Percussion Instruments

The Movie:

There's a lot more to percussion instruments than a set of drums. Featured: Emil Richards, percussionist. *(Movie length: 2:09)*

Background:

Why is it that when you beat, tap or hammer on some objects you get nothing but a "thud", while on others you get pure ringing tones? The answer lies in the science of vibrations and resonance, which is nowhere better exemplified than in the design, manufacture and use of percussion instruments.

Curriculum Connections:

Geometry (solid figures) 1

Determine the volume of each of these types of drums:

	Diameter	Height
Snare Drum	14"	5"
Tom	9"	10"
Bass Drum	40"	12"

Algebra (exponents) 2

For one type of xylophone, the ratio of the lengths of two adjacent bars is given by the following formula:

$$\frac{length\ of\ bar\ for\ next\ higher\ pitch}{length\ of\ bar} = 2^{-1/24}$$

a) Suppose that the length of the bar for the note "A above middle C" is exactly 8.75 inches. What would be the length of the next bar (for the next higher pitch)?

b) An octave is 12 notes. What is the ratio of the length of one bar to that of the bar one octave up?

c) Find the expression for the ratio of the lengths of two bars which are N notes apart from each other.

Cowbell Concerts

To: Research Team

From: Research Director

As you know, it's an important part of our program to get young people interested in music, but it is often difficult to find instruments for them. I would like you to investigate the use of food cans for this purpose, as follows:

1. Gather a collection of food cans of various sizes. They should be empty and cleaned, with all paper removed, one end open and the other closed:

open

no covering
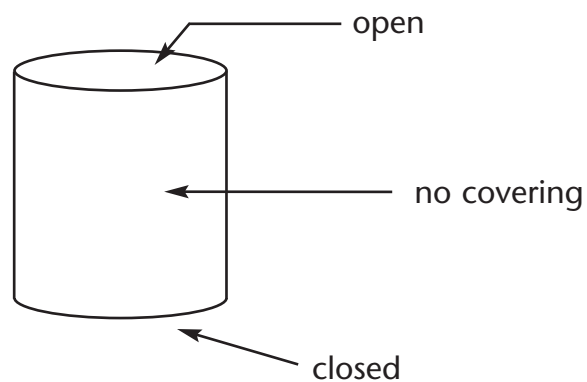
closed

2. Choose one can and squeeze the open end on two sides so as to form an elliptical opening.
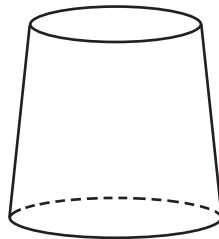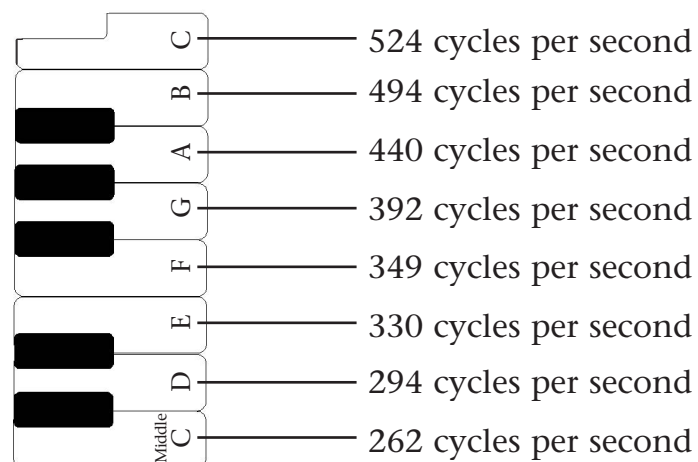
3. Holding the can lightly at the closed end, tap on the open end with a spoon or fork. You should hear a distinct tone.

4. Bend the open end of the can so that it is slightly more closed. Tap again, and notice that the tone is a little lower.

5. Your task is to use 5 cans in this fashion to make five different tones which match tones produced by keys on the piano. Then make measurements as needed to fill out this chart:

Can #	radius of closed end	height of can	ratio of height to radius	long width of open end	short width of open end	ratio of long width to short width	frequency of tone produced
1							
2							
3							
4							
5							

To determine the frequency, use the information provided in this diagram, plus the fact that when you go down an octave on a piano, you halve the frequency of the tone:

C — 524 cycles per second
B — 494 cycles per second
A — 440 cycles per second
G — 392 cycles per second
F — 349 cycles per second
E — 330 cycles per second
D — 294 cycles per second
Middle C — 262 cycles per second

6. Study your data. What is the relationship, if any, between the measurements of the cans and the frequencies produced?

Teaching Guidelines: Cowbell Concerts
Math Topics: Algebra (patterns and functions)

What is most important in this activity is that students identify the variables involved (the various dimensions of the cans and the frequencies of the ones produced), and then see that there is a relationship between those dimensions.

In investigating those relationships, it may be helpful to combine data from all students, and then look for patterns. For example, look at the data all cans with the same height and radius. How does the frequency vary with the ratio of long width to short width?

With more advanced students, you may wish to ask them to try to find the algebraic functions that represent the relationships they discover. With less advanced students, ask them to look for patterns of "increasing" and "decreasing". With all students, it is a good idea to ask them to make a prediction for a can size that they haven't yet tried out, and test that prediction.

Algebra 4

Materials (for each student): Two pencils, three "rhythm instruments" (For this activity, a rhythm instrument can be almost anything that is portable. Cups or glasses, staplers, tape dispensers, markers, etc. are suitable.)

Tell students that this lesson has to do with patterns, and ensure through discussion and examples that they understand what a "pattern" is.

Explain that in this activity their assignment will be to create a pattern and come up with a way of describing that pattern so that another person can produce the same pattern. The pattern they will create will be a pattern of sounds.

Arrange the students into teams of two. Make sure each student has two pencils and three rhythm instruments of some kind, and then have the teams split up to opposite sides of the room.

Each student is to first create a sound pattern, using his or her pencils and rhythm instruments. It should be relatively short—between 5 and 10 seconds. It should use all three rhythm instruments.

Once they have created their pattern, each student is to find some way to write it down as a single line of symbols.

They will need to find a way to show how quickly or slowly the instruments should be struck, and also the volume of the sound produced (loud or soft). They may not use any words in this description—only letters, numbers and punctuation marks. Standard music notation is not to be used.

Give students 20 minutes to create their patterns and write them down. Once all students have created their patterns, they are to meet with their partners and exchange their written pattern descriptions. Students may not explain anything about their descriptions to their partners, and they may not demonstrate the pattern. However, they may revise their written descriptions to try to improve them.

Give students another 20 minutes to try to re-create the patterns that their partners created, from the descriptions. Then call a halt to the activity and have some of the teams describe their experiences. As they do so, have the partners play the patterns as best they can based on the written descriptions, and then have the students play the original patterns so that they can be compared.

Wrap up with a discussion of what students discovered as they did this activity.

If you enjoyed this Futures Channel Movie, you will probably also like these:

The Bose Speaker, #1017	"You can never do anything better unless it is different," according to Dr. Amar Bose, who uses the rules of mathematics to achieve superior sound quality in his Bose radio and speakers.
Drumming in Fractions, #4001	Understanding fractions is the most essential skill of playing the drums.
Music for Movies, #4006	To write and play music, you need to know how to work with patterns.