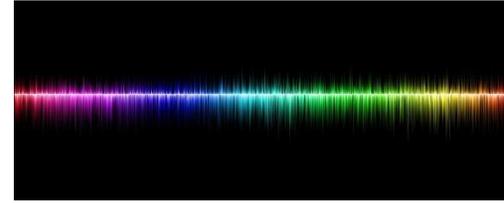




# DIY Air Force Activities:

## Musical bottles



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### Materials:

- 2-8 identical empty 12 oz glass bottles (Jones soda bottles work well)
- water (1.5+ cups. The amount of water depends on your number of bottles)
- metal spoon
- paper and pencil/pen to record your observations

\*\*optional: food coloring

Sound, like light, travels in waves. Sound waves, however, travel a lot slower (1,100 ft per second vs 186,000 miles per second)! Sound waves also require a medium (matter: solid, liquid, or gas) to travel through. These types of waves are referred to as mechanical waves. The sound wave involves the oscillation (movement back and forth) of matter as well as the transfer of energy. Think of a rope or a water wave. The amplitude (height) of the wave tells you how loud it is, while the frequency (number of waves) affects the pitch: more waves = higher pitch, less waves = lower pitch. The science of sound is all about vibrations. Let's experiment and explore!

1. Add 1.5 cups of water to one bottle and no water to another. Tap each bottle with a spoon and record your observations.
2. Now blow across the openings and record your observations again. Did anything change?

You should notice that when you tap your spoon against the bottle with water it makes a lower pitched sound than the empty bottle. However, when you blow across the top the result is a higher pitched sound. How is this possible?! The answer is the change in media. When you tap, it is the glass vibrating. When there is more water in the bottle, the vibrations are damped (reduced). The glass vibrates slower (lower frequency) and the pitch is lower. When the bottle is empty, the glass vibrates faster (higher frequency) and the pitch is higher. Blowing across the top causes the air inside to vibrate. An empty bottle gives the air room to vibrate, the waves are slower and the pitch is lower. More water means a tighter space for the air; it bounces off the water and vibrates faster, raising the pitch. Music is all about using different vibrations to create beautiful sounds! Take your remaining bottles and fill them in increments, if the bottles are clear you can use the food coloring to make the water pretty. You now have a musical scale! Can you see the vibrations in the water??? What music will you play? Add and remove water to tune your instruments!



### Air Force Associations:

Sound waves in jet and rocket engines can be very problematic. They can lead to unstable combustion and cause catastrophic engine failure. Finding a solution to the problem requires an in-depth knowledge of the complicated fluid mechanical and acoustic interactions in these complex engines. Air Force researchers are using simulations, high speed cameras and optical probes to capture the formation and movements of sound waves within the engines. They are hopeful that dampening devices and adjustments in injector distribution will help solve this issue.

