Grade 6 Music Monday

Exploring the frequency of Sound Through Math

Arts Education: CP6.7
Demonstrate increased skills and abilities in the use of voice and instruments.

Grade 6 Math: N6.2
Demonstrate understanding of factors and multiples (concretely, pictorially, and symbolically) including:

a determining factors and multiples of numbers less than 100
b relating factors and multiples to multiplication and division
c determining and relating prime and composite numbers.

Grade 6 Math: N6.3
Demonstrate understanding of the order of operations on whole numbers (excluding exponents) with and without technology.

Part I: How does a Piano use Math in order to produce sound?

I. Introduction:
   a. Open up the piano and look inside
   b. What can we see?
   c. Any ideas on how this works?
   d. What happens when we push keys down?

II. Bridge Familiar Vocabulary (in bold)
   a. What is **vibrating** to create the sound we hear?
   b. What kind of **frequency** (speed of the vibrations) do we hear with the low **pitches**/high **pitches**?

III. Introduce the keyboard and names:
   a. Explain the 7 letters in the Musical Alphabet and how they sit on the piano
   b. Give students a picture of the piano (attached)
   c. Demonstrate what octaves are and show how the letters repeat along the keyboard (Use previous learnings about shapes to understand that an octave refers to 8 tones)

Part II: Measuring Frequencies

IV. A440
   a. Explain that each note we hear on the piano has been determined mathematically
   b. We *know* that A4 vibrates 440 times/second.
   c. We also *know* that each octave vibrates 2x faster than the previous one. We can hear this in the frequencies as we press the keys from different octaves.
   d. Students can create tables and look for patterns to help come to solutions.

V. Problem-Solving using the "Knowns"
   a. Using the 2 knowns from above, students can solve the problems attached.

Music/Math Problems:

In groups or partners, determine the solutions to the following problems using the following knowns:

1. A4 = 440 vibrations per second
2. Each *A* vibrates 2 x faster than the previous octave

1. A4 + A5 =

2. A4-A3 =

3. A2 x 2 =

4. A0 =

5. A7 =

6. Which A = 1760 vibrations/second?

7. Which A = 55 vibrations/second?

8. What can we say about how high the frequency number is in relation the sound we hear?

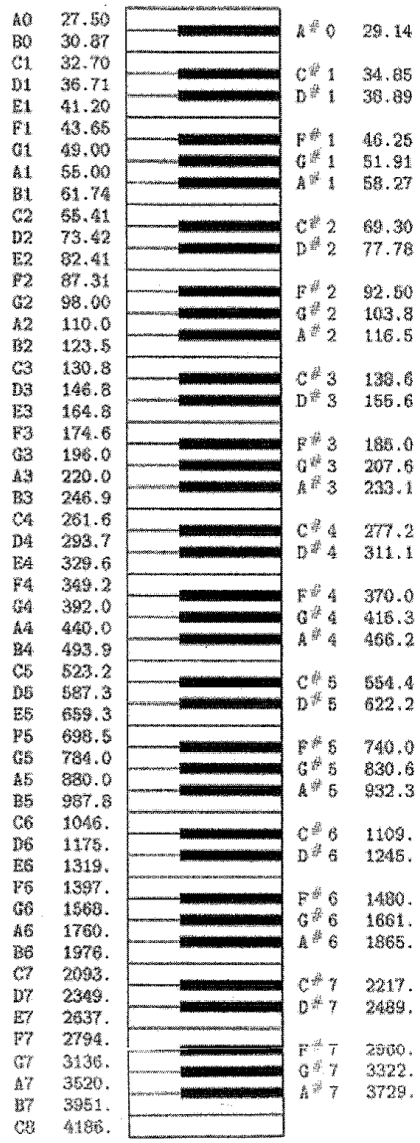
9. What can we say about how low the frequency number is in relation to the sound we hear?

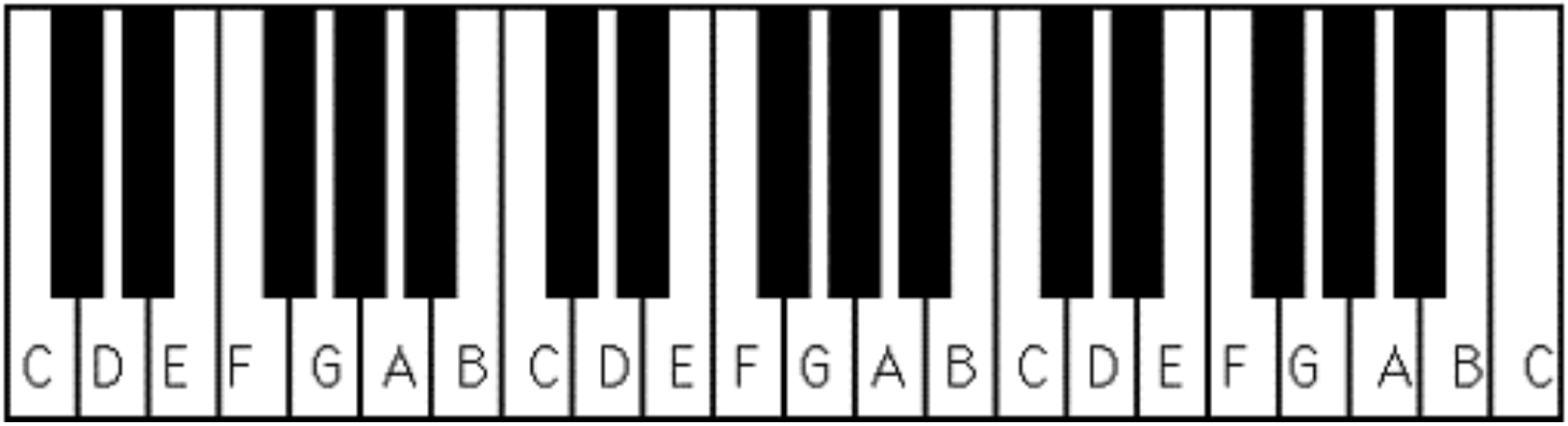
10. Which A equals the following: (A7/4) – A4

11. Can you write a problem for another group to solve?

Appendix 8 Frequencies of the piano keyboard

The standard piano keyboard has 88 keys with A4 tuned to 440 Hz and with the uniform semitone ratio $2^{1/12} = 1.05946\ldots$. The 7+ octave range (27.5 to 4186 Hz) includes the 5+ octave range (60 to 2000 Hz) of the human voice, and is included in the 10- octave range (20 to 20000 Hz) of the human ear.

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