Integrating Music and Mathematics in the Elementary Classroom

Gretchen L. Johnson and R. Jill Edelson

Increasingly, teachers are being encouraged to engage in interdisciplinary instruction. Although many of us are comfortable using children's literature as the basis for interdisciplinary units, we rarely think to integrate mathematics and music in our lessons. Music actively involves students in learning and helps develop important academic skills (Rothenberg 1996). By using music to enhance children's enjoyment and understanding of mathematics concepts and skills, teachers can help children gain access to mathematics through new intelligences (Gardner 1993). This integration is especially effective with children who have strong senses of hearing and musical intelligence.

Music enhances spatial-temporal reasoning skills, which are crucial for learning concepts in proportional reasoning and geometry, two areas in which U.S. students show below-average achievement (Grandin, Peterson, and Shaw 1998). "Math and science tend to be stronger in students who have a music or an arts background" (Jensen, quoted in D'Arcangelo 1998, p. 25). Humans have created multiple sign systems to express and construct meaning. These sign systems increase our ability to express what we know in multiple ways. Language, music, art, and mathematics are all examples of these multiple communication systems. We can use the signs and symbols of the music and mathematics sign systems to help children explore this important symbol-human connection (Berghoff 1998).

Activities integrating music and mathematics do not require musical training or expensive equipment. All that a teacher needs is a set of rhythm instruments, many of which can be made by the children; a few charts or posters depicting musical instruments; a phonograph, tape recorder, or CD player; a few musical selections; and an object that can serve as a baton.

The following activities teach children to express mathematical ideas, such as patterns and ratios, with physical materials, such as musical instruments. Songs and musical symbols are used to illustrate such ideas as serial order and fractions and to gather data for graphs and charts. The activities are grouped by mathematical concepts and suggested grade levels are indicated.

Pattern Activities: Grades Pre-K–3

Patterns are essential to both mathematics and music. Work with patterns enhances the thinking and reasoning skills of children because they must analyze a pattern to figure out its rule, communicate the rule in words, and then predict what comes next in the pattern. To translate a pattern, children keep the same rule but express it

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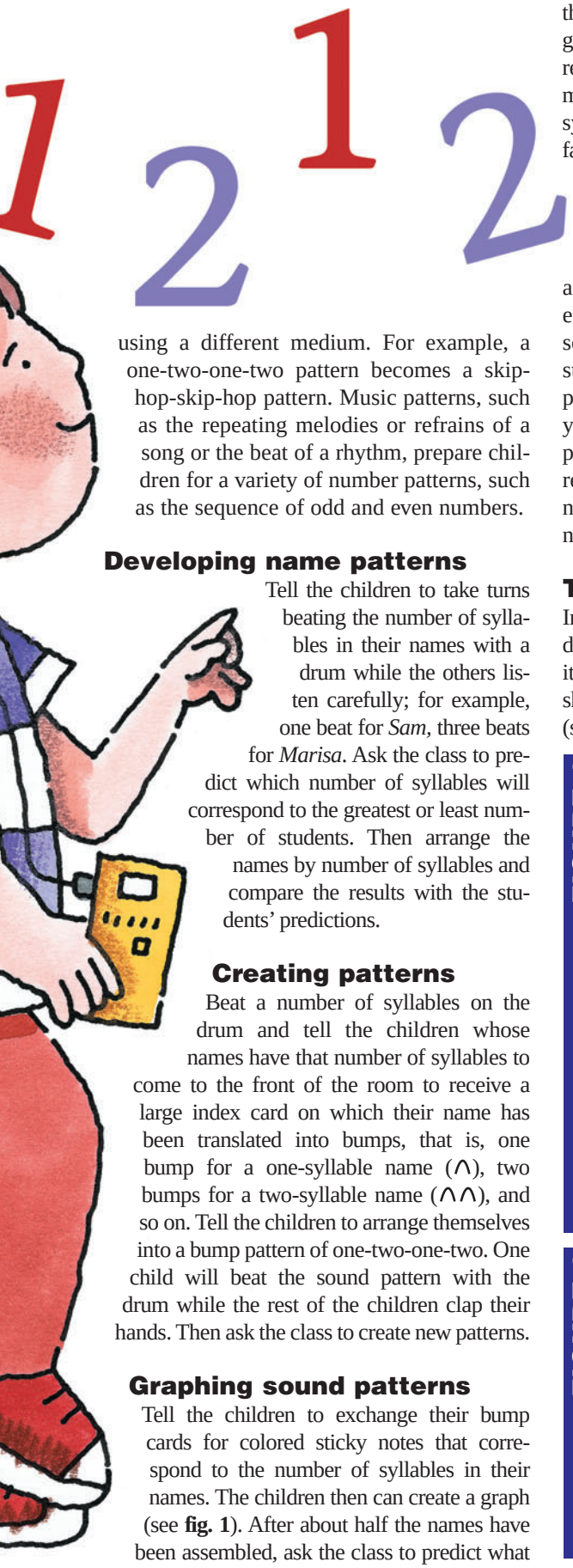

using a different medium. For example, a one-two-one-two pattern becomes a skip-hop-skip-hop pattern. Music patterns, such as the repeating melodies or refrains of a song or the beat of a rhythm, prepare children for a variety of number patterns, such as the sequence of odd and even numbers.

Developing name patterns

Tell the children to take turns beating the number of syllables in their names with a drum while the others listen carefully; for example, one beat for *Sam*, three beats for *Marisa*. Ask the class to predict which number of syllables will correspond to the greatest or least number of students. Then arrange the names by number of syllables and compare the results with the students' predictions.

Creating patterns

Beat a number of syllables on the drum and tell the children whose names have that number of syllables to come to the front of the room to receive a large index card on which their name has been translated into bumps, that is, one bump for a one-syllable name (∧), two bumps for a two-syllable name (∧∧), and so on. Tell the children to arrange themselves into a bump pattern of one-two-one-two. One child will beat the sound pattern with the drum while the rest of the children clap their hands. Then ask the class to create new patterns.

Graphing sound patterns

Tell the children to exchange their bump cards for colored sticky notes that correspond to the number of syllables in their names. The children then can create a graph (see **fig. 1**). After about half the names have been assembled, ask the class to predict what the final graph will look like. After they complete the graph, discuss their predictions and interpret the final results. For example, the children may discover that more children have two-syllable names than one-syllable names. Tell the children to look through their favorite stories for one-, two-, and three-bump names.

Patterning the symbols for notes and rests

Introduce to the class two symbols, quarter notes and quarter rests, and display them in a pattern either on a poster (see **fig. 2**) or on individual cards set in the tray of a chalkboard (see **fig. 3**). Using a stick for a baton, tell the children to clap when you point to a note and spread their arms wide when you point to a rest. Then tell them to create new patterns for the class to "play." If the children are ready for more of a challenge, you can add the half note (𝅗𝅥), which is held for two beats, and the whole note (𝅝), which is held for four beats.

Three-element patterns

Introduce several rhythm instruments to the class and discuss with the children how each instrument makes its sound—by hitting (triangle, sticks, wood blocks), shaking (bells, maracas, tambourine), or rubbing (sticks, sandpaper blocks). Distribute instruments to

FIGURE 1

Graph of children's name-syllable patterns

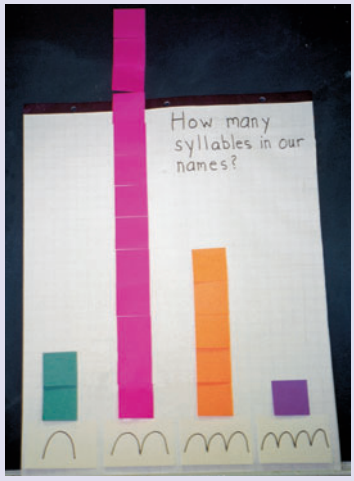

FIGURE 2

Quarter-note and quarter-rest patterns

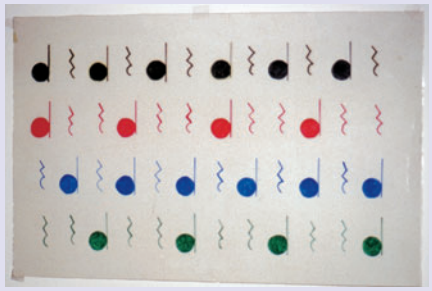

FIGURE 3

Individual note and rest cards for children to arrange in a variety of patterns

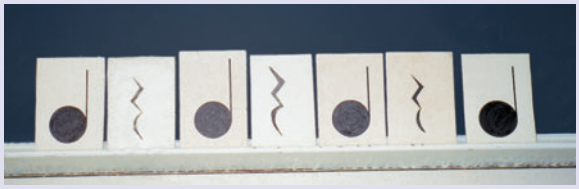

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FIGURE 4

Kindergarten children display animals in serial order from "The Old Lady Who Swallowed a Fly."

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FIGURE 5

A symphony orchestra (Hoffman 1997)

	Type of Instruments	Number of Instruments
I.	The Strings	64–68
	1. Violins:	
	First Violins	16–18
	Second Violins	16
	2. Violas	12
	3. Cellos	12
	4. Double Basses	8–10
II.	The Woodwinds	16
	1. Flutes	4
	2. Oboes	4
	3. Clarinets	4
	4. Bassoons	4
III.	The Brass Instruments	14–15
	1. French Horns	5–6
	2. Trumpets	4
	3. Trombones	4
	4. Tuba	1
IV.	The Percussion Instruments	4
	1. Timpani	1
	2. Others: snare drum, bass drum, triangle, cymbals, glockenspiel, chimes, xylophone, celesta, tam-tam	3
Also:	Harp	1–2
	Piano (used occasionally)	1

nine children—three hitting, three shaking, and three rubbing instruments—and ask each child to tell the class how his or her instrument makes its sound. Tell the children to arrange themselves in a pattern of shake-rub-hit-shake-rub-hit and ask each child to play in turn while the class listens to the pattern. Then tell the students to rearrange themselves and play other patterns.

Ordering Activities: Grades K–3

Using sound to expand the concept of serial order

Use a xylophone, tone bells, or a piano to demonstrate the scale as an example of serial order, with sounds arranged according to pitch, that is, how high or low they sound. The sounds can be played from lower to higher pitch or from higher to lower pitch. Select a child to play the scale while the other children close their eyes. Can they tell if the scale was played from high to low or from low to high?

Serial order from lowest to highest

Sing "The Jack in the Box" to further demonstrate serial order and pitch. While the children crouch down, use a xylophone or piano to play a higher tone with each successive line of the song. At the highest note, the children bounce up out of their "boxes."

Jack in the box
Still as a mouse
Deep down inside his
Little white house
Jack in the box
Still as can be
Will he pop out?
Yes! Let's see!

Using songs and visuals to reinforce serial order

Sing "The Old Lady Who Swallowed a Fly" with the class while children at the front of the room display each animal in order as it is "swallowed" (see **fig. 4**). The old lady in the song swallows a fly, spider, bird, cat, dog, goat, and cow and then tries unsuccessfully to swallow a horse. When the song ends, discuss which animal the lady swallowed first, second, third, and so on. Discuss the sizes of the animals, which also are in order from the smallest to the largest.

Sorting, Classifying, and Combination Activities

Sorting and classifying are essential concepts in

mathematics because numbers and shapes are grouped into sets according to their properties. The skills of sorting and classifying can be strengthened through integrated music and mathematics lessons that begin by asking, "What kinds of instruments are in an orchestra or band?"

Sorting and classifying rhythm instruments: grades K–2

Tell the children to sort themselves into three groups according to the ways in which their rhythm instruments make sounds, that is, by being hit, shaken, or rubbed. If an instrument, such as a tambourine, can make a sound in more than one way, ask the student to choose the way in which he or she would like to play the instrument. After each group makes its sounds, tell the children to describe the sounds and help them write the descriptive words on a chart.

Sorting the instruments in an orchestra: grades 3–4

Symphony orchestras have about one hundred instruments that can be sorted into four groups: strings ("pluck"), woodwinds ("whistle"), horns and brass ("toot"), and percussion ("boom") (see **fig. 5**). Play a brief selection of music that illustrates the sounds of each group, such as Benjamin Britten's "Young People's Guide to the Instruments of the Orchestra," and ask the students to examine pictures or samples of the instruments. The strings are usually the most numerous group in an orchestra, followed by the horns, the woodwinds, and the percussion instruments. The strings are sorted further into five groups: first violins, second violins, violas, cellos, and double basses.

You can start the activity with a chamber orchestra that has only twenty to forty instruments made up of two or three groups, such as strings, woodwinds, and horns. Play music performed by a chamber orchestra, such as Tchaikovsky's "Serenade for Strings," and draw a diagram to illustrate the orchestra. If the children can work with greater numbers, tell them to illustrate a possible 100-piece symphony orchestra, creating their own symbols for the instruments and making sure that the instruments in their orchestra total 100.

Problem solving using combinations: grades 3–4

People play music in duos, trios, quartets, quintets, sextets, septets, octets, and nonets. After playing brief musical selections that demonstrate duos and trios, such as Wolfgang Amadeus Mozart's "String Quartet in C Major, K. 157" and "Piano Trio in E Major, K. 542," ask the children how many different duos they can make with a piano, violin, viola, cello, bass, and flute. How many combinations of three can they make using a string instrument, woodwind, and horn? You also can give the children more complex problems, such as the following:

> This musical group is an octet. It has twice as many string instruments as horns. It has one percussion instrument and one woodwind. Describe the possible instruments in this group.

Tell the children to create their own word problems.

FIGURE 6

Venn diagram of rhythm instruments

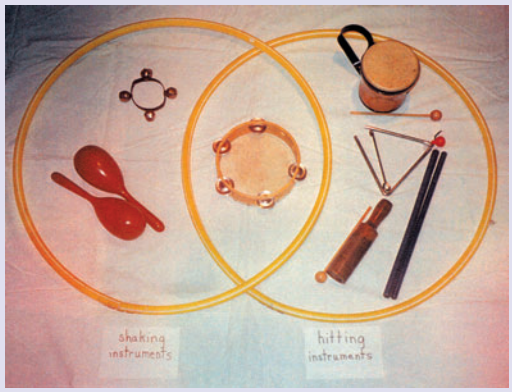
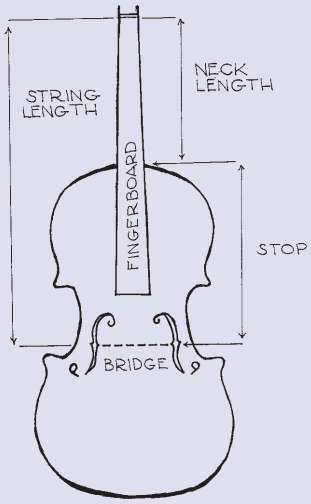


FIGURE 7

Example of parts of an instrument used in a ratio investigation



Using Venn diagrams to illustrate a rhythm band: grades 5–6

After examining and playing rhythm instruments, fifth and sixth graders can represent them using Venn diagrams. Ask the children to identify the universal set and the three discrete sets of rubbing, shaking, or hitting instruments, then create a variety of intersecting sets (see **fig. 6** for one example).

Ratio Activities

The concept of ratio can be developed with "Let's make a band" activities. The ratio of instruments in

FIGURE 8

Discovering ratios in string instruments

Instrument	Length of Neck	Length of Stop	Length of String	Ratio of Neck to Stop (N:S)
Violin	13 cm	19.5 cm	32.5 cm	2:3
Viola	14.6 cm	21.9 cm	36.5 cm	2:3
Cello (full-size)	28 cm	40 cm	68 cm	7:10

FIGURE 9

Musical notation

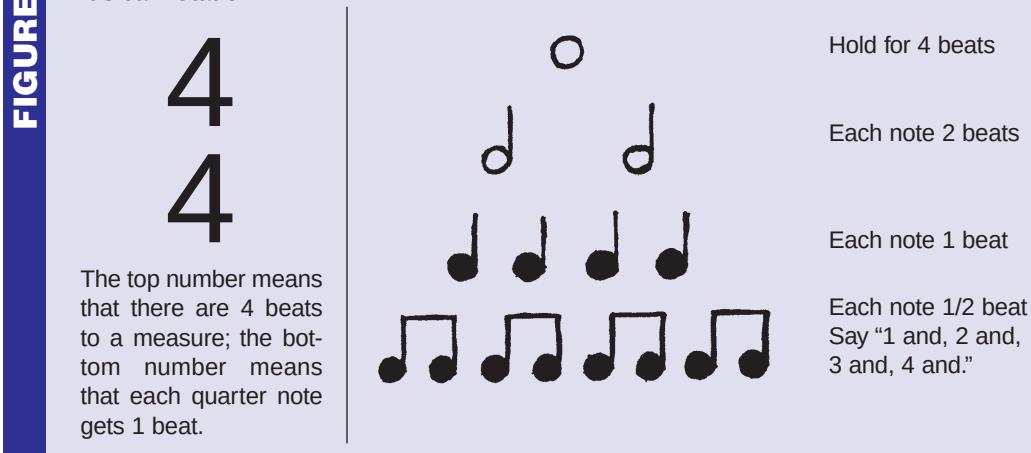
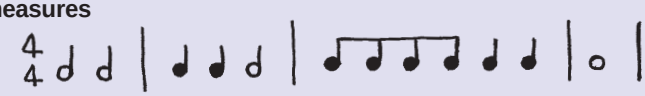
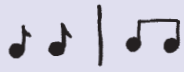


FIGURE 10

A sample of four measures



Two ways to write two eighth notes



a rhythm band or orchestra affects the sound of a musical group. Orchestra and band instruments are assembled in different ratios to create a variety of sounds. This is called *orchestration,* which is the art of designing collective musical sounds.

Rhythm instrument ratios: grades K–4

Assemble a band by selecting one child with a "shaking" rhythm instrument, such as a tambourine, and one child with a "hitting" instrument, such as sticks. Choose four more pairs of children to reinforce the one-to-one correspondence of the shaking and hitting groups. Tell this band of eight to gently play a tune, and record the sound on tape.

Form a different band by selecting three children with shaking instruments and only one child with a hitting instrument. Repeat this once more until you have another band of eight children but this time with the instruments in a ratio of 3:1. Discuss how this band is different from the first one. Will the second band sound different? Tell the students to play a tune, and record the sound on tape. Play the tape and ask the children to describe the sounds of the two bands. The children can predict and then investigate the sound of a band with the reverse ratio of 1:3. They also can analyze their favorite musical groups to determine the types and ratios of instruments in them.

A ratio investigation: grades 5–6

Children can investigate the relationship between the neck length of a string instrument and the length of its "stop" (see **fig. 7**). Using a diagram of a violin or viola, or preferably a real instrument, ask the children to measure the string length or "vibrating string" of the instrument. The string behind the bridge and in the peg box does not count because it does not vibrate. The string length is made up of two parts: the length of the neck of the instrument and the length of the stop. Tell the children to measure the neck, the stop, and the string and fill in a chart to determine the ratio of the length of the neck to the length of the stop (see **fig. 8**). The students will discover that the ratio is 2:3 for the violin and the viola, and 7:10 for the cello.

Learning Fractions by Creating Musical Arrangements: Grades 4–6

Musical notation and rhythm offer additional ways to investigate the fractional parts that can make a whole. Music often has four beats to a measure, with each quarter note getting one beat. This four-beat measure represents the unit or whole that can be constructed out of various fractional parts. The whole note gets four beats, the half note two beats, the quarter note one beat, and the eighth note one-half beat (see **fig. 9**).

Ask the children to investigate all the ways they can make one whole measure using quarter notes, half notes, and eighth notes. Then, with a partner, they can write four measures of music and practice tapping out the rhythm with sticks (see **fig. 10**).

Conclusion

Many good reasons exist for using music to help children learn mathematics. One reason is the broad range of significant concepts and skills (NCTM 2000) that can be taught, such as recognizing, describing, and translating patterns; comparing and ordering the attributes of objects; representing data using pictures and graphs; and applying mathematics to everyday life. A second reason is the value that integrated mathematics and music activities have for children whose strengths lie in areas other than the logical-mathematical. A third reason is the ease with which even those of us who have a limited musical background can be successful with such activities. As teachers, we must take advantage of the many opportunities that music offers to help all our children learn mathematics in challenging and enjoyable ways.

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Musical Resources

(These are all well-known selections and should be easy to locate.)

Britten, Benjamin. *Young people's guide to the orchestra.*

Hindemith, Paul. *Symphonic metamorphosis.* (A selection of modern music that may be intriguing to children.)

Mozart, Wolfgang Amadeus. *String quartet in C major, K. 157.*

———. *Piano trio in E major, K. 542.*

Tchaikovsky, Peter Ilitch. *Serenade in C major for strings, op. 48.* ▲