



ALGEBRA: EVERYONE'S DOING IT

A lot of what you learn to do in algebra class you have been doing since third grade. That's right, you have been doing algebra since the time you started to count and figure out simple calculations such as how much more time you had to wait until your birthday or how long it would be until class was over. (Let's see . . . I have been here for 20 minutes and the class is 50 minutes long, so there are 30 minutes left; $50 - 20 = 30$.) Record producers also think in this way when they communicate with writers, singers, and musicians.

Record producers are responsible for overseeing all the decisions that take place in recording a song. They help the musicians and singers understand what the songwriter wants, decide which takes (recorded samples) should be kept and which need to be redone, decide how to make the sound of the instruments complement the vision of the artists and the style of the song, keep everyone happy—the list goes on and on. With all the different responsibilities a producer has and the variety of talents the job demands, are you surprised that record producers use algebra to produce hit songs? It's true, even though they may not realize it! Let's take a look at what's going on.

Musicians organize music according to something called the *beat*, a reference point that musicians use to count time in music. By counting beats, musicians know when to play or not play and

they keep track of the number of beats that pass before their part comes in. So, as you can imagine, when musicians play music they are always counting in some form or another, depending on how much they actually have to think about it. There are convenient ways to group beats together so counting is easier, sort of like you do when you buy three dozen eggs. Since eggs are packaged in groups of 12, when you buy three cartons you don't have to count to know you have 36 eggs. You can just multiply 12 by 3.

As people get used to working with music, they don't need to count at all (at least not the way you're used to). Their counting almost becomes unconscious. The seventeenth-century mathematician Gottfried Wilhelm Leibniz had a great way of expressing this: "Music is the pleasure the human soul experiences from counting without being aware it is counting." Think about that—doing mathematics without even being aware of it! You may find it hard to believe, but you do this all the time, and you have been doing it since long before you started learning mathematics in school.

In this activity you will arrange a pop rap tune by counting, doing calculations, and writing algebraic formulas in ways similar to the methods writers, musicians, and record producers use. You just might discover yourself doing algebra without even realizing it!

THE PRODUCER'S PROBLEMS

In today's activity you are playing the role of a record producer working on the timing for a rap song. For each problem, your teacher will play a section of the song. Listen to it and work through the problems as described on the worksheet.

Problem 1

The songwriter wants a rap phrase to end exactly where the band comes in on the CD track. The phrase is "Now we want to take you there." The songwriter is very picky and has these requirements for how the phrase should be sung:

- The syllables of the phrase must fall exactly on consecutive beats. There can be no words between beats and no beats between words.
- The last syllable of the phrase must fall on the same beat on which the band enters.

Where should the singer start the rap so that the requirements are met?

Problem 2

The writer wants to add another voice with the phrase "Take me there." The phrase is to be repeated four times, and the last syllable of the last repetition must land on the beat on which the band enters.

Where should the singer start the rap so that this is accomplished?

Problem 3

The songwriter would like another rap line to enter on the same beat on which the bass guitar enters and he would like this rap line to repeat three times. As with the raps before it, he wants the syllables to fall on consecutive beats with the last syllable falling on the beat on which the band enters. To write the words he needs to know how many syllables the phrase must have.

How many syllables must the rap phrase have?

Problem 4

To add more variety, the songwriter wants one last phrase to be sung. This phrase is different from the others in that it does not immediately repeat. The songwriter wants the phrase "I'm there" to be followed by two empty beats. It is sung five times and ends so that the word *there* of the last cycle lands on the same beat on which the band enters.

Where should the singer start the rap so that this is accomplished?

Problem 5

No problem! Perform all the rap parts together as a class. If you don't like how the parts fit together, you can change them and use the formulas you created to help the class perform them correctly.

The Producer's Workstation (continued)

- c. Solve the problem using an algebraic equation. Let x represent the number of beats before the singer enters.
- d. Generalize the problem and write a formula for how you could direct a singer to enter for any number of repetitions, n , of the same phrase. Let x be the number of beats before the singer enters.

Problem 3

- a. Use an algebraic equation to solve this problem. Let r represent the length of the rap phrase.
- b. After you have found the number of syllables for the phrase, make up some words for the phrase and volunteer to rap it with the CD track. Write your words below.
- c. Generalize the problem and write a formula for the length, r , of a rap phrase repeated n times.
- d. Generalize the problem further and write a formula for the length, r , of a rap phrase, letting x represent the number of beats before the rap starts and n the number of repetitions.
- e. Generalize the problem completely and write a formula for r if the entire CD track before the band enters is B beats. Create three more formulas by solving for x , n , and B .

