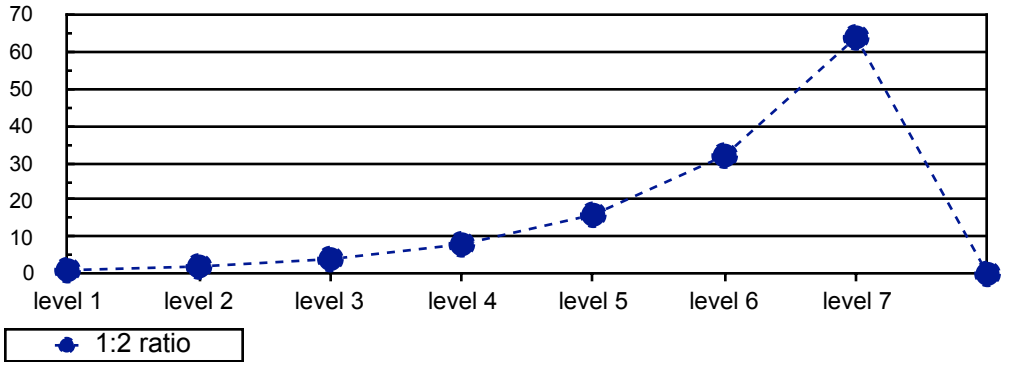
Activity steps for moving by proportion and analyzing a Swedish folk dance:

1. **Geometrical proportion:** Dance of the Proportions (8 8 4 4 2 2 2 2).
2. Define **Proportion**: "*a statement of equality between two ratios. Four quantities, a, b, c, d, are said to be in proportion if a/b = c/d*"
3. **Rhythm sequence:** quarter, quarter, eighth–eighth, quarter

   How many beats are in this rhythm? (4 beats in a measure). How many times is it repeated?
4. **Movement:** stamp stamp clap clap clap - Do 3 times, improvise 4th measure.
5. Define **Ostinato**: "*A short melody or pattern that is constantly repeated, usually in the same part at the same pitch*."

6. **Sing and dance**: "I have lost my little partner." How long is the song? Count measures? As you progress through the dance, notice the pattern of accumulation: 1 – 2 – 4 – 6 – 16 – 32.



7. **Note values:** Discuss above pattern and relate it to: 

8. **Reflection questions for students:** Describe the difference between incremental and proportional. What is an Ostinato? What is the relationship between the Swedish folk dance and the circle dance?

Possible assessment tools:

°Notate a different song using musical note values.

°Create a new ostinato and draw a chart showing which part of your ostinato uses which body percussion sound.

°Graph out which sound occurs on which beat.

Reflection on the activity

°How does this activity relate to the circle dance we did in the beginning?

°What teaching strategies did I use in this activity?

°How does proportion relate to logic, analogy and simile?

°How important is good listening and teamwork to solving these rhythm problems?

FINAL PROJECT and CONCLUSION

Create a performance using layered ostinato.

- Create your own 8-beat body percussion rhythm. Notate using musical note values.
- Analyze your body percussion ostinato. Draw pie graph showing how many stamps, claps, snaps, and pats make up your ostinato.
- Give your notation to another person so they can perform it by speaking, clapping, stepping, and/or body percussion
- Perform all ostinato making decisions about number of repetitions, how many will be layered, how loud/soft, how slow/fast. Create larger forms out of smaller structures.

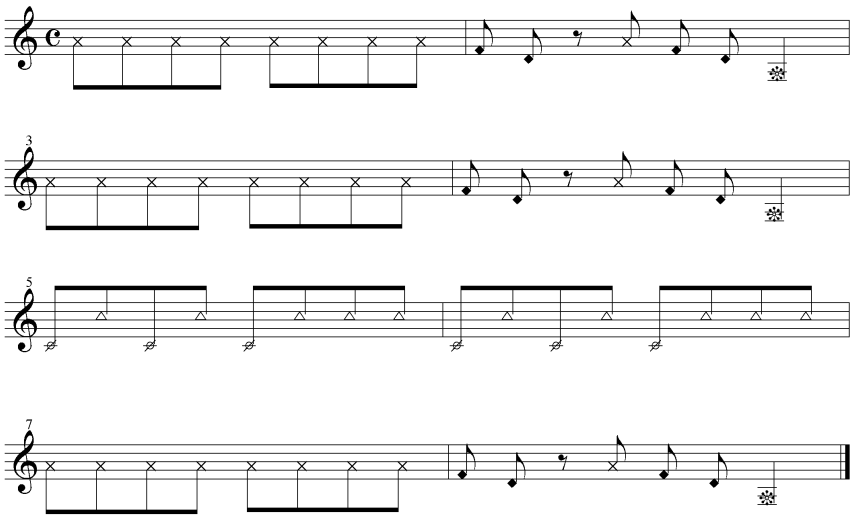
Discussion

- Did you feel comfortable with the process of counting, measuring, and working together to create the final performance?
- How could you implement these ideas in your curriculum? How might you apply these skills to your math or language arts classes?
- How can these activities develop listening skills and improve self-management?
- What other songs do you know that could work with these math concepts? How could you find music that works with these activities?
- Suggestions for converting or transmuting activities:
    - Instead of the Swedish Folk Dance use a rhythm tag where each person "tags" two others.
    - Instead of "How Time Flies" use "Ah Poor Bird."
    - Instead of the Body Percussion piece, use a chant such as "I saw Esau."
    - Simultaneous performance of the Body Percussion piece (32 beats) and the Dance of the Proportions (32 beats).

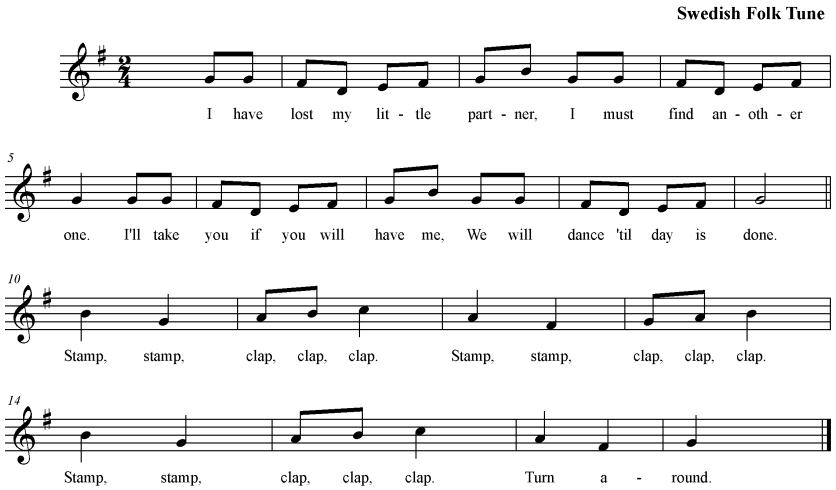
MUSIC USED IN THE WORKSHOP

How Time Flies

Body Percussion Piece



I Have Lost My Little Partner



SUPPLEMENTARY MATERIALS

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Internet lessons combining music and math:

"Music Math: Create a Clapping Symphony (Plus Fraction Math)"

http://www.educationworld.com/a_lesson/03/lp303-05.shtml

"A Stomping Good Time: Using Found Instruments and Invented Rhythms to Make Beautiful Music" http://www.educationworld.com/a_lesson/03/lp303-02.shtml

"Rhythm, Math, Rhythm"

https://artsedge.kennedy-center.org/students/features/connections/math-and-music

Ideas for combining music and math:
https://www.liveabout.com/music-education-lesson-plans-p4-2456493

General information on elemental music theory: https://www.musictheory.net/

Chart of Musical Note Values

Notes:

Whole Note (1)	**Whole Rest (1)**
Half Note (1/2)	**Half Rest (1/2)**
Quarter Note (1/4)	**Quarter Rest (1/4)**
Eighth Note (1/8)	**Eighth Rest (1/8)**
Sixteenth Note (1/16)	**Sixteenth Rest (1/16)**

Sample Music & Math Worksheet

Directions:

Each whole note below represents 1 whole.
Each half note represents the fraction 1/2.
Each quarter note represents the fraction 1/4.
Each eighth note represents the fraction 1/8.
Each sixteenth note represents the fraction 1/16.
Add or subtract the fractions represented below by each group of notes. Write your answers as fractions. The first one is done for you.

𝅗𝅥 + ♪ = _____ (1/2 + 1/8 = 5/8)

𝅗𝅥 - 𝅘𝅥𝅯 = _____

♪ + ♪ = _____

𝅘𝅥𝅯 + 𝅘𝅥𝅯 + 𝅘𝅥𝅯 = _____

𝅝 - 𝅗𝅥 = _____

𝅗𝅥 + ♪ = _____

𝅝 + 𝅗𝅥 + 𝅗𝅥 = _____

♪ + 𝅘𝅥𝅯 = _____

♪ - 𝅘𝅥𝅯 = _____

♪ + ♪ + 𝅘𝅥𝅯 + 𝅘𝅥𝅯 = _____

Contact Information and Biography

Terry Boyarsky, pianist, is a movement specialist, singer and ethnomusicologist who believes that every person is musical. Her search for musical collaboration has led her into chamber music, choral singing, folk dance, coaching, accompanying dance and creating ceremony. Terry has collaborated with singers and dancers across the United States, Canada, France, Switzerland, Venezuela.

Terry holds a BA in experimental psychology from Reed College, a BM in Eurhythmics from Cleveland Institute of Music, and an MA in Ethnomusicology from Kent State University. She has further training from the Dalcroze School in New York and is certified in Orff-Schulwerk (II).

Terry has taught and created events for institutions such as the **Dalcroze Society of America**, American Orff-Schulwerk Society, Society for Ethnomusicology, the Cleveland Institute of Music, University of Hawaii, Rowe Center in Massachusetts, Kasetsat University in Bangkok, Thailand, Los Hipocampitos in Carrizal, Venezuela, Bard College Conservatory of Music, and the Atlanta Symphony Orchestra.

Terry was a Teaching Artist for almost two decades with the Center for Arts-Inspired Learning. She was in the first group of artists selected for the **Ohio's Kennedy Center Collaborative**, and is a Teaching Artist for **Ohio Arts Council**. She presents professional development workshops on arts integration and Dalcroze Eurhythmics nationally. She has published articles in the Orff Echo, the American Dalcroze Journal, Seminars in Neurology, and Teaching Artist Journal.

Among her more creative projects was a collaboration with a Taipei puppeteer and a Cleveland dancer, to create "Young Dreams - Life in 3 Parts," an intimate work of puppetry, dance, and improvised music, sponsored by Cleveland Foundation Creative Fusion Program. She is certified by the National Center for Creative Aging and participated in the OAC's "Artful Aging" Artist Residency.

Currently Terry sings with the **Cleveland Orchestra Blossom Festival Chorus** and **Choral Arts Cleveland**. She teaches a course in **Russian Song** for Case Western Reserve University. She has been performing and teaching internationally with Siberian balalaika virtuoso Oleg Kruglyakov as "**Russian Duo**" since 2007. In July 2017, Russian Duo performed in Kirov, Russia.

terryboyarsky.blog 216-932-5825 tboyarsky@ameritech.net