

Musical Bottles

Teacher Notes

In this activity each group of students will play a song by blowing on a set of bottles that they have tuned to the correct frequencies. This is the culminating section of the music unit in which the students are to use the information gained in the earlier sections. In particular, they will need to use the frequency chart from the final monochord activity.

Instructional Time Required for This Section

Two to three hours

Required Materials

- student activity sheet, one per student
- a song page (see the songs in the Resources section of these Teacher Notes) for each member of a group
- graphing calculator loaded with the frequency program and the programs required to collect the sound data, one per group
- data collection device with a microphone and appropriate cords to connect data collection device, graphing calculator, and microphone, one per group. If you have access to a computer setup that can be used to collect sound data, the accuracy of the tuning will be better than a calculator setup. A computer can collect more data in a shorter amount of time, and some of the computer collection programs contain a fast Fourier transform feature that allows the user to see the fundamental frequency of the sound.
- computer programs from the Examining Sound section (Resources section of Examining Sound)
- a set of 6 or 7 glass cold drink bottles (preferably the same type) for each group
- a carton to hold the bottles, labeled with the names of the students in the group. Collect these cartons in a specific location in the room so that the materials for different classes do not get confused.
- water bucket (a pickle bucket is perfect)
- large cup to be used to pour the water into the bottles. A two-cup measuring cup with a pour spout helps control the amount of water being poured into the bottles. The handle can be hooked onto the water bucket for easy access.
- disinfectant wipes for cleaning the mouths of the bottles; ask the nurse for a large container of these

- Plastic wrap for each bottle. When the bottle is tuned, cover the top of the bottle with plastic wrap and secure in place with a rubber band.
- rubber band for each bottle (keep the supply in your pocket in order to control the flight of these objects)
- masking tape to use to mark the water level and to label the note name
- marker for labeling the bottles and the cartons
- lots of paper towels to clean up the spilled water

Suggested Materials

- set of tuning forks (you should be able to borrow these from the science department)
- pitchpipe
- a physics teacher to use as a resource

Procedures

Preparation:

- *before the unit* – Practice doing this activity. Make sure that you understand how to use the equipment and that you can produce sound by blowing on a bottle. Working with a science teacher who is accustomed to setting up labs will be very helpful.
- *before the activity* - have the students choose the song for their group
- make one copy of the group song for each member of the group
- Arrange the room so that there is as much space as possible between groups. The groups will need to hear their own sounds. Fill the large bucket with water and set out the supplies for sealing and marking the finished bottles. Make sure that the bottle cartons are labeled with the names of the groups.

Ask the students to clean the tops of the bottles with the disinfectant wipes.

Teach the students how to make sound by blowing on a bottle. Tell them to hold the bottle next to the middle of their bottom lip and to blow across the top of the bottle with enough pressure to create a tune. This is similar to how flutists make sound on their flutes, so flute players can be used a resource.

Review the use of the graphing calculator and data collection equipment. Explain that as the height of the water in the bottle increases, the pitch of the sound will increase.

When collecting data, hold the microphone so that air is not directly blown onto the microphone. The microphone collects vibrations and the air motion can distort the measurement. Try holding the microphone to the side or above the air flow.

Musical sounds produce overtones which keep the sound waves from being perfect sine waves. Tell the students to look for periodic patterns, not perfect sine graphs. The frequencies being collected are between 200 and 400 cycles per second; expect to have to blow on the bottles several times in order to get good readings.

The students need to tune one bottle for each note in their song.

When the groups complete their tuning, send them outside to practice the song.

Assessment

Check for the correct frequencies as the students tune the bottles (if you have an ear for pitches, this is where you might want to use a tuning fork or pitchpipe to evaluate whether the pitches are correct). While the groups are practicing, make any needed adjustments to the pitches by adding or deleting water.

When all of the groups are ready, invite an audience and give a recital. Grade the performance for the accuracy of the song. Plan to assess on effort not just accuracy; this is a place where effort is more important than the actual results. Be sure that students are evaluated on whether they understand the concept of frequency, not their musical ability.

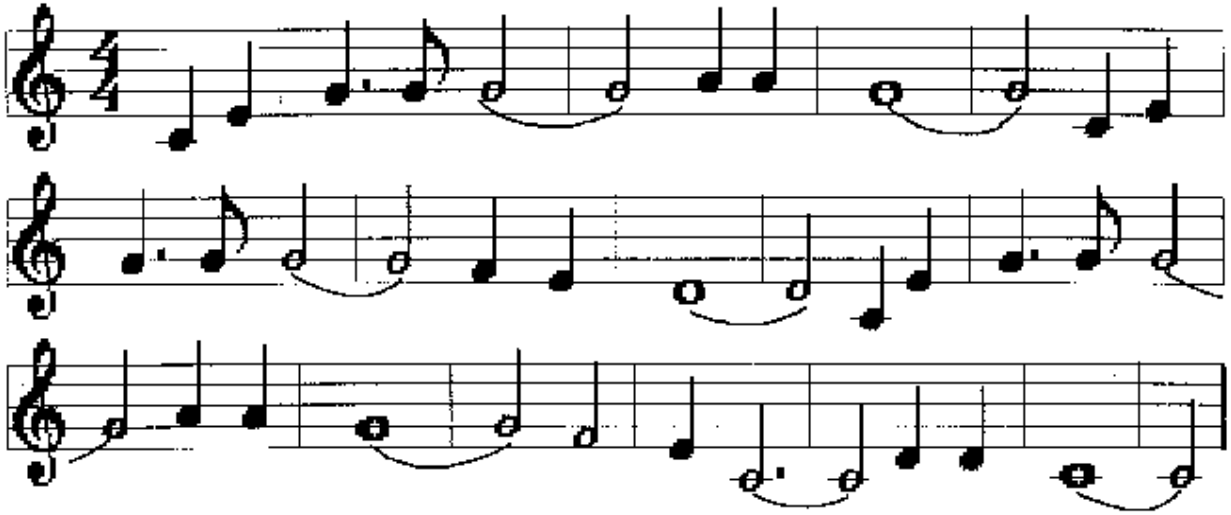
A Grading Form is provided in the Resources section of these Teacher Notes as an aid to the teacher; its use is optional. It summarizes, for each student, the song performed and the notes and frequencies for each note of the group's song. It also gives the students an opportunity to evaluate the participation of the members of their group (including themselves).

Musical Bottles Resources

The songs for musical bottles and the Grading Form follow.

Kum-Ba-Ya

(6 notes – C, D, E, F, G, A)



C	E	G	G	G	A	A	G	C	E
G	G	G	F	E	D	C	E	G	G
G	A	A	G	F	E	C	D	D	C

Mary Had a Little Lamb

(4 notes – C, D, E, G)



E D C D E E E D D D E G
G E D C D E E E E D D E
D C

(Repeat from the beginning.)

This Old Man

(6 notes – D, E, F#, G, A, B)



A F# A A F# A B A G F# E F#
G A D D D D D E F# G A A
E E G F# E D

Row, Row, Row Your Boat

(6 notes – C, D, E, F, G, C_{high})



C	C	C	D	E	E	D	E	F	G	C _{high}
C _{high}	C _{high}	G	G	G	E	E	E	C	C	C
G	F	E	D	C						

Scotland's Burning

(5 notes – C, F, G, A, C_{high})



C	C	F	F	C	C	F	F	G	A
G	A	C _{high}	C _{high}	C _{high}	C _{high}	C	C	F	F
C	C	F	F						

Puffer Billies

(7 notes – C, D, E, F, G, A, C_{high})



C	C	C	E	E	F	F	F	F	E
E	C	C	C	C	E	E	E	E	D
D	D	C	C	D	E	F	G	G	A
A	A	G	G	C	C	C _{high}	C _{high}	C	D
C									

Amazing Grace

(6 notes – D, E, G, A, B, D_{high})



D	G	B	G	B	A	G	E	D	D
G	B	G	B	A	D _{high}	B	D _{high}	D _{high}	B
G	D	E	G	G	E	D	D	G	B
G	B	A	G						

Shoo Fly

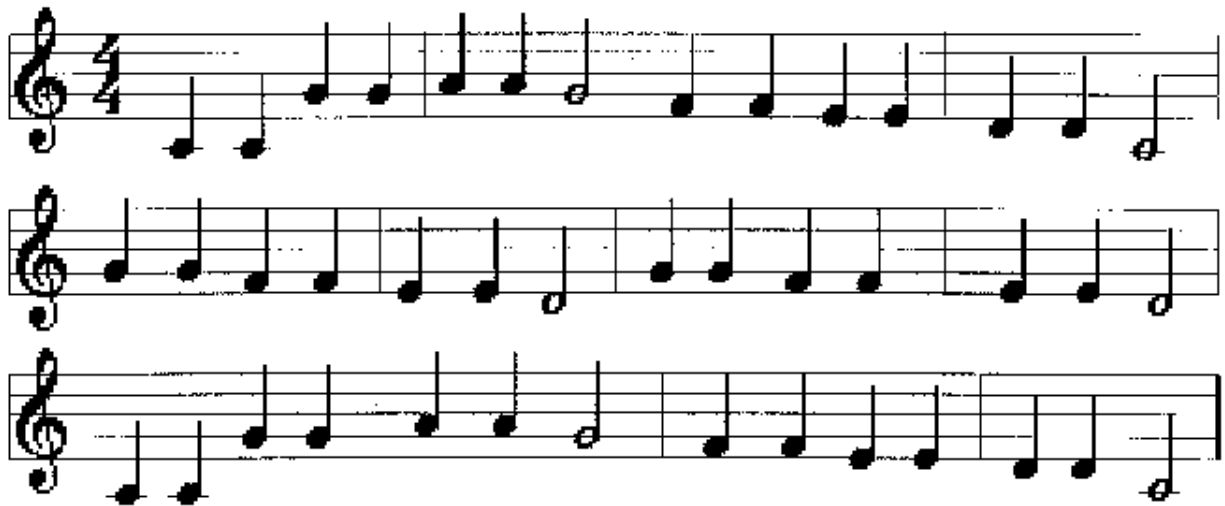
(6 notes – E, F, G, A, B \flat , C_{high})



A F G A B \flat G G E F G
A F A F G A B \flat G C_{high} C_{high}
C_{high} B \flat A A G F

Twinkle Twinkle Little Star

(6 notes – D, D, E, F, G, A)



C	C	G	G	A	A	G	F	F	E	E	D
D	C	G	G	F	F	E	E	D	G	G	F
F	E	E	D	C	C	G	G	A	A	G	F
F	E	E	D	D	C						

Musical Bottles Grading Form

Your Name

1. Name of your song

2. List the notes of your song and the frequency for each note.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

3. List the members of your group, including yourself, and give each person a grade for their participation in the activity.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Musical Bottles

This is a group activity in which each group will play a song on a set of bottles that are tuned by the group. Each group must select a song from the list provided.

Your group should have one bottle for each note in your song and a container in which to keep the bottles. Label each bottle with your name and the frequency that it is to have.

You will tune the bottles by adding water and checking the frequency with the graphing calculator, data collection device, and the microphone. The program will collect data for only 0.5 seconds, so begin the sound before starting to collect data.

When you blow on the bottle, do not blow directly at the microphone since this will alter the data that is collected. Try holding the microphone close to the bottle, but a little to the side.

If you use one of the songs provided, the lowest note C will have a frequency of approximately 262 hertz. The highest note, Dhigh, is approximate 494 hertz.

The frequency of an empty IBC root beer bottle is approximately 220 hertz. This, of course, could vary from bottle to bottle.

When all of the groups are ready, we will have a “recital”. Your grade will depend on the accuracy of the tuning and the quality of the “performance.”