

If music be the food of physics, play on. [See Shakespeare, *Twelfth Night*, line 1.]

An orchestra contains stringed instruments, whose sound depends on transverse standing waves on strings, and wind instruments whose sound originates in longitudinal standing waves of an air column. Percussion instruments create more complicated standing waves.

Besides examining sources of sound, we also study the decibel scale of sound level, the ear's response, sound wave interference and beats, the Doppler effect, shock waves and sonic booms, and ultrasound imaging.



CHAPTER 12

Sound

Sound is associated with our sense of hearing and, therefore, with the physiology of our ears and the psychology of our brain, which interprets the sensations that reach our ears. The term *sound* also refers to the physical sensation that stimulates our ears: namely, longitudinal waves.

We can distinguish three aspects of any sound. First, there must be a *source* for a sound; as with any wave, the source of a sound wave is a vibrating object. Second, the energy is transferred from the source in the form of longitudinal sound *waves*. And third, the sound is *detected* by an ear or by a microphone. We start this Chapter by looking at some aspects of sound waves themselves.

12-1 Characteristics of Sound

We saw in Chapter 11, Fig. 11-25, how a vibrating drumhead produces a sound wave in air. Indeed, we usually think of sound waves traveling in the air, for normally it is the vibrations of the air that force our eardrums to vibrate. But sound waves can also travel in other materials.