613-0018 (55-200) Audio Generator

⇧ Sine ⇧ Square

Additional Materials Needed:

Introduction: Sound is an interesting phenomenon. Nearly every physical event has a unique sound associated with it. By itself, sound travels through a medium in sinusoidal waves. This means that it needs a material to propagate through, and that if graphed, the sound waves follow a sine curve. In air at sea level, sound travels approximately 343 m/s (767 mph). It travels at 1482 m/s (3,315 mph) in fresh water at 20^0 C. However, a problem with natural sounds is that they are difficult to experiment with in a laboratory. Among other issues, it is difficult to capture recordings of natural sounds without distortion. For experimental purposes, it is much better to use an audio generator.

Audio, or signal generators are devices that can produce a wide variety of sounds. Our device is capable of generating between 0.1Hz and 200 kHz. Unlike normal sounds, it can generate square as well as sine waves (a separate jack for each is provided). Square waves are signals that instantaneously shift between two separate levels. For convenience, it has four levels: 100 Hz, 1 kHz, 10 kHz, and 100 kHz. A knob located in the upper right corner precisely controls the frequency. There is also a jack for a 5.5-watt speaker, which is controlled by a dedicated amplitude knob. The entire unit runs on a low voltage 110 V AC. An included cord allows you to plug the device into a wall outlet.

Experiments:

An exciting way to use your audio generator is to attach it to an oscilloscope. An oscilloscope is a device that can display signal voltages in two dimensions. In other words, it allows one to view electrical waves. One advantage to this is if you attach an audio generator to it, the oscilloscope will show a representation of the sound wave. Since it is impossible to see sound directly, the oscilloscope is a very good way of showing it. You can use our audio generator to produce the signal needed to drive the oscilloscope. After plugging it in, try different frequencies and see what they look like. Observe the difference between pure sinusoidal waves and square ones by plugging into either sine or square wave jacks. You will notice that lower frequencies are close to a flat line, whereas higher ones may exceed the display capabilities of your oscilloscope.

Another interesting use of the audio generator is in conjunction with a small loudspeaker. Our unit can drive a speaker of up to 5.5 watts, using a shielded jack. A normal human ear can detect frequencies between 20 Hz and 20 kHz. This upper range often deteriorates with age. Using the speaker, determine what the ranges of your students' ears are. You can set up an experiment that takes certain criteria such as age, sex, and other variables into account.

If you have access to a vibration generator, you can use the audio generator for a number of exciting demonstrations. It can be used in conjunction with sonometers, Kundt's tube, and Chladni plates by plugging into the amplifier jack.

A Chladni plate is essentially a metal plate fixed atop a vibration generator or speaker. When attached to an audio generator, the plate will resonate at the same frequency. Pour salt onto the plate and set the audio generator to the desired frequency. You will find that some frequencies will merely cause the salt to dance, whereas others compel it to form patterns. These patterns can be beautiful, and they show the nodal regions of the wave. Because you can generate a wide range of frequencies with our audio generator, many different patterns can be formed using the Chladni Plates. Sand, chalk dust, and similar substances will work instead of salt.

Kundt's tube is an interesting apparatus. It is used to measure the speed of sound in air. It consists of a glass tube, with a metal rod held in the center. A disc on the end of the rod nearly fits the tube. It cannot touch it or the glass will shatter, so it is slightly smaller. This disc also acts as an adjustable stop for sound waves. A stopper closes the other end of the tube.

To use the Kundt's tube, attach the audio generator to a vibration generator or a small speaker. This in turn needs to be attached to a plate, which is held against the metal rod. This will allow you to use the audio generator to set up vibrations in the rod. Spread a layer of chalk dust approximately 2mm thick throughout the entire length of the tube. Make sure to replace the stopper. Next, adjust the frequency until the rod resonates, which is indicated by the rod ringing loudly. The vibrations in the rod are transmitted through the disc into the air. Standing waves will be produced at the resonant frequency of the tube which will cause the dust to gather in heaps. If you measure the distance between the centers of the heaps, you can calculate the speed of sound. Twice the distance between the heaps is the wavelength of the sound waves. The velocity of any wave is given by the equation V=fl, where f is the frequency and l is the wavelength. The frequency will be displayed on the screen of the audio generator. In this way, you can calculate the speed of sound in air.

Warranty and Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

Benchmarks for Science Literacy				National Science Education Standard
Grades 9 – 12 **The Physical Setting**	4F/H5ab.	The observed wavelength of a wave depends upon the relative motion of the source and the observer. If either is moving toward the other, the observed wavelength is shorter; if either is moving away, the wavelength is longer.	Grades 9-12 **Physical Science Content Standard B.6**-Interactions of Energy and Matter	"Waves, including sound and seismic waves, waves on water and light waves have energy and can transfer energy when they interact with matter."

May we suggest:

613-0075 Hand Cranked Wave Model: Demonstrate transverse waves with our low friction, easy to use model. Simply turn the crank to generate longitudinal and transverse waves.

613-0015 Ripple Tank: Project waves onto a 10 x 9" screen for viewing from a distance. Tune the wave generation of this self-contained easy-to-use apparatus to match the stroboscopic light. We include light source, adjustable 2 and 3 prong wave generators, 2 baffles and removable 12 x 10" basin.

613-0010 Vibration Generator: This device produces a low frequency mechanical oscillation with a range of 0.5 to 5000 Hz. Mount springs, chladni plates or cords to learn about oscillations and resonance. 90 x 90 x 100 mm. 15 W. You need wave function generator, not included.

613-0115 Dynamic Microphone: Unidirectional microphone, features include: 9 foot cord, 1/4" (6.3mm) adaptor, 1/8" (3.5mm) adaptor and on-off switch.

613-0000 Resonance Wave Demonstrator: In physics, resonance is the tendency for materials to oscillate at maximum amplitude at certain frequencies. in other words, under the right conditions, materials will vibrate at their maximum rate.
This device consists of an aluminum tube bolted to a steel base. Easy to use.

613-0005 Resonance Apparatus with Stand: Investigate the length, frequency and velocity of sound waves by studying the resonance of air columns. We attach a movable container to a 80 cm long transparent tube that is mounted on a stand. Fill the container with water and strike a tuning fork above the top of the tube. The reverberated tuning fork becomes louder or softer depending on the location of the water. Tuning fork not included.