INTRODUCTION

Why do kids get so much pleasure from running, skipping, bouncing, jumping rope? In a word—rhythm. Rhythmic movement not only feels good, it clears the mind and activates creative energy. Rhythm is the energetic expression of mathematics; musical rhythm is created by adding, multiplying and dividing. Rhythm is math.

Here, in *Rhythm of Math*™, we are presenting a way for children to learn about addition, multiplication, division, and fractions through a rhythmic experience that releases their creative energy. Using hands, feet and voice, they express abstract ideas (math) in a direct and immediate way—in the body. We call it **Body Music®**.

But no matter what you call it (body drumming, body percussion, etc.) it's probably the oldest music on the planet. Before we hollowed out logs and played gourds, we clapped, slapped, stepped and sang our musical ideas. Ancient forms of embodied knowledge, the many traditional styles of body music contain kinesthetic "libraries" of memories and cultural heritage.

In the late 70s, I played drums in the Jazz Tap Ensemble—three tap dancers plus piano, bass and drums. With that group I had the good fortune to play for some of the greatest tap dancers of all time: artists such as the Nicholas Brothers, Eddie Brown and Charles "Honi" Coles. The connection between the music and the dance had such an effect on me that one day in rehearsal I stood up and put the rhythms I'd been playing on my drums onto my body. My rim shots and cymbal crashes became snaps and claps, and before I knew it, I had created a new style of body percussion. Since then I've been calling it simply Body Music. ("Music" here implies melody and harmony created with the voice in addition to the purely percussive/rhythmic element.)

In 1978 I came up with the idea of Rhythm Blocks and began using them in Body Music Workshops to construct rhythmic phrases much as you would use words to construct a sentence. That work focused on music and dance but a new door opened when Linda Akiyama, an elementary school teacher appeared.

Here is Linda's account of how the *Rhythm of Math* evolved from her experience with Body Music:

> One day, on a playground in Los Angeles, I watched two boys patting hambone, a traditional style of African American body music, while nearby a circle of girls clapped out rhythms, interweaving movements with amazing precision. Across the yard a fifth grader's footsteps punctuated the swish, swish of Double Dutch as the girls recited verse after verse of jump rope chants learned from sisters, cousins and neighbors.
>
> That was my first encounter with traditional body music. As a dancer, I loved how rhythms on the body fused music and movement and as an educator I marveled at how much energy the children devoted to learning complex patterns, memorizing verses and working cooperatively to perfect a task. Could I use body music with academic subjects to motivate children?
>
> In 2003 I was teaching third grade at New Traditions Creative Arts Elementary School in San Francisco when Keith Terry and his Crosspulse Percussion Ensemble came to perform their Body Music. I knew immediately this was something I needed to learn and soon became a regular at Keith's Body Music workshops. I began combining the Rhythm Blocks with chants to help my students remember math, science, and geography terms.
>
> A few years later I was teaching students essential math concepts using the Rhythm Blocks. We played a rhythm, studied its structure mathematically and notated it using math expressions or visual symbols. My students began to create their own rhythms, often sharing them on the playground.

Since 2008, Linda and I have co-taught workshops on integrating Body Music into the academic curriculum. Several years later the lessons presented here were used in a pilot program for 2nd through 5th grade classrooms in four public schools in San Francisco and Oakland, California. A typical Rhythm of Math session looked like this:

> Ms. Flores' third grade class is cheering because she has just announced that today they're going to do math with the Rhythm Blocks. Jamal is demonstrating:
>
> "The **1 Rhythm Block** is just a clap. The **2 Rhythm Block** goes like this." He claps his hands then pats the middle of his chest.
>
> "Make three sounds for the **3 Rhythm Block**: clap, chest, chest. The name of the Rhythm Block tells you how many sounds to make."
>
> When it's time to do the **9 Rhythm Block**, Tonya asks to lead the class. This is unusual since normally she's more reserved, but now she takes a deep breath then claps, pats, and speaks her way down the body.
>
> *"Clap, chest, chest, thigh, thigh, hip, hip, step, step."*
> 1 2 3 4 5 6 7 8 9

The class plays a warm-up exercise based on that 9 beat sequence.

Ms. Flores says, “In past lessons, you’ve used numbers and operation signs to notate your own rhythms. Today I’ve notated a four part rhythm using this mathematical expression.”

(3 + 5) + (3 + 5) + (5+ 3) + (8 + 0)

“Can you figure out how to play it with the Rhythm Blocks?”

The next morning the students apply the commutative and identity property of addition as they work in their Rhythm of Math journals. Jamal uses the properties to create a rhythm that makes him smile. He turns to his friend, “Hey, Fernando—listen to this!”

That kind of enthusiasm from students and teachers inspired us to write this book. In our pilot program we found that even those who have struggled with traditional teaching said they felt smarter and understood the concepts better. We are confident that smiles will multiply in your classroom when feet, hands and voices sound out the *Rhythm of Math*.

—Keith Terry and Linda Akiyama

HOW TO USE THIS BOOK AND DVD

Rhythm of Math is intended to enrich your own math curriculum. Think of the unit as a starting point, a chance to learn and apply this classroom tested, multi-modal approach to learning. You will soon be adapting it to your own teaching style and using it to increase student understanding throughout your curriculum.

In *Rhythm of Math*, students see, hear and move numerical patterns. They use mathematics to create their own rhythms and solve challenging problems based on the rhythms they perform.

The lessons are accompanied by an instructional DVD, support material, and reproducible student activity pages. Lesson objectives address Common Core Mathematics Standards.

ORGANIZATION OF LESSONS

Lessons are divided into three parts which can be spread throughout a day or over a few days.

PART 1 RHYTHM ACTIVITIES

In Part 1 students learn to play a rhythm that they will explore mathematically. The rhythms are specifically chosen for their ability to motivate students and for the richness of their mathematical content. All rhythms take only a few minutes to learn and are taught to the teacher through the instructional DVD.

PART 2 MATHEMATICS ACTIVITIES

Students are introduced to math concepts through guided inquiry and problem solving situations. They investigate, represent, and explain the mathematical structure of the rhythm they have performed.

PART 3 COMPOSITION AND MATH APPLICATION ACTIVITIES

In Part 3, students apply what they have learned musically and mathematically to create their own composition. Then they share their rhythms and explain their representations.

THE LESSON PLAN

- The first page of each lesson lists math and rhythm objectives and the page numbers for the beginning of each lesson part.
- Prepare to Teach instructions are found on the next page.
- A detailed lesson plan follows. The left hand column contains an outline of the lesson. The right hand column is more detailed and makes visual connections with the student journal.
- DVD chapters are listed in the left hand column next to the lesson steps that they illustrate.

STUDENT JOURNAL

The reproducible student journal follows the lesson section. The journal has two pages for each lesson. In the "A" pages, students are asked to reason mathematically while applying concepts introduced in the lesson. The "B" pages give students an opportunity to apply their math knowledge to the creation of rhythms.

GOING FURTHER

Going Further pages provide challenging problem-solving activities for upper elementary students.

Student journal and Going Further activities provides formative assessments of mathematical understanding and application.

COMMON CORE MATHEMATICS STANDARDS ADDRESSED IN LESSONS

The Mathematical Practices and Content Standards for each lesson are listed in this section.

LESSON SUPPORT

This section contains charts, warm ups, techniques, games, and extension activities that support the teaching of the Rhythm of Math unit.

THE RHYTHM BLOCKS

At the heart of the *Rhythm of Math* program is a technique for composing and performing body music called the Rhythm Blocks™. It is a technique that is easy to learn, even for teachers and students with little or no music experience.

A Rhythm Block is a unit of beats played using claps, pats and steps. There are nine basic Rhythm Blocks, each named for the number of beats they contain.

A rhythm can be created with Rhythm Blocks by adding them together, playing them multiple times or using them to divide a larger rhythmic unit.

Studied mathematically, a Rhythm Block can be a unit for measuring time in music. It can also be a fractional part of a larger rhythmic unit.

Variations of a base rhythm can be created using properties of addition and multiplication. Rhythm Block duration can be notated as points on a number line or represented on column and line charts. Two Rhythm Blocks grouped together can be illustrated as coordinates and graphed as points on a coordinate plane. Fractions, multiplication, division, composing and decomposing numbers, and properties of whole numbers can all be investigated through playing, notating and creating rhythms.

USING THE DVD

In the instructional DVD, Keith Terry teaches the Rhythm Blocks, rhythmic warm ups, and the rhythms you'll need to do all lessons in the Rhythm of Math book. After learning the Rhythm Blocks, it only takes a few minutes to learn the rhythms used in a lesson.

Keith also does an in-class demonstration on how to teach each rhythm. In each demonstration, the mathematical notation for a rhythm is shown on the screen. As a part is played, its notation is highlighted. The math notation makes it easy to remember what to play and makes a clear connection between the rhythm and math notation.

Although the DVD is intended for the teacher, there are many chapters that you may want to show to your students.

HOW TO USE THE RHYTHM OF MATH LESSONS

The lessons in Rhythm of Math can be taught together as an integrated math and music unit; or they can be integrated into your yearly curriculum and taught throughout the year.

- Lesson 1 and Lesson 2 should be taught before the other lessons. In Lesson 1, students learn and practice the Rhythm Blocks. In Lesson 2, they have their first experience studying and representing a rhythm mathematically and then using what they have learned to compose their own rhythms.
- Lesson 3 and Lesson 4 focus on developing a flexible and deeper understanding of multiplication through playing polymeters and rhythmic improvisation.
- Lesson 5 explores the relationship of division to multiplication using a rhythmic phrase based on factors of 12.

- Lesson 2, 3, and 7 investigate creating rhythmic variations using properties of addition and multiplication and composing and decomposing numbers.
- Lesson 6 looks at Rhythm Blocks as fractional parts of a whole rhythmic unit. Ideas for extending the study of fractions can also be found in the Lesson Support section.
- Lesson 8 is a collection of culminating activities wherein students celebrate and share their achievements in both math and rhythmic music.
- All lessons give students the opportunity to apply Math Practices in the formulation of creative solutions to real world problems.

PART 3

COMPOSITION AND MATH APPLICATION

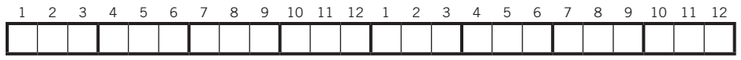
Teacher Outline

FIND THE DURATION OF THE THREES AND FOURS POLYMETER

1. Turn to page 4B in the *Rhythm of Math* journal and read the directions.

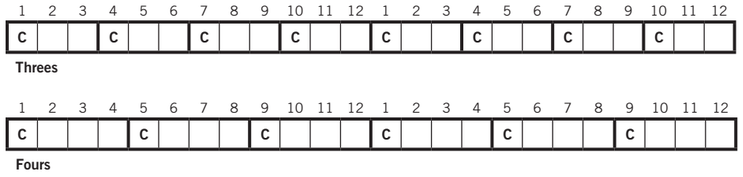
> A composer creates a polymeter using the **3RBs** played by one section, and using the **4RBs** played by another section. She knows that a polymeter ends when both sections finish playing a Rhythm Block at the same time. Then the polymeter starts over with both sections clapping at the same time.
>
> Use the beat grid below to block out each Rhythm Block. Put a "C" in the places where there are claps.

2. Working in pairs, students divide the top beat grid into groups of three beats by "blocking out" the **3 Rhythm Blocks**. Have them block out the bottom beat grid into groups of four beats.



3. Remind them that claps are the accented beats that always are played at the beginning of each Rhythm Block. They can put a "C" at the beginning of each Rhythm Block to see the rhythmic pattern that they played.

   Example of completed work:



4. Check that students have understood the directions.

5. Ask students to examine the lines on the beat grids and the "C" symbols to see if they can find the first place where a **3RB** and a **4RB** end at the same time. This is where the polymeter ends; on the next beat the polymeter will start again. Have pairs mark the end of the polymeter and share with the class where they think the first polymeter ends (at the end of the 12th beat).

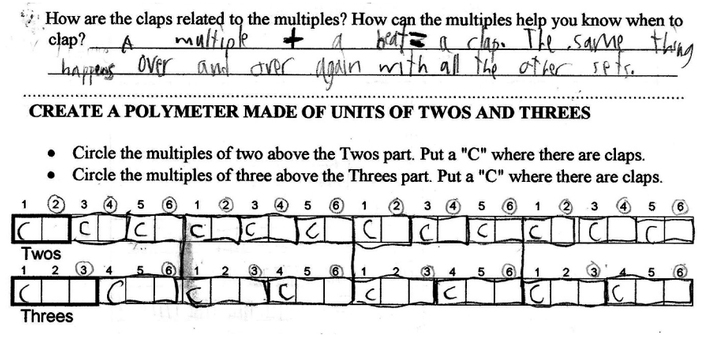
6. Discuss and answer questions one through four.

> 1. How many beats are in one polymeter made of groups of threes and fours?
> 2. Circle the multiples of three above the Threes part.
> 3. Circle the multiples of fours above the Fours part.
> 4. How can the multiples help you know when to clap?

CREATE THE 3X 2RB AND 2 X 3RB POLYMETER

7. Guide the class in creating a visual representation of a polymeter that uses repeated **2 Rhythm Blocks** for one rhythm and repeated **3 Rhythm Blocks** for the other rhythm.

   Example of completed student work, problems 4 and 5:



REVIEW THE COMMUTATIVE PROPERTY OF MULTIPLICATION

8. Student pairs do problems six through eight. Discuss as class. Ask students what they notice about the equations. Review the commutative property of multiplication. Ask questions to guide students to see that even though 3 x **2RB** and 2 x **3RB** are different rhythms, the total beats in each is the same.

6. How many beats are in one polymeter made of units of twos and threes? _____
7. Represent the Twos part of the polymeter as an equation. _____
8. Represent the Threes part of the polymeter as an equation. _____

EXTENSION

SEE DVD: LESSON 4 PART 3—2 X 3 AND 3 X 2

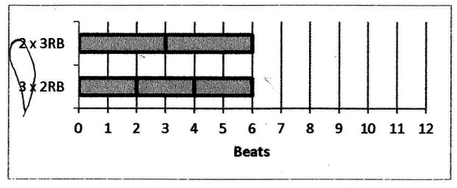
1. Play the 2 x **3RB** and 3 x **2RB** polymeter by dividing the class into two sections with one section playing the **3RB** while the other section plays the other **2RB**.

Alternatively, play one of the sections yourself and choose a student to play the other section.

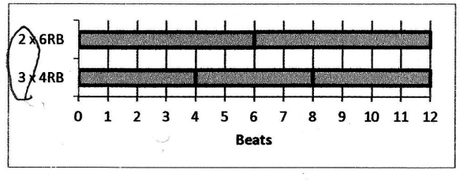
A student example of Lesson 4: Going Further is below. See Going Further section page 139 for activity.

Polymeter Diagrams

1. 2 x **3RB** and 3 x **2RB** polymeter



2. 2 x **6RB** and 3 x **4RB** polymeter



3. Use the diagrams to compare polymeters 1 and 2. How are the polymeters alike?

The rhythm blocks are all played the same amount of times.

How is the **6RB** related to the **3RB**? How are the **4RB** and **2RB** related?

The 3 is a factor of 6 and the 2 is a factor of 4.

How many times longer is the 2 x **6RB** and 3 x **4RB** polymeter than 2 x **3RB** and 3 x **2RB** polymeter? the 2x6 RB and 3x4RB is 2 times longer than 2x3RB and 3x2R