DAVE LAVIN & CAOLAN BURKE-PRIOR	FRACTIONAL TIME KEEPING	SCTC 4385
Grade: 2nd-4th	**Topics:** Music Theory Fractions	**Lesson #:** 1-2 day lesson

Description:

Mathematics and music are often looked at as disparate topics with little to no direct relation; supposedly one field uses just half of the brain to apply logic and analysis, and the other uses the opposite half purely for creative endeavors that pursue beauty. The truth of the matter, however, is that mathematical concepts, particularly fractions, are deeply ingrained into the theory of music, and combining the two subjects in the classroom from an early age can result in a better understanding of both.

Leading Question:

How can we apply fractions to music in a way that helps give them context and importance as well as exercise students' creative abilities?

Students Will Be Able To:

- Recognize the fractional value of various music notes
- Find equivalent fractions
- Add fractions with the same or different denominators
- Write rhythms that fit certain time signatures

Students Will Understand:

Throughout the course of this unit, students will learn the fractional values of several notes (e.g. ⅛, ¼, ½) as well as the combined values counting the number of beats in a measure. Furthermore, students will come to understand how time signatures are used to determine the number of beats in a measure and how that affects the rhythm of the music.

Key Definitions & Concepts:

- Beat: The most basic rhythmic unit, the pulse underlying most western music
- Quarter Note: A musical utterance that lasts one beat, the most commonly used note
- Whole Note: A single tone which lasts for as long as 4 quarter notes, the largest in common use
- Rest: A time in which no notes are played, a pause which lasts some number of beats
- Measure (or Bar): A segment of time that corresponds with a certain number and type of beats
- Time Signature: Specifies how many beats are in a given measure, most common one in western music is 4/4
- Fraction: A numerical quantity expressed as a "part" over a "whole" (numerator/denominator)

Standards:

CCSS.MATH.CONTENT.3.NF.A.3: Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size.

- Students will be actively comparing different fractional values and find equivalencies based on audial cues and represented by different notes.

CCSS.MATH.CONTENT.3.NF.A.3.A: Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line.

- This standard will be met as students learn how different quantities of different notes can take up the same amount of time in a measure. For example, two quarter notes take up the same amount of time as one half notes.

CCSS.MATH.CONTENT.3.NF.A.3.B: Recognize and generate simple equivalent fractions, e.g., 1/2 = 2/4, 4/6 = 2/3. Explain why the fractions are equivalent, e.g., by using a visual fraction model.

- When students are required to do the fractional math necessary to see if their rhythms fit into a measure, they will need to scale fractions up or down to do so. The process of doing this will address this particular standard.

BACKGROUND INFORMATION:

Prior Knowledge:

- Basic knowledge of coin values
- Basic arithmetic skills
- Some understanding of rhythm
- Familiarity with popular rhythms

Possible Preconceptions/Misconceptions:

- Quarter/Eighth/whatever smallest note presented is the shortest note possible
  - Notes, like numbers, can theoretically be divided indefinitely. However, historically, the shortest note ever
- Common time signatures and western tendencies are fixed and superior to other systems of organization

LESSON PLAN– 5E(+) MODEL:

Engage:

Engage students with an initial activity where they use rhythm sticks to follow the rhythmic pattern of popular songs. The iconic introduction to Queen's "We will Rock You" is likely a good starting point, but other well known songs that the students recognize are encouraged. Consider asking your students what music they like and choosing from their answers.

Explore:

Students will use sticks to create various different notes in different ways (hitting sticks on desk/floor simultaneously, striking independently, striking the sticks together) and associate the different temporal audio cues with the notes written on the board. As the students create more and more complex rhythms, the names of the notes and rests will be given and students will be given the opportunity to create their own rhythms with either the sticks or whatever instruments are present in the class. Students will be asked afterward to write the rhythmic configuration in terms of both notes and fractions of beats/measures.

Explain:

Using a rhythm the students know and have successfully reproduced, whether it be by sticks or proper instruments, introduce the students to written notes (e.g. quarter and half notes for "We Will Rock You"). Show students the visual representations of the notes before naming them so that they can associate them with amounts of time before potentially getting bogged down

by the mathematical vocabulary. Gradually introduce names for each of the notes, checking for understanding and using a comparison to coins (quarters) or a similar analogy to help students understand the concept of parts of a whole. This is a good time to touch on equivalent fractions as well, given that four quarter notes take up as much time as a whole note just like four quarters equal a dollar. The key element for students to learn from this mathematically is that in order to maintain a fraction, they must perform the same multiplication on the numerator as on the denominator.

As students get more comfortable with the different notes and rests, introduce to the students the terms Measure (or Bar) and Time Signature, ideally with a drawing or similar image. A measure is an increment of a musical piece that has a predetermined number of beats, and a time signature is what determines that number. Students will learn that a time signature is composed of a top and bottom number which correspond to a number of beats (numerator) and the length of each beat with respect to a whole note (denominator).

To help students with these relatively abstract concepts, attached are a few options for worksheets that can be given to them to give them practice with beats, measures, and time signatures.

Elaborate:

Over the course of the lesson as students learn the (fractional) names of notes and rests, numerical representations should accompany them so that students become comfortable with such notation. Students will be asked to expand on what they have learned by composing their own short rhythms and writing out the musical notation of them. This can take anywhere from a few minutes to a few class periods depending on how engaged/creative the students are, and students can either do this in groups or individually. Once students have a rhythm written out, they will be asked to write the fractional notation of the notes and perform fraction addition to find the total number of whole notes in their rhythm. Students can also be asked to find a common time signature for their rhythm and use their mathematical skills to verify that the measure divisions are correct. The level of detail asked of students here can vary greatly depending on grade and ability.

Evaluate:

After students have had some time to play around with some original rhythms they will have the opportunity to present them to the rest of their class. Students will be asked to show their work having found through fractional addition the number of beats and whole notes (and verifying time signatures if applicable). By presenting their own musical compositions as well as demonstrating what they have learned about fractions and their applications will embolden students in their creative as well as analytical endeavors.

Enrichment:

There are many ways this lesson can easily be scaled up for older, more advanced students in middle or high school, or simply stretched into a longer unit. The lesson can be expanded to include more complex musical concepts such as dotted notes, which carry one and a half (or 1 + ½ + ¼ in the case of double dots, etc.), tied notes which conjoin otherwise separate notes, or further delving into smaller and smaller notes (as marked with more and more flags or bars).

The lesson can also be expanded with instruction based on *pitch*, which is the perceived tone of a sound determined by its frequency. Students can explore this phenomenon with a nearly

any instrument, including makeshift ones such as crystal glasses filled with different volumes of water or plucking stretched rubber bands. This can be very easily demonstrated using string or xylophonic instruments. Students will find that pitch is determined by the wavelength of the sound produced by an instrument which is a result of the physical properties of the instrument.

Students' attention should also be brought to the fact that doubling a tone's frequency results in a very similar sounding note, one that is given the same name as the original however lies on a different octave. Octaves are a very powerful concept for students as they demonstrate the mathematics innate in music and how we hear it. A fun fact for students is that there is no agreed upon reason for this phenomenon, among scientists nor musicians. Challenge them to seek their own explanations.

Adding Fractions Worksheet Name_____

Using the method of finding a common denominator, solve the following equations:

1) $\frac{1}{4} + \frac{1}{4} =$ ___

2) $\frac{1}{2} + \frac{1}{4} =$ ___

3) $\frac{1}{3} + \frac{1}{3} =$ ___

4) $\frac{2}{4} + \frac{1}{8} =$ ___

5) $\frac{1}{2} + 1 =$ ___

6) $\frac{3}{4} + \frac{1}{4} =$ ___

7) $\frac{1}{8} + \frac{2}{8} =$ ___

8) $\frac{2}{2} + \frac{1}{4} =$ ___

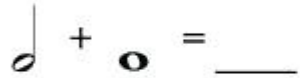
9) $\frac{3}{8} + \frac{1}{4} =$ ___

10) $1 + \frac{1}{8} =$ ___

Music Math - Level 1

(Add the beats)

Notes

1.  = ____
2.  = ____
3.  = ____
4.  = ____
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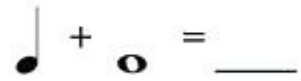
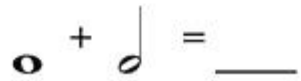
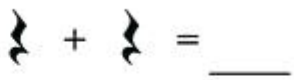
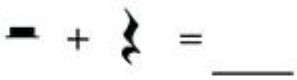
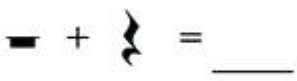
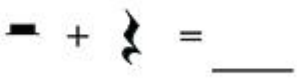
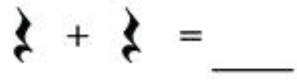
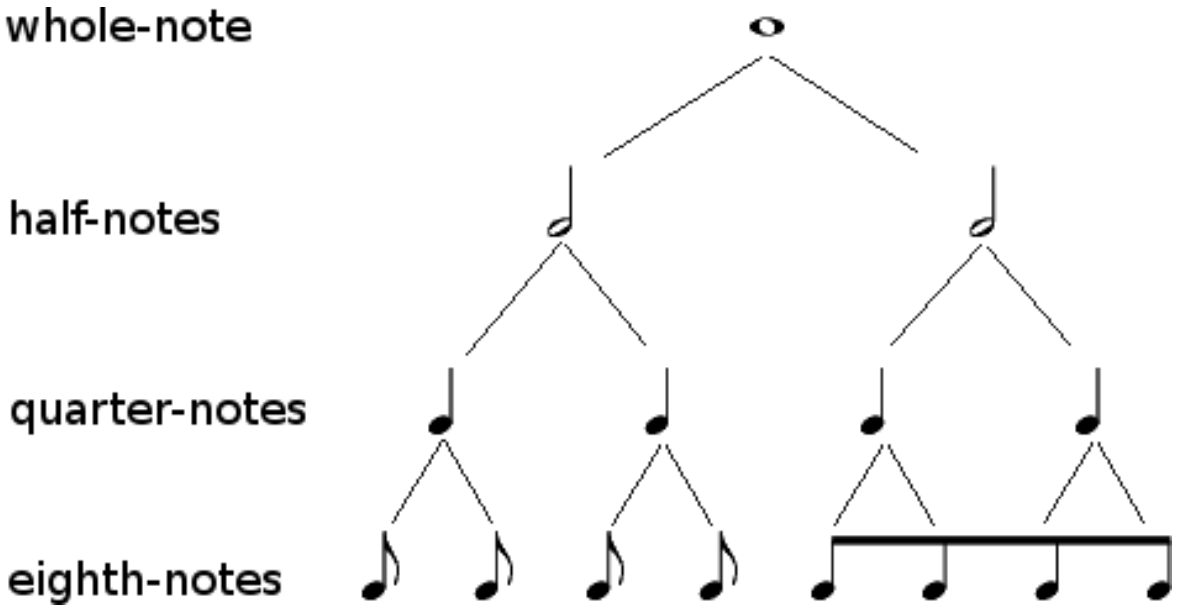
6.  = ____
7.  = ____
8.  = ____
9.  = ____
10.  = ____

Rests

11.  = ____
12.  = ____
13.  = ____
14.  = ____
15.  = ____
16.  = ____
17.  = ____
18.  = ____
19.  = ____
20.  = ____

StepWise
Publications


whole-note
half-notes
quarter-notes
eighth-notes