

BPM: Beats Per Minute

Sixth Grade + Math and Music

Adapted by L. Lang

CORE SUBJECT AREA

Math

ART FORM + ELEMENTS

Music: Rhythm, Form, Expression, Style

DURATION

Two 45-minute class periods

OBJECTIVES

I can describe scenarios that require musicians to use mathematics and algebraic reasoning in their work.

I can explain how to use algebraic concepts and reasoning to calculate beats per minute.

I can identify a strategy and create a model for problem solving.

I can recognize, describe, and represent linear relationships using words, tables, numerical patterns, graphs, and/or equations.

I can understand, explain, and use algebraic and numeric expressions and equations that are interconnected and build on one another to produce a coherent whole.

VOCABULARY

Equation, inequality, values, set, substitution, variable, represent, expression, rational, nonnegative, constraint, condition, infinite, solution, number line, diagram, quantity/quantities, relationship, dependent, independent.

MSCCR CREATIVE ARTS STANDARDS

MU:Re7.1.6a - Select or choose music to listen to and explain the connections to specific interests or experiences for a specific purpose.

MU:Re9.1.6a - Apply teacher-provided criteria to evaluate musical works or performances.

MSCCR STANDARDS

6.EE.B.5 - Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true?

6.EE.B.6 - Use variables to represent numbers and write expressions when solving a real-world or mathematical problem.

6.EE.B.7 - Solve real-world and mathematical problems by writing and solving equations of the form $x+p = q$ and $px = q$ for cases in which $p, q,$ and x are all non-negative rational numbers.

6.EE.B.8 - Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real world or mathematical problem.

6.EE.C.9 - Use variables to represent two quantities in a real-world problem that change in relationship to one another.

MATERIALS NEEDED

- Computer, projection screen, and speakers (for class viewing of online/downloaded video segments)
- One copy of “Math in Music: Take the challenge” answer key
- One copy of the “Math in Music: Try other music challenges” answer key For each student:
- One copy of the “Math in Music: Take the challenge” handout
- One copy of the “Math in Music: Try other music challenges” handout
- One calculator for use in Learning Activities 1 and 2 (Optional)
- Grid paper, chart paper, whiteboards/markers or other materials for students to display their math strategies used to solve the challenges in the Learning Activities.

RECOMMENDED RESOURCES

The Setup (video) Optional: an introduction to Get the Math and the professionals and student teams featured in the program.

- Math in Music: Introduction (video): Manny Dominguez and Luis Lopez of DobleFlo talk about how their duo got started, how they use math in producing hip-hop music, and set up a music related algebra challenge.
- Math in Music: Take the challenge (web interactive): In this interactive activity, users try to solve the challenge presented in the video segment, “Math in Music: Introduction,” by matching the tempo of the electronic drum track to the tempo of the instrumental sample.
- Math in Music: See how the teams solved the challenge (video): The teams use algebra to match the tempo of an electronic drum track to the tempo of an instrumental sample created by DobleFlo.
- Math in Music: Try other music challenges (web interactive): In this activity, students select from several options of instrumental samples and drum tracks and then try to match the tempo of the selected drum track to that of the selected instrumental sample.

LESSON SEQUENCE

Begin with a brief discussion about music. For example, ask students to tell you their favorite genres of music (jazz, hip-hop, pop, classical, etc.). Explain that today’s lesson will be focusing on the use of math in music. Ask students where they think mathematics might be used in music. (Possible answers include: in counting the beat, in calculating the tempo, writing rhymes, in digital music programs, etc.) Ask your students if they play a musical instrument and, if so, to describe how math can be helpful in mastering music. Explain that today’s lesson features video segments and interactives from “Get the Math”, a program that highlights how math is used in the real world. If this is your first time using the program with this class, you may choose to play the video segment “The Setup”, which introduces the professionals and student teams featured in “Get the Math”. Introduce the video segment “Math in Music: Introduction” by letting students know that you will now be showing them a segment which features musicians Manny Dominguez and Luis Lopez from Brooklyn, NY, who have formed a hip-hop duo named DobleFlo. Ask students to watch for the math that the artists are using and to write down their observations as they watch the video. After showing the segment, ask students to discuss the different ways that Manny and Luis use math in their music. (Sample responses: counting, decimals, numerical operations, ratios, rates, subtraction, elapsed time, problem solving using proportions.)

Explain that the students will now have an opportunity to solve the problem. Ask students what common rates they are familiar with in daily life. (Sample responses: miles per gallon; miles per hour, etc.) Ask students if they have ever had their pulse taken at the doctor’s office. Ask if the doctors/nurses hold their fingers on your pulse for a full minute or several minutes to find beats per minute. Explain that the word “per” means “for each” (for example, miles per gallon/miles per hour) and a rate can be represented by division. (For example, to calculate miles per gallon, the equation would be miles divided by gallons.) Explain that just like the doctors/nurses only need to calculate the pulse for a few seconds to figure out the pulse rate, the same is true for calculating the beats per minute in music. Students only need to listen to the music for a few seconds to calculate the beats per minute.

Distribute the “Math in Music: Take the challenge” handout. Note: The handout is designed to be used in conjunction with the “Math in Music: Take the challenge” activity on the “Get the Math” website. Let your students know that it is now their turn to solve the challenge DobleFlo presented to the teams in the video at the beginning of class. Ask students to work together to explore the “Math in Music Take the challenge interactive” and complete the handout. Use the “Math in Music: Take the challenge” answer key as a guide to help students explore the interactive.

- If you have multiple computers, ask students to work in small groups to explore the interactive and complete the handout.
- If you only have one computer, conduct the activity with your students as a group, so they can all hear the instrumental sample and count the total number of beats together. As students complete the challenge, encourage them to use the following 4-step mathematical modeling cycle to solve the problem:
 - Step 1: Understand the problem: Identify variables in the situation that represent essential features (For example, let “b” represent the number of beats and “t” represent the time, or specify in either seconds “s” or minutes “m”).
 - Step 2: Formulate a model by creating and selecting multiple representations (For example, students may use symbolic representations such as a proportion, or may use a chart or table to record information).
 - Step 3: Compute by analyzing and performing operations on relationships to draw conclusions (For example, operations include multiplication and algebraic transformations used to determine cross products as they solve a proportion).
 - Step 4: Interpret the results in terms of the original situation (The results of the first three steps should be examined in the context of the challenge to mix the music tracks). After students have completed the handout, ask each group to share their solutions and problem solving strategies with the class using whiteboards, chart paper, or other tools to illustrate how they solved the challenge. As students present their solutions, ask them to discuss the mathematics they used in solving the challenge. (Sample responses: counting beats, numerical operations, ratios, rates, problem solving using proportions.) Introduce the “Math in Music: See how the teams solved the challenge video” segment by letting students know that they will now be seeing how the teams in the video calculated the BPM. Ask students to observe what strategies the teams used and whether they were similar to or different from the strategies presented by the class.

EXTENDED LEARNING ACTIVITIES

Why is it useful to represent real-life situations algebraically? (Sample responses: Symbols or variables can be used to represent missing values to set up and solve equations to find a solution. Using algebra can be a simpler and efficient way to set up and solve problems by using ratios, rates, or proportions.)

SOURCES

Adapt from [Math in Music](#) (by Deborah L. Ives, Ed.D.)



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