Math and Music: Algebra Featuring Mickey Hart - Unit Plan

Grade Range: Middle School/Early High School
Subjects: Mathematics, Science
Estimated Time: 1-2 Weeks (1-2 days for each lesson and assessment)
Standards: Common Core Math Standards, Next Generation Science Standards (NGSS)

What is Math and Music: Algebra Featuring Mickey Hart?
Created in collaboration with reknown percussionist and musicologist Mickey Hart (Dead & Company, Planet Drum, Grateful Dead), this 4-lesson collection examines the mathematical and scientific principles of sound and music. Designed for 7th to 9th grade, students will:
- Conduct hands-on activities to discover the physical principles of soundwaves, and why sounds vary so widely
- Calculate, plot, and graph soundwaves based on measurable, real-world acoustic data
- Calculate pitch, tension, and frequency using Mickey Hart's famous beam instrument
- Discover the math and science behind Pythagoras' calculations of ratio, tuning, and harmony

What standards does the unit meet?
Collectively, the 4 lessons that make up the unit meet the following Math and Science standards:

Next Generation Science Standards

4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS4-1: Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Common Core Math Standards

CCSS.Math.Content.6.NS.C.6.C: Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane.

CCSS.Math.Content.6.EE.A.2: Write, read, and evaluate expressions in which letters stand for numbers.

- CCSS.Math.Content.6.EE.A.2.c: Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).

CCSS.Math.Content.6.SP.B.5: Summarize numerical data sets in relation to their context, such as by:

- CCSS.Math.Content.6.EE.A.2.c: Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).

CCSS.Math.Content.7.EE.B.3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

CCSS.Math.Content.7.CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R.

CCSS.Math.Content.7.RP.A.2 Recognize and represent proportional relationships between quantities.

CCSS.Math.Content.7.RP.A.3: Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

How will Math and Music: Algebra Featuring Mickey Hart be assessed?
Included in the unit is a summative assessment in the form of a student handout which acts as a capstone activity. In the activity, students draw upon what they learned in the 4 lessons to create their own musical riff, which they then "submit" via a letter to Mickey Hart.

This unit plan encompasses the following TeachRock content:

LESSON 1 - THE SCIENCE OF SOUND
Mastery Objective: Students will be able to explain the science behind sound waves by conducting hands-on activities.

LESSON 2 - THE MATHEMATICS BEHIND SOUND
Mastery Objective: Students will be able to identify, calculate, and visually represent the amplitude, envelope, frequency, and spectrum of a sound by closely analyzing the performance of four musical instruments.

LESSON 3 - CALCULATING PITCH
Mastery Objective: Students will be able to analyze and explain how the variables of an instrument affect the pitch it produces by experimenting with the calculation for fundamental frequency.

LESSON 4 - MUSICAL RATIOS
Mastery Objective: Students will be able to simplify ratios and find equivalent ratios using proportion by investigating rhythm in Western music, recreating the Pythagorean scale, and calculating the C scale tuning ratios.