A Fractional Song

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Introduction/Rationale

The Common Core State Standards for Mathematics call for 5th grade students to use fractions with understanding. Students are expected to add, multiply and divide fractions in fifth grade and understand the concepts behind the computation. Students are expected to learn the basic concepts of fractions and fractional equivalency in third and fourth grades now. These standards used to be taught in 5th grade in my school district before the Common Core. It is now expected that students will have fluent knowledge of these concepts by fifth grade. However this is not the case, at least not yet, in my experience. Our old state standards and the recommended mathematics curriculum in my school district called for a spiraling approach in mathematics. It was theorized that many students would not master standards the first time they were exposed to them. Some students, it was reasoned would not be developmentally ready to fully understand the standard, or they might need multiple exposures to master the standard. In this approach, students were not expected to master all concepts in a grade. In addition, since there were so many concepts to cover in the grade, teachers could not spend a lot of time with each standard in a given school year. Concepts were spiraled back in again throughout the elementary school years. So, if students did not quite understand fraction equivalency in fourth grade, there was no pressure, because they had another chance in fifth grade. With the Common Core State Standards, there is no spiraling. The students are expected to master the material in the grade in which the material is presented. In addition, due to the design of the standards, each grade level depends on mastery from the previous yearf because the next year's standards build upon the previous year's standards. So, there is a two-pronged problem at present. Fractional concepts that were previously introduced in fifth grade are now introduced in third and fourth grade, and the students are expected to master this subject matter in third and fourth grades.

When I tested my students at the beginning of fifth grade this year to see what they knew about fractions, the results were discouraging. They did not know much beyond the very basics of the definition of a fraction. In addition, the mistakes they made showed that they held to previous misconceptions of fractions. For example, when presented with two fractions to add, they added both the numerators and the denominators. This demonstrated conclusively that the majority of my students had not mastered the subject matter relating to fractions from third and fourth grades.

I consequently have to reteach the concepts my students should have learned in third and fourth grades. I do not have the time to do this adequately as well as teach my students the fifth grade standards since now the Common Core has added fractional concepts that used to be taught in 6th grade to 5th grade. One of the motivating concepts behind the Common Core State Standards in Mathematics is the idea that mathematics teachers should teach less at each grade level, but teach what they do teach at a deeper level to ensure mastery. Researchers found that countries with more successful math scores follow this approach. It is near impossible to allot more time to concepts if I have to reteach the material that should have been mastered before 5th grade. In addition, my students typically forget or do not retain the fractional concepts that I teach them in fifth grade, unless I continuously review the concepts throughout the year. In addition, the sixth grade teachers tell us that the students have significant gaps in their fractional understanding when they reach sixth grade.

I taught fourth grade for many years, and I know what I taught them in fourth grade, only to realize that the same students in fifth grade did not retain what they were taught in fourth grade. I believe and sincerely hope that by integrating the music into my fractional teaching, the students will retain the information better than they have in the past. Additionally I think they will enjoy learning about fractions infused with music which they all enjoy.

My students currently do not see the relevancy of learning about fractions. While I bring in examples of using fractions for measuring, either using linear measurements or those with volume, such as cooking, my students do not see themselves participating in activities that use these measurements. I need to give them another example where fractions are used where they can see relevancy. This is where I see that the musical integration can fill this void. While most of my students do not measure much or cook, they all listen to music! Many of them participate in creating music with a musical instrument as well. If I can integrate the two areas, I believe my students will notice the relevancy between the two. My students will be more motivated to learn about fractions!

Demographics

I teach 5th grade in Richey Elementary School, a diverse, Title I school, (62% low income), just outside of the city of Wilmington, Delaware. While technically the school is considered a suburban school, it is a mere three miles from the center of Wilmington, surrounded by strip shopping centers, highways, and I-95. We have students from a range of social economic backgrounds, from middle class to those in extreme poverty.

While the most recent standardized reading test scores have rivaled some of the more affluent suburban schools in the state, the math test scores have lagged behind with little growth. In fact, several of our goals in our most recent building success plan call for increasing math standardized test scores, particularly for economically disadvantaged

students. Although our school planned to provide an after school math program for students with low math test scores this year, the program has been sidelined due to lack of teacher participation. While many parents have shown interest in the program, many students with low math test scores, see math as a subject they want to avoid. They do not want to spend more time after school doing the same activities they did in the regular school day.

All grades in my school are predominantly self-contained classrooms. Reading, math, writing, science, and social studies are taught by the same teacher with heterogeneous groupings. This allows some flexibility with some opportunities to integrate subjects. In addition, my school is using the inclusion model for most of the special education students. Currently, I am providing the special education support as well as the regular education instruction for students in my classroom, so differentiation of all subject matter is necessary for all of my students to achieve success.

Many of my students participate in an extra music program, either the strings, band, or chorus programs. In addition, I have noticed how much my students enjoy music in their lives. They are very excited whenever I infuse music into their learning, even if it is just background music in the classroom. They would love to have more music however I am limited by inappropriate lyrics of many popular songs. Consequently a lot of the music I use has to be instrumental. But with or without lyrics, music is remains a huge motivator for them.

Arts Integration

What is arts integration? Is it helpful? Should I do it? Arts integration is a process of infusing arts into the other academic areas such as reading, writing, math, science, or social studies. There are lots of ways to do it. Russell-Bowie presents three different models of arts integration, service connections, symmetric correlations, and syntegration.[1] "Service connections within subjects occur when concepts and outcomes are learned and reinforced in one subject by using material or resources from another subject with no specific outcomes from the servicing subject." An example of this type of integration would be a song that helps students remember multiplication facts. There is no consequential musical product from the integration. [2]"Symmetric correlations centre around common or shared resources, materials or ideas being used within two or more subjects to achieve authentic outcomes in both subjects." In this integration both subjects produce outcomes. For example, acting out a story would enhance both reading comprehension as well as drama. [3]"Synergy occurs when the sum of the whole is greater than the sum of the individual parts." In this concept, the integration would be accomplished by using common themes, ideas, or concepts to link the arts with various other subject areas. For example, a unit about rivers might include knowledge about rivers from Science or Social Studies, music such as *The Moldau*, a symphonic poem by

Smetena, as well as dance and artistic representations. Each discreet subject area would produce an authentic product as a result of the integration.

Not too long ago, educational experts promoted integration across subject themes in elementary school. A theme of apples might be integrated across reading, writing, mathematics, and social studies. In the past few years, though, subject integration has taken a back seat to results oriented, specific, explicit strategies. The standardized test scores are foremost on the trajectory. Administrators have responded with more and more pacing guides, and observations to make sure all teachers are following specific plans, schedules and teaching to the standards. While, not exactly forbidden, integration has been discouraged. Gone are the days when a teacher could keep a relaxed schedule, exploring a theme. Such challenges can make arts integration difficult as well. As teachers we need to back our creative ideas with the extensive research to our administrators. Arts integration is not a waste of precious time to prepare for the tests, it is time well spent that will enhance the subjects we are teaching. While the challenges exist to arts integration today, As Appel states, [4]"In da Vinci's time, the arts were an integral part of education, community life and reflection upon the human condition; they were inseparable from the sciences and other academic disciplines." I think we would all consider daVinci a successful product from his education, whereas today we see many deficits in the students we graduate. Perhaps we should take lessons from the past. According to Appel, [5]"The body of work on arts education…shows that the arts positively impact cross-curricular achievement and the teachers' abilities to use multiple modalities and intelligences…"

Jensen sums it up in his book, Music with the Brain when he says,

> [6]The evidence suggests that musical arts are central to learning. The systems they nourish (which include our integrated sensory, attentional, cognitive, emotional, and motor capacity processes) are in fact, the driving force behind all other learning. This doesn't mean that one can't learn without the arts, many have. But learning with the arts provides more opportunity to develop these multiple brain systems, none of which is easy to quantify due to the nature of the process.

As with most trends in education, good pedagogy recycles back, even if it is abandoned for a time. Arts integration will enhance our students' test scores as well as our students' lives.

As far as evidence supporting arts integration to improve the retention of information, Rinne states, [7]"…utilizing artistic activities for instruction in other content areas may be a particularly effective means of enhancing long term retention of content…" Specifically, Rinne mentions in his article that academic retention is enhanced when students are engaged in particular activities which often occur with arts integration. One activity Rinne mentions in his article is the [8]"enactment effect". [9]"The 'enactment effect' refers to the finding that physically acting out material leads to improved recall relative to simply reading or hearing material." When students combine actions with learning

material, retention of learning is improved. Another activity Rinne mentions is called, [10]"effort after meaning". This effort is referring to an unusual effort used to learn material may make the material much more memorable due to the increased amount of processing required to complete the activity. When teachers integrate the arts with content information, the activities will be more unusual than the more common classroom activities to learn content information. This unusual aspect of the activity can lead to improved retention according to Rinne. Finally, Rinne mentions activities that involve the emotions are likely to lead to improved retention of the academic material linked to the emotional response. Music naturally evokes emotional responses, so it can be inferred from Rinne's findings that such integration will tend to lead to improved retention of the academic material linked with it.

Music Integration

Music naturally incorporates math. Music includes time signatures that are measured in numbers. Notes have numerical values which vary with the time signature as well as pitch. Even pitch can be described in numeric intervals between two notes Rhythms are counted. By changing the notes used or the time signatures, the music is altered. This can be observed visually or experienced by listening. Musical octaves are a system of whole and half steps up an 8 note scale. In a major scale all the steps are whole steps except between the third and fourth notes and the seventh and eighth notes, no matter which key you are using. Minor scales have similar mathematical rules. Chords are formed with mathematical formulas for the number of steps between the notes. When these notes are played together they are harmonious to the human ear. When the mathematical "rules" of whole steps and half steps are not followed, we have dissonance which also helps express a feeling or emotion musically.

Benefits of music integration with math

According to several authors, music education enhances most of the qualities that are considered beneficial for mathematical understanding. For instance, Heimrich states, [11]"Complex math processes are more accessible to students who have studied music because the same parts of the brain used in processing math are strengthened through practice in music." I would say that fractional problems are complex math processes. So, by integrating music into my math curriculum, I am making the math more available to my students. In addition, Berti et al state, [12]"Musicians are better able to sustain mental control during memory and recall tasks, most likely as a result of their long-term musical training." Working memory is paramount for students to understand new math concepts so that they can internalize them and truly understand them. (This would answer some of my concerns of memory retention of new concepts. If my students could improve their memory retention of math, I would reteach less and I could cover more mathematics in any given year.) Baker asserts, "[13]Students who study music outperform their non-music peers in assessments of math, and the advantage that music provides increases over time.

These findings hold true regardless of socio-economic status and race/ ethnicity. "In addition, Neville et al states, [14]"Early childhood training in instrumental music improves these attention abilities, while continued music education throughout adolescence reinforces and strengthens them." These attention abilities are those that support and reinforce the ability to persevere with a math problem. Perseverance with a math problem is one of the Common Core Math Practices that are part of the standards in every grade, K-12." Working memory is paramount for students to understand new math concepts so that they can internalize them and truly understand them.

Don Campbell in his book, *Mozart and the Brain,* asserts that students benefit from listening to Mozart while testing. The Baroque music of Mozart follows even more stringent mathematical "rules" of intervals and patterns, which, some attest, programs the human brain for better thought patterns as well. There have been many research studies regarding this phenomenon, with mixed conclusions. However, the research overwhelmingly supports the connection of music with mathematics, even if you only believe half of the studies.

Music Theory

Music always has a rhythm or beat. Some sophisticated musical compositions have altering rhythms throughout. Most catchy tunes or melodies have recurring rhythms. Rhythm has a pattern of accented and less accented beats. Most people can sense rhythms with little effort. There is rhythm in speech and particularly in most poetry. Most people even walk with a rhythm. Melodies also have a tempo, which is the speed. You can have the same rhythm for a melody and play it either slower or faster. That is why many musical pieces have a notation for the tempo which you can set a metronome to. For example, you would still recognize the melody Row, Row, Row Your Boat whether I sing it with a slow tempo or a fast tempo. The rhythm of the notes is still the same.

Music is composed using a pattern of notes within a rhythm. Composed music is written with measures of notes. Simple melodies can use various numbers of measures when they are written. For example, Row, Row, Row Your Boat encompasses 16 measures. Each measure has the same value of beats, no matter how many measures there are. Beyond the measures, music is written with a time signature. The time signature establishes the rhythm and the length that each note is extended. While the time signature looks like a fraction, it is not. The top number defines how many beats per measure and the bottom number defines which note will be equivalent to one beat. Note names are expressed as whole notes, half notes, quarter notes, eighth notes and sixteenth notes. Musicians can also add a dot to a note which adds ½ of the note value or put in rests in a measure where you don't want a note so that the total of the measure adds up to the number of beats required in the time signature. Actually though, notes do not always act as a fractional amount. For instance, you cannot always write a measure of music with just one whole note, unless the time signature is 4/4. This is because the note values are

really proportional to each other. Technically, a quarter note has the value of 1 beat with the time signature of 4/4. This would be ¼ of the measure if you assume that each measure adds to equal a whole. Since I want to integrate fractions with the music, my students will be using a 4/4 time signature and we will be adding the fractional value of the notes, assuming that each measure is equal to a whole. They will also be required to use a variety of notes to add to the complexity of the fractions.

In order to compose a melody, you need to determine pitches for each note within the octaves available on a standard keyboard, determine the value of the note which works in combination with the time signature, and portion them into measures. The infinite possibilities give birth to infinite creative opportunities to create unique melodies. The exact same pitches could sound entirely different with a different rhythm. More complex musical composition would also consider elements such as meter, which is similar to meter in a poem- the steady recurring pattern in a measure of music. Composition would also include harmonies or other "voices" in the melody beyond the simple line of single notes. This is where you hear multiple notes played together, such as a chord.

Mathematics

Fractions with different denominators can be added or subtracted by finding equivalent fractions with the same, or common, denominator. The fractions are converted to the equivalent fractions which have the common denominator. Then the fractions can be added or subtracted. Understanding the concept of equivalency is at the heart of understanding how to add or subtract fractions with different denominators. Students who do not understand this concept tend to mistakenly add both the numerator and denominators of fractions without understanding their mistake. Other students make mistakes converting fractions to equivalent fractions by failing to understand the concept behind equivalent fractions, learning only algorithms which they confuse or distort.

Fractions can also be multiplied by whole numbers or other fractions. This process is fairly easy as the whole number can be converted into a fraction by making the whole number the numerator and giving it a denominator of 1, such as 4/1 = the whole number 4. Then numerators and denominators are multiplied. Multiplying a fraction by a whole number increases the amount of the fraction as adding it by the number multiplied does. For example, 3 times ¼ = 3/1 times ¼ which equals ¾. If I add ¼ + ¼ + ¼ = ¾. Both answers are identical and ¾ is a larger amount than ¼. Multiplying a fraction by a fraction will decrease its size. For instance ½ multiplied by ½ now becomes ¼ which is a smaller fraction than ½. In fact fraction multiplication can be interpreted as the fraction of the other fraction such as ½ of ½ for ½ multiplied by ½. It's easy to see with a model that ½ of ½ is indeed ¼. This is often misunderstood since the product of a positive whole number results in a larger number.

Objectives

My objectives are to meet the Common Core State Standards in Mathematics to add fractions with uncommon denominators and to multiply fractions. I will also incorporate Music Standards for composition at the 5th grade level in my unit. The Standards for Music Education for 5th grade state that students will compose short songs and instrumental pieces. In order to support the work of the composition that my students will complete, there will be lessons about rhythm, notes and time signatures, depending on the experience of my students. I know that the fifth grade students at my school have had experience in their general music class in composition, notation, and rhythm. I will expect my students to be able to use musical vocabulary such as rhythm, beat, time signature, all the notes and their values, as well as the value for dotted notes. My final objective is that my students will see another real life application of fractions within the musical compositions.

Strategies

While I usually use the Frayer Model for vocabulary in reading, math, science and social studies, I will rely more on opportunities for my students to show mastery of the vocabulary for this unit in their application of the terms. They will need direct, explicit instruction as well as graphic organizers, or reference charts they can refer to, in order to help them master the terms and use them correctly. I found a number of internet web sites that support and reinforce these concepts that I will utilize as well, incorporating technology. Vocabulary is mastered by using it correctly repeatedly.

In addition, I will utilize the strategy of working with partners for support and input. (The creative process is naturally enhanced when it is shared.) The students will be composing a melody, so they will be using instruments in a "hands on" strategy. They will also be sharing their compositions with each other in a final group presentation, so they will be listening and performing.

Activities

Vocabulary:

The following words need to be mastered: tempo, rhythm, notes, Treble Clef, time signature, measure, melody, numerator, denominator, fraction, equivalent fraction, and whole number. I have included a vocabulary reference in the appendix. Ordinarily, students will have become familiar with the vocabulary in the mathematics classes and their general music classes. However, it is essential that the vocabulary is learned and mastered. While I would not use the Frayer Model in this context, it would be wise to have definitions readily available to the students to refer to.

Lesson 1:

Essential Questions: What do different rhythms sound like? How are rhythms written? Depending on the experience of the students, start clapping simple rhythms, such as their name as they say it. Once students master clapping their names, play a simple melody and lead the students to clap the rhythm of the song. The melody could be as simple as Mary Had a Little Lamb. Then introduce the notes with their values for a 4-4 time signature. A whole note would get 4 beats, a half note would get 2 beats, and quarter note would get 1 beat, an eighth note would get ½ beat, and a sixteenth note would get ¼ beat. Practice tapping out written rhythms in common songs, such as Row, Row, Row Your Boat or America. If you do it together as a class, you will be able to assess understanding of rhythm fairly easily by rotating throughout the room. The tapping should be in unison. Work with students who have trouble with this concept in a small group, separate from the whole group until the students understand the concept.

Lesson 2:

Essential Question: How do we record a melody? In order to compose a melody, students need to know how to record it. Many students will know how to record notes from their general music classes. If they do not know this, they will need to learn how to record particular notes using the treble clef (higher notes) with notes. Each line in the treble clef represents a note on a piano. The spaces between the lines also represent notes. Actually, the notes are in order of the alphabet, starting with A and going through G, then they repeat for each octave. I would recommend using the key of C for these purposes. The key of C has no sharps or flats, so you do not have to worry about the black keys on the piano. The bottom line of the Treble Clef is the note of E, followed by the note of F in the space above that line, followed by G on the next line, and A in the space, and B on the next line, and C on the next space, and D on the next line and E in the top space and F on the highest line. You can add lines above and below the Treble Clef but they follow the same pattern. Many students learn the lines with a mnemonic for the lines: Every Good Boy Does Fine and the spaces: FACE. You can give the students an outline of the Treble Clef with the notes marked. The orph instruments usually have the notes marked as well.

You can decide if your students need to spend time learning their notes or if they know them already from general or other music classes. For those students who do not know their notes, practice by giving the students random notes to record on the lines and spaces of the treble clef. Students who need more help should be grouped together. Review the concept of the lines and spaces for the notes and practice writing notes as given by the teacher.

Lesson 3

Essential Question: How does the rhythm affect a melody? Students will be given a melody and have the challenge of putting the notes into 4 measures using 4/4 time. The notes have been given a proportional value, (fractional). Students must arrange the notes in such a way that each measure equals 1 whole when the proportional values are added together. They may use ½ notes, quarter notes, eighth notes, and sixteenth notes. (I did not include whole notes because that would be too easy and wouldn't help them see the connection with the fractions since they would have the value of a whole number.) If you have the opportunity to use orph instruments, most 5th graders have experience with them from their general music classes. After the students have assigned time values to the notes, play the various renditions for the students. Let the students comment on the differences between the renditions.

Lesson 4

Essential Question: What happens if I change the rhythm, but keep the same tempo? Students will multiply each of the note values from their previous melodies by 2. This will change the note values, for instance 1 half note will become 1 whole note. 4 quarter notes will become 2 half notes. Students should notice the differences in their melodies as they play the transformed rhythms. It would be wise to use a metronome to keep to the same tempo. There are many current apps that can be downloaded into a smart phone or onto the computer. Mathematically, the students should see that the values of the notes have doubled. ¼ becomes 2/4 which equals ½, so the quarter note becomes a half note. When multiplying a fraction by a whole number, the quantity increases. I have included a melody in the appendix that you can use for this lesson. I have written out the notes for the melody as well.

As a variation, then multiply each note proportional value by the fraction ½. In mathematics, if you multiply a fraction by a fraction, you get a smaller amount. In essence, ½ multiplied by ¼ is really ½ of ¼ which is 1/8. 1/8 is smaller in amount than ¼. If the students do this activity the totals in the measures will be divided in half, so students will need to combine every two measures to equal one measure. They can then repeat the two measures to have four measures. After multiplying the note values, play the melody again with the new notation and notice the differences. It would be helpful to record the melodies throughout the transitions to replay and listen to the differences.

As an additional assessment, you can give the students a melody, such as Row, Row, Row Your Boat and ask them to do what they did with their personal melodies. First, multiply the note values by 2. Then multiply the note values by ½. You can also play these variations for the class after the assessment, so the students hear the difference.

Lesson 5

Essential Question: What happens when I compose a melody and change the rhythms?

Students will compose their own melodies and then repeat the activities they did in Lesson 3 where they were given a melody. They should determine the notation as before using the fractional values for the notes so that each measures has the combined value of 1 whole. Then the students can multiply the values by 2 again and then by ½ and notice the differences when they play them.

The following exercise will be easier for students who have had many of these concepts in their general music classes. If your class does not have general music or has not had experience composing melodies and recording them, they will need more time and assistance to accomplish this part of the task. You will have to judge what your students know and to what extent they are proficient composing and then recording their compositions in notation. If they have limited experience, you may have to spend more time with this skill or give more assistance to them as they do this task.

Students will be expected to compose a short melody of 8 measures. They can use the orph instruments or an application on the smart board or an ipad or using a key board. They will be expected to record the melody using a treble clef. The notes of the melody must have the values to add to 1 for each measure. They will be expected to use a variety of notational values, such as half notes, quarter notes, eighth notes and sixteenth notes. I would give them the expectation to include at least one of each of the above note values. I would not allow them to use a whole note value- this would be too easy! The students will need to show their mathematical work below the measure to show how they combined the fractional amounts to find the sum of 1 whole. Then they will be required to represent the same melody multiplying the note values by 2 and then multiplying them by ½. It would be most beneficial if the students would be able to play their melodies with the variations, (multiplied by 2 and multiplied by ½). It would be best if the whole class participates and comments on the differences that they hear in the melodies.

This final product would be the summative assessment for the unit. This addresses both mathematical and general music standards. It would be beneficial if the teacher could record the melodies for the final assessments.

Conclusion

I believe that students who engage in these activities will understand and remember the concept of combining fractions with uncommon denominators. I believe this because they will have combined the experience of creating music with mathematical concepts. They will not only “hear” about combining fractions, they will “hear” how it happens through hearing the music. By using the multiple senses, they will retain the concepts. Then, whenever they are engaged in music, they will think about fractions with uncommon denominators as well as the music. The multiple visits to the concept will also help instill the concept in the long term memory. In addition, since the activities involve additional

physical effort as well as emotional connections through the music, research is supporting that the students are more likely to retain the concepts.

Resources for Teachers:

http://www.susanparadis.com/catalog/SP754/preview.pdf
This website has a rhythm pizza. It shows the notes as fractions of a pizza. This would be a good resource to teach the value of the notes.

https://itunes.apple.com/us/app/metronome/id287965434
This is a link to a metronome app for an iphone.

https://play.google.com/store/apps/details?id=gabriel.metronome
This is a link to a metronome app for android devices.

http://metricscat.com/smart-boards.html
This is a metronome app for the smart board. It costs $ 1.99

http://www.pdfpad.com/staffpaper/
This is a link for blank music staves.

Smart Exchange: Music Pizza Fractions
This is a good way to reinforce the fractional amounts for the notes.

http://www.virtualpiano.net/
This is a virtual keyboard you can use to play the musical pieces the students create. It can show the notes on the keys and it can also record what you play.

http://www.piano-keyboard-guide.com/piano-notes-chart.html
This link has a good simple note chart for the treble clef that you can print for the students.

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1. Bowie, R. "Syntegration or disintegration? Models of integrating the arts across the primary curriculum". *International Journal of Education & the Arts* 10, no. 28 (2009).
2. Ibid
3. Ibid.
4. Appel, M.P. "Arts integration across the curriculum". *Leadership* 36, no. 2 (2006): 14-17.
5. Ibid.
6. Jensen, Eric. *Music with the brain in mind*. San Diego, CA: The Brain Store, 2000.

7. Rinne, Luke, Gregory, Emma, Yarmolinskaya, Julia, Hardiman, Mariale. “Why arts integration improves long-term retention of content”. *Mind, Brain, and Education* 5, no. 2 (2011): 89-96.
8. Ibid.
9. Ibid.
10. Ibid.
11. Helmrich, B. H.. "Window of opportunity? Adolescence, music, and algebra." *Journal of Adolescent Research* 25, no. 4 (2010): 557-577.
12. Berti, Stefan, Stefan Münzer, Erich Schröger, and Thomas Pechmann. "Different interference effects in musicians and a control group." *Experimental Psychology (formerly "Zeitschrift für Experimentelle Psychologie")* 53, no. 2 (2006): 111-116.
, Pallesen et al, 2010
13. Baker, R. A. “The relationship between music and visual arts formal study and academic achievement on the eighth-grade Louisiana educational assessment program (LEAP) test.” Doctoral Dissertation, Louisiana Statae University (2011).
14. Neville, H. et al, “Effects of music training on brain and cognitive development in under-privileged 3-to 5-year old children”. New York, NY Dana Press. (2008)

Common Core State Standards for Math

5.NF.A.1 Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)*

5.NF B.4 Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.

> 5.NF.B.4a_ Interpret the product $(a/b) \times q$ as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. *For example, use a visual fraction model to show $(2/3) \times 4 = 8/3$, and create a story context for this equation. Do the same with $(2/3) \times (4/5) = 8/15$. (In general, $(a/b) \times (c/d) = ac/bd$.*

5.NF B.5 Interpret multiplication as scaling (resizing), by:

> 5.NF.B.5a_ Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication.

5.NF.B.5b Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $a/b = (n \times a)/(n \times b)$ to the effect of multiplying a/b by 1.

Common Core Mathematical Practices

Mathematical.Practice.MP.1 Make sense of problems and persevere in solving them.

Mathematical.Practice.MP.2 Reason abstractly and quantitatively

Mathematical.Practice.MP.7 Look for and make use of structure.

Mathematical.Practice.MP.8 Look for and express regularity in repeated reasoning.

Delaware Music Standards

Standard 2: Performing on instruments independently and with others a varied repertoire of music.
2.1 Imitate rhythmic and melodic patterns on pitched and unpitched instruments.
2.2 Perform on pitched and unpitched instruments in rhythm while applying a steady beat.
2.7 Perform with proper instrument technique

Standard 4: Composing and Arranging Music within specific guidelines
4.1 Compose short songs and instrumental pieces.
4.3 Utilize standard written notation in composition of short songs.

Bibliography

Abbs, Peter. *Living powers: the arts in education*. London: Routledge, 2011.
Appel, M.P. "Arts Integration across the Curriculum". *Leadership* 36, no. 2 (2006): 14-17.

Baker, R. A. “The Relationship between Music and Visual Arts Formal Study and Academic Achievement on the Eighth-Grade Louisiana Educational Assessment Program (LEAP) Test.” Doctoral Dissertation, Louisiana Statae University (2011).

Berti, Stefan, Stefan Münzer, Erich Schröger, and Thomas Pechmann. "Different Interference Effects In Musicians And A ControlGroup." *Experimental Psychology (formerly "Zeitschrift für Experimentelle Psychologie")* 53, no. 2 (2006): 111-116.
, Pallesen et al, 2010

Bloomfield, Anne, and John Childs. *Teaching integrated arts in the primary school: dance, drama, music, and the visual arts*. London: David Fulton, 2000.

Bowie, R. “Syntegration or Disintegration? Models of Integrating the Arts Across the Primary Curriculum”. *International Journal of Education & the Arts* 10, no. 28 (2009).

Burnaford, Gail E.. *Renaissance in the classroom arts integration and meaningful learning*. Mahwah, N.J.: L. Erlbaum, 2001.

Burz, Helen L., and Kit Marshall. *Performance-based curriculum for music and the visual arts: from knowing to showing*. Thousand Oaks, Calif.: Corwin Press, 1999.

Campbell, Don G.. *The Mozart effect: tapping the power of music to heal the body, strengthen the mind, and unlock the creative spirit*. New York: Avon Books, 1997.

Colwell, C. M.. "Integration Of Music And Core Academic Objectives In The K-12 Curriculum: Perceptions Of Music And Classroom Teachers." *Update: Applications of Research in Music Education* 26, no. 2 (2008): 33-41.

Cornett, Claudia E.. *Creating meaning through literature and the arts: an integration resource for classroom teachers*. 2nd ed. Upper Saddle River, N.J.: Merrill/Prentice-Hall, 2003.

Giles, A. M., and R. J. D. Frego. "An Inventory Of Music Activities Used By Elementary Classroom Teachers: An Exploratory Study." *Update: Applications of Research in Music Education* 22, no. 2 (2004): 13-22.

Helmrich, B. H.. "Window Of Opportunity? Adolescence, Music, And Algebra." *Journal of Adolescent Research* 25, no. 4 (2010): 557-577.

Jensen, Eric. *Music with the brain in mind*. San Diego, CA: The Brain Store, 2000.

Neville, H. et al, "Effects of Music Training on Brain and Cognitive Development in Under-privileged 3-to 5-year old Children.New York, NY Dana Press. (2008)

Overby, Lynnette Young, Beth C. Post, and Diane Newman. *Interdisciplinary learning through dance: 101 moventures*. Champaign, IL: Human Kinetics 2005.

Noblit, George W.. *Creating and sustaining arts-based school reform: the A+ schools program*. New York: Routledge, 2009.

Prokes, Dorothy. *A road map to education: the CRE-ACT way*. Lanham, Md.: University Press of America, 2009.

Rinne, Luke, Gregory, Emma, Yarmolinskaya, Julia, Hardiman, Mariale "Why arts integration improves long-term retention of content". *Mind, Brain, and Education* 5, no.2 (2011*):*89-96.

Russell-Bowie, D. "Syntegration or disintegration? Models of integrating the arts across the primary curriculum". *International Journal of Education & the Arts* 10 no. 28 (2009).

Shanet, Howard. *Learn how to read music.* New York: New York, Simon and Schuster, 1956.

Appendix A

Vocabulary

Music Vocabulary

Tempo: The tempo is the beat or pace of the music.

Rhythm: The rhythm is the individual beats of the particular notes in the melody.

Melody; A melody is the pitches sung in a sequence that creates a pattern.

Notes: Notes are the way pitches in music are written.

Key signature: The flats or sharps (or lack of) that indicate the key that the music is played in.

Time signature: A time signature is the indication of the number of beats in each measure, such as 4/4.

Staff (staves): The staff is the 5 parallel lines and 4 spaces where the notes are placed in each of the treble or bass clef.

Treble Clef: The treble clef is the staff for the notes above middle C on the piano.

Math Vocabulary

Fraction: A number that is less than a whole number. It represents a portion of a whole number, such as ½, ¼, etc.

Numerator: The numerator is the top number of a fraction. Such as ½, the numerator is the one.

Denominator: The denominator is the number on the bottom of a fraction. Such as ½, the denominator is the 2.

Equivalent fraction: A fraction that represents the same amount as another fraction even though different numbers are used, such as ¼ is equivalent to 2/4. They represent the same amount.

Whole number: A number that is not a fraction, such as 1,2,3,….

Common denominator: When you want to add or subtract or compare fractions, you may want to find the common denominator. The common denominator is a denominator that you can convert both fractions into using equivalent fractions. Such as if you were adding ½ and ¼, you could use the common denominator of 4, converting ½ into the equivalent fraction of 2/4 and then simply add it to ¼ since both fractions would have the same, (common) denominator and thus get ¾.

Appendix B

Sample Worksheet

Name _____ Date _____

Using the following melody, put the notes into 4 measures. Use a variety of kind of notes. The total of the note values in each measure should be 1 whole. You may not need the entire melody, but use it in the order it is written. If you need more notes, repeat from the beginning.

Use the following note values:

Write the equation under each measure, for example: ¼ + ¼ + ¼ = 1

Curriculum Unit Title	A Fractional Song	Author	Ellen Shackelford

KEY LEARNING, ENDURING UNDERSTANDING, ETC.

Students will learn how to combine fractions with uncommon denominators by converting fractions to common denominators. Students will learn that multiplying a fraction will change the whole. Students will also learn that multiplying the notational values by a common number will change the rhythm.

ESSENTIAL QUESTION(S) for the UNIT

Why do we change the denominators to add or subtract a fraction? How is a melody affected if the rhythm is multiplied by 2 or if the rhythm is multiplied by ½. What patterns can I see?

CONCEPT A	CONCEPT B	CONCEPT C
h wll		
ESSENTIAL QUESTIONS A	**ESSENTIAL QUESTIONS B**	**ESSENTIAL QUESTIONS C**
How do I make dfferent wholes from different fractions?	What happens if I change the rhythm by a fixed amount, like 2?	What happens If I change the rhythm by a fixed amount like ½?
VOCABULARY A	**VOCABULARY A**	**VOCABULARY A**
rhythm common denominator notes treble clef time signature numerator denominator equivalent fractions	fractions beat rhythm multiplication	beat rhythm fraction multiplication

ADDITIONAL INFORMATION/MATERIAL/TEXT/FILM/RESOURCES