

## Sound Off [Activity]

This is a great one! It is actually a demo, but so impressive that students will appreciate doing it themselves. They'll one day remember it nostalgically when anti-noise technology is commonplace.

You'll want to have your department invest in a common "boom box" and insert a DPDT switch in one of the speaker wires. This will likely become a routine demo in all courses where interference is taught.

Where does the energy go when sound is canceled? It turns out that each loudspeaker is also a microphone. When the speakers face each other they "drive" each other, inducing back voltages in each other that cut the currents down in each. Thus energy is diminished, but not canceled. So as the speakers are brought closer, and as sound is diminished, the electric bill for powering the sound source diminishes accordingly!

### *Answers to the Questions*

1. Volume is "normal" when speakers are in phase.
2. When out of phase, cancellation of sound occurs as regions of compression from one speaker fill in regions of rarefaction from the other. If the overlap of out of phase waves is exact, then complete cancellation occurs (barring stray waves). Exact overlap cannot occur, however, because of the displacement between the speaker cones. So much of the interference is partial. For long waves, the displacement of the speaker cones is small compared to their wavelength, overlap is relatively exact, and these waves cancel well. But overlap is less exact for shorter wavelengths, producing cancellation that is more partial. For very short waves, reinforcement rather than cancellation occurs. This occurs if the displacement of the cones is a half wavelength of such higher-frequency sound. Then overlap is *in* phase. So for these reasons, high frequency sound survives, giving the music that "tinny" sound.
3. Answers will vary. But interestingly enough, students were asked twenty-five years ago for the practical applications for a laser. Today we ask the same question at the outset period of a growing anti-noise technology.