Dear Teachers,

The musicians and staff of the Fort Worth Symphony are eager to share our love of symphonic music with you and your students this school year! We’ll hear how the music adds up as we explore tempo, meter, note values and time signatures and their relationship to mathematics.

The program includes the following works:

- Mozart: Overture to Marriage of Figaro
- Beethoven: Funeral March from Symphony No. 3
- Brahms: Hungarian Dance No. 5
- Pachelbel: Canon in D
- Copland: Hoedown from Rodeo
- Tchaikovsky: Waltz of the Flowers
- Bizet: The Toreador Song from Carmen Suite No. 2
- Beethoven: Symphony No. 6, V. Allegretto
- Beethoven: Symphony No. 3, Scherzo

The suggested activities in the study guide bring together the disciplines of math and fine arts and meet multiple TEKS objectives, as listed on page 3.

Please contact me with any questions. We look forward to performing for you and your students!

Warm regards,

Lindsey Stortz Branch
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Fort Worth Symphony Orchestra Association
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LBranch@fwsymphony.org

These materials are for educational use only in connection with the Adventures in Music program of the Fort Worth Symphony Orchestra.
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Chapter 111, Math:

111.5b1, 111.6b1, 111.7b1 – Mathematical process standards. Student uses mathematical processes to acquire and demonstrate mathematical understanding.

111.5b3, 111.6b3 – Number and operations. Student applies mathematical process standards to represent and explain fractional units.

111.5b7 – Geometry and measurement. Student applies mathematical process standards to select appropriate units, strategies, and tools to solve problems involving customary and metric measurement.

111.5b8 – Data analysis. Student applies mathematical process standards to solve problems by collecting, organizing, displaying, and interpreting data.

111.22b2, 111.23b2 – Number, operation, and quantitative reasoning. Student adds, subtracts, multiplies, and divides to solve problems and justify solutions.

111.22b10 – Probability and statistics. Student uses statistical representation to analyze data.

111.23b11 – Probability and statistics. Student understands that the way a set of data is displayed influences its interpretation.

111.24b12 – Probability and statistics. Student uses statistical procedures to describe data.

111.22b11, 111.23b13, 111.24b14 – Underlying processes and mathematical tools. Student applies mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school.

Chapter 117, Music:

115b.1, 118b.1, 208c.1 – Foundations: Music literacy. Student describes and analyzes musical sound.

115b.5, 118b.5, 208c.4 – Historical and cultural relevance. Student relates music to history, culture, and the world.

115b.6, 118b.6, 208c.5 – Critical evaluation and response. Student responds to and evaluates music and musical performance.
Fractions in Music

- Review students prior knowledge of fractions using real objects such as money (show a dollar, two half-dollars, and four quarters), pizza (cut a representational pizza into half and then quarters), and time (use a clock to demonstrate the hour, half hour, and quarter hour). Practice writing fractional notation for each of the examples.

- Introduce musical vocabulary and visual representation of a whole note, a half note, and a quarter note.

- Next, introduce a measure using 4/4 time. Use paper music notes (see following page) to see the relationship of whole note=4 beats, half note=2 beats, quarter note=1 beat. Have students stand and clap and count 4 quarter notes, while looking at a measure with 4 quarter notes. Count out loud (1 2 3 4) with each clap. Repeat with measure showing 2 half notes and count out loud (1 2 3 4). Repeat with measure showing 1 whole note and count out loud (1 2 3 4).

- Divide the class into two groups. One group will clap and count quarter notes while the other group claps and counts half notes. Begin with the quarter note group first to establish the rhythm.

- Next, divide the class into three groups. One group will clap and count quarter notes; one group will clap and count half notes; and the third group will clap and count whole notes. Switch groups so all students have a chance to participate clapping each note value.

- Using paper representations of the note values learned (whole, half, and quarter), have students work in pairs to create their own compositions, writing at least three measures of 4/4 time.

- Ask students to clap or use simple percussion instruments to perform their compositions. Combine all of the groups’ compositions into one class musical work and perform together!
Explain to students that music notes follow the same rules as fractions. (See Fraction of a Note handout.) In music, every measure must equal 1. Ask the students questions such as:

- How many sixteenths make up 1 quarter note?
- How many quarter notes make up 1 whole note?
- How many sixteenth notes are in two eighth notes?
- How long does a quarter note last?
- How long does an eighth note last?
- How long does a sixteenth note last?

On the board, notate a 4-beat “call” rhythm. Then add the value under the note (ex. 1/2, 1/4, 1/8, 1/16).

Have students either color in a pie chart or bar manipulative, or use the pie chart cutouts, to visually explain your “call” rhythm. See below for an example. Note: when notes are slurred together, only the first note is articulated.

Ask students to work in collaborative teams to create a “response” to your “call”. They may notate it however they wish (notes, pie chart, bars) but the answer must equal 1. Each team will then clap their “response” to your “call”. As a class, determine if the responses equal 1.
Fraction of a Note
Rhythms Worksheet

Fill in the blanks as shown below, then check if fractions add up to 1.

Example:

\[ \frac{1}{4} + \frac{1}{4} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} = 1 \]

1) 
\[ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ ]
\[ \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + 1 \]
Add them up =

2) 
\[ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ ]
\[ \frac{1}{16} + \frac{1}{16} + \frac{1}{16} + \frac{1}{16} + \frac{1}{8} + 1 \]
Add them up =

3) 
\[ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ ]
\[ \frac{1}{4} + \frac{3}{16} + 1 \]
Add them up =
Students should understand that just as music notes follow the same rule as fractions, note values can also be expressed in decimals and percent of the entire measure.

Have students complete the first part of the “Musical Fractions, Decimals, and Percents” handout: draw each note listed, how many beats are counted, then the fraction, decimal, and percent.

Using the two measures from the previous lesson (your “call” and their “response”), each team will then write out all of the notes. Beneath each note, students will list what fraction of the measure each note value represents. Students should then write the decimal and then the percent below that. See below for an example.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
<th>Percent</th>
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<tbody>
<tr>
<td>1/2</td>
<td>.5</td>
<td>50%</td>
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</table>
# Musical Fractions, Decimals, and Percents

Write out your two measures here. Underneath each note write out the fraction, decimal, and percent of each note you've written.

<table>
<thead>
<tr>
<th>Note Name</th>
<th>Picture</th>
<th>How many beats?</th>
<th>Fraction</th>
<th>Decimal</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Whole Note</td>
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<td>Half Note</td>
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<td>Quarter Note</td>
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<td>Eighth Note</td>
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<td>Sixteenth Note</td>
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The Effect of Tempo on Pulse Rate

Suggested Repertoire:
Overture to The Marriage of Figaro, by W.A. Mozart
Funeral March (2nd mvt.) from Symphony No. 3 "Eroica", by Ludwig van Beethoven
Hungarian Dance No. 5, by Johannes Brahms

- Have students practice taking their pulse before the lesson.

- Begin the lesson by listening to the Overture to The Marriage of Figaro (fast), then the opening few minutes of the Funeral March from the Eroica Symphony (slow), and finally the Hungarian Dance No. 5 (mixed tempos). After each selection, students should take their pulse and record the data on an Excel spreadsheet.

- Have students use the data in their spreadsheets to create a bar graph showing their pulse rate for each piece.

- Combine individual student data to find a class average pulse for each piece. Students should then create a new spreadsheet with this data and create a double bar graph comparing their pulse with the class average for each piece.

- After the lesson, have a class discussion about your observations and the students' reaction to the musical selections. What was the effect of tempo on their pulse rates?
Musical Polygons

Suggested Repertoire:
Hoe Down from Rodeo, by Aaron Copland
Waltz of the Flowers from The Nutcracker, by P.I. Tchaikovsky
Toreador Song from Carmen Suite No. 2, by Georges Bizet
Mars from The Planets, by Gustav Holst*
2nd mvt. From Symphony No. 6 “Pastoral”, by Ludwig van Beethoven

* Not featured on concert program.

- Review students knowledge of polygons and the formulas for determining the area of a polygon.
- Have students tap their own pulse lightly on their desk.
- Next, play various selections of music with different time signatures and have students lightly tap the pulse. For each selection, ask the students: what does it feel best to count to as the music plays?
- Ask students to relate the count of the pulse to a geometric shape. 3 beats relates to a triangle, 4 beats to a rectangle or square, etc.
- Have students complete the “Musical Polygons” handout, recording the name of the musical selection, the pulse, and a geometric shape it relates to.
- Ask students to work in collaborative groups to create a poster that contains the name of their musical selection, the reason for their choice, the “pulse” of their selection, a cutout of the geometric shape which relates to the pulse, the formula used to find the area of their shape, and an example of the formula on their poster.
<table>
<thead>
<tr>
<th>Song</th>
<th>Composer</th>
<th>&quot;It feel best to count to...&quot;</th>
<th>Polygon (name and picture)</th>
<th>Area formula</th>
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The string family is the largest section of the orchestra. String instruments are all made of wood. The bodies of the string instruments are hollow inside to allow sound to vibrate within them. The strings on the instrument are most often made of nylon and steel, and are played by drawing a bow across them. Sometimes string players use their fingers to pluck the strings.

The **VIOLIN** is the smallest of the string instruments and can play the highest notes. You play the violin by resting it between your chin and left shoulder. Then you press down on the strings with your left hand to change the pitch, while your right hand moves the bow or plucks the strings.

The **VIOLA** is slightly larger than the violin and plays lower notes. The strings on a viola are also thicker. You play the viola the same way you do the violin.

The **CELLO** is much larger than the violin and the viola. You play it sitting down with the body of the cello between your knees and the neck of the instrument on your left shoulder. The body of the cello rests on the ground and is supported by a metal peg.

The **DOUBLE BASS** is the largest string instrument and plays the lowest notes. This instrument is so large that you have to stand up or sit on a tall stool to play it. Like the cello, the body of the instrument stands on the ground and is supported by a metal peg.
WOODWINDS

Woodwind instruments produce sound when players blow air into them. All of these instruments were originally made out of wood, which is why they are called woodwinds! Today, they are made of wood, metal, plastic or some combination.

The FLUTE is made of metals such as silver, gold, or platinum. You play the flute by holding it sideways with both hands and blowing across a hole in the mouthpiece. You change notes by pressing down on round, metal buttons called keys.

The OBOE makes sound when the player blows air through a mouthpiece containing two cut pieces of bamboo that have been tied together called a double reed. You play the oboe by holding it upright and pressing down on the keys to change the pitch. The first oboist is also responsible for tuning the whole orchestra before each concert.

The CLARINET looks a lot like the oboe, except for the mouthpiece, which uses a single reed. You play the clarinet as you do an oboe, by holding it upright, blowing through the reed, and using your fingers to press the keys and change the pitch.

The BASSOON is the largest of the woodwind instruments. Like the oboe, the bassoon uses a double reed. You play the bassoon by holding it upright and blowing through the double reed. The air travels down a long pipe, then makes a U-turn, and goes out the top.
Brass instruments got their name because they are made of brass! This family of instruments plays louder than any other in the orchestra. Brass instruments are long tubes that are bent into different shapes and widen and flare out at the end.

The **Trumpet** is the smallest brass instrument and can play the highest notes of all the brass instruments. You play the trumpet by holding it horizontally, buzzing your lips into the mouthpiece, and pressing down the valves to change the pitch.

The **Horn** is a very long tube that is twisted and curled into an instrument about one foot wide. If you untwisted the tube, it would be 18 feet long! You play the horn by holding it with the bell curving downward and buzzing into the mouthpiece. Your left hand plays three valves. You can change the type of sound by the way you place your right hand in the bell.

The **Trombone** is the only brass instrument that does not use valves. Instead, the player moves a curved tube, called a *slide*, back and forth in order to change notes. You play the trombone by holding it horizontally, buzzing into the mouthpiece, and using your right hand to push or pull the slide.

The **Tuba** is the largest and lowest sounding instrument in the brass section. If you uncoiled it, it would be 35 feet long! You play the tuba sitting down with the instrument on your lap and the bell facing up. The you blow and buzz into the mouthpiece and use your hand to press down on the valves which changes the sound.
PERCUSSION

Percussion instruments include any instrument that makes a sound when it is hit, shaken, or scraped.

One of the most commonly used percussion instruments is the **TIMPANI**. They are also called kettledrums. Timpani are big copper pots with drumheads made of calfskin or plastic stretched over the top. The timpani are played by striking the covering with padded sticks called mallets. Timpani are tuned instruments, which means they can play different notes.

Other percussion instruments that are struck by a mallet or stick are the **SNARE DRUM, BASS DRUM, TRIANGLE, XYLOPHONE, GONG, and CHIMES**.

A few other percussion instruments are **CYMBALS, CASTANETS, MARACAS, and TAMBOURINE**.

The **PIANO** is also considered a percussion instrument. You make sound on the piano by pressing down on a key with your finger, which lifts a hammer inside the piano that then strikes a steel string.
BEFORE, DURING, AND AFTER THE CONCERT

BEFORE THE CONCERT:

- After reviewing the instruments of the orchestra, ask students to draw a picture of their favorite instrument.
- Ask students to draw a picture of an original, made-up instrument. It can be a new string, wind, brass, or percussion instrument. The only restriction is that it must be clear in the drawing how the instrument is to be played.
- Have students draw pictures to illustrate the different pieces of music from the program.
- Practice special audience member skills. Ask students to practice maintaining complete silence for one minute. Before the minute of silence begins, tell students they will be listening for any sound they hear—sounds might include birds, kids laughing, a car passing by, or the ticking of the clock. After the minute of silence is over, ask students to draw a picture of what they heard.

DURING THE CONCERT:

- ALWAYS remain quiet during a performance. It’s impolite to talk while the music is being performed.
- BE attentive and give the performers your attention.
- Be CONSIDERATE of others.
- DO not leave early, please.
- ENTER and EXIT in a quiet and organized fashion.
- Expect a FANTASTIC performance!
- GIVE applause when the conductor enters and in between pieces. Whistling, yelling, or screaming are not appropriate.
- HAVE a great time!

AFTER THE CONCERT:

- Have your students write a letter to the conductor and musicians telling them what they thought of the concert! (Letters may be sent to: Fort Worth Symphony Education, 330 E. 4th Street, Suite 200, Fort Worth, TX 76102.)
- As a class project, create a poster describing the experience of attending a symphony performance. Have each student contribute their own adjective or memory of the performance.