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The Music Of Sound

See It. Don't Just Hear It!

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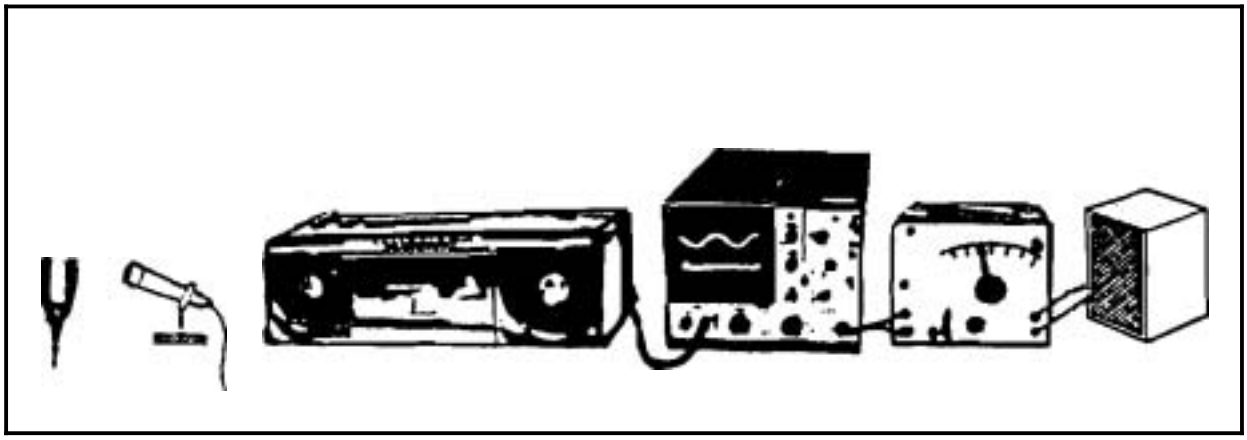

FIGURE 1. A SYSTEM FOR DISPLAYING SOUND WAVES
(From L to R: Turning Fork, FM microphone, Radio, Oscilloscope, Signal Generator, Loudspeaker)

~Ooooh! That's fun! How does it look like? Aah! Now I see it!" Those are the sounds of excitement .... and understanding from your students when they are invited to sing into a microphone and take a good look at the shape of the sound waves.

Many science teachers know that a display of sound waves with the aid of an oscillioscope is necessary for making a lesson on SOUND an exciting, meaningful voyage of discovery. They have often tried to meet this requirement by using an ordinary microphone which is directly connected to an.oscilloscope as suggested in some Physics textbooks (see References). The experimental results, however, have often been unsatisfactory due to a number of technical problems.

In showing my students how sound waves look like, I found that the results can be improved by having the sound signals adequately amplified before they are fed to the oscilloscope for display. This is achieved by employing a few common electronic instruments to set up the FM sound system as shown In the above diagram (Fig. 1).

Teachers can easily instruct students on how to set up the simple sound system and carry out the following activities: .

WHAT YOU NEED

FM Microphone	Signal Generator
FM Radio	Loudspeaker
Oscilloscope (CRO)	Tuning Forks

WHAT YOU AND YOUR STUDENTS CAN DO

SETTING UP THE SOUND SYSTEM

1 Connect the loudspeaker terminals of a radio to the input of an oscilloscope. It may be necessary to open the back cover of the radio to make this connection.

2 Switch on the oscilloscope and make the normal adjustments for displaying AC waveforms.

3 Switch on the radio and tune in to a FM radio station, such as the Radio 10 operating at 98.7 MHz. By setting the CRO VOLTS/CM control and the TIME-BASE control to the appropriate positions, the CRO screen will show waveforms of the sounds coming out from the radio. Observe the constantly changing waveforms.

4 Ask a student to switch on the FM microphone and place it in front of the radio loudspeaker. Adjust the radio frequency dial to a position which coincides with the frequency of the FM microphone. At some critical position, the radio will give off a high-pitch sound indicating that the FM microphone and the radio are both operating at the same frequency. The FM microphone can now be used to pick up whatever sounds for the oscilloscope to display.

LOOKING AT THE SHAPE OF SOUND WAVES

5 Ask students to sound a few tuning torks of different frequencies and place them near the FM microphone. Listen carefully to the sound made by each tuning fork and observe the corresponding waveform. Look at the waves made by a low-pitched sound and a high-pitched sound. Which sound has a higher frequency? In what way is the loudness of the sound related to its amplitude?

6. Invite a few students to sing doh, re, me, fah, soh or say A, B, C, D and E into the microphone. Do they sound the same in quality? Observe and compare the waveforms of the same note made by different people. What is the relationship between the quality and shape of the same note?

7. As the FM microphone is portable, it can be used to pick up the musical notes from instruments that are situated quite far away from the oscilloscope. Get students to play the same note on a piano, harmonica, flute and a violin. Observe the waveforms of the same note produced by different instruments. Do they all look the same?

8. Connect the two terminals of a loudspeaker to the output of a signal generator. Also connect the output of the signal generator to the second INPUT terminal of the double-beam oscilloscope. A single-beam oscilloscope with only one INPUT terminal can also be used. This will enable you to listen to the sound produced by the signal generator and observe the corresponding waveforms simultaneously. Adjust the signal generator frequency dial to produce sounds with frequencies ranging from 20 Hz to 20 KHz. Find out the range of frequencies your students can hear comfortably. Sounds with frequencies higher than 20 KHz are called ultrasonic sounds. Can your students hear the ultrasonic sounds? Can the ultrasonic sounds be displayed on the screen of your oscilloscope?

REINFORCING THE SCIENCE CONCEPTS

9. The preceding activities are designed to provide students with hands-on experience in setting up a simple FM sound system and investigating the nature of sound waves. Alternatively, teachers can integrate these activities with the related theory lessons to reinforce the following concepts:

* Sound is produced by vibration and it travels in longitudinal waves.

* Regular vibrations produce sounds in the form of speeches or musical notes whereas irregular vibrations give rise to noise.

* Musical notes have three properties, namely pitch, loudness and quality. In some ways, speech is a form of music as it has a definite pitch, a definite loudness and a certain quality.

* A high-pitched note has a high frequency and a short wavelength.

* The loudness of a sound depends on its amplitude and is measured in decibels (dB).

* The same note made by different people or instruments (at the same pitch and the same loudness) does not sound the same. A piano and a guitar, for example, can be distinguished by the quality of the notes they produce. The quality depends on the shape of the sound wave.

* People can hear sounds as low as 20 Hz (20 cycles per second) and as high as 20,000 Hz. Only some animals (like dogs and bats) can hear ultrasonic sounds.

CONCLUSION

Teaching sound can be fun and exciting when students are actively involved in the learning process. By using an inexpensive wireless FM microphone obtainable from any electronics supermarket, teachers can be assured of success in carrying out the suggested activities to promote learning with understanding. There is no doubt that the making of music and sound waves in the classroom or laboratory will prove to be most welcome by students.

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