

## 10.6: Frequency and Pitch of Sound



Figure 12.4.1

A marching band passes you as it parades down the street. You heard it coming from several blocks away. Now that the different instruments have finally reached you, their distinctive sounds can be heard. The tiny piccolos trill their bird-like high notes, and the big tubas rumble out their booming bass notes. Clearly, some sounds are higher or lower than others.

### High or Low

How high or low a sound seems to a listener is its **pitch**. Pitch, in turn, depends on the frequency of sound waves. **Wave frequency** is the number of waves that pass a fixed point in a given amount of time. High-pitched sounds, like the sounds of the piccolo in the Figure below, have high-frequency waves. Low-pitched sounds, like the sounds of the tuba Figure below, have low-frequency waves.



A piccolo produces high-frequency sound waves and high-pitched sounds.



A tuba produces low-frequency sound waves and low-pitched sounds.



Figure 12.4.2

## Can You Hear It?

The frequency of sound waves is measured in hertz (Hz), or the number of waves that pass a fixed point in a second. Human beings can normally hear sounds with a frequency between about 20 Hz and 20,000 Hz. Sounds with frequencies below 20 hertz are called **infrasound**. Infrasound is too low-pitched for humans to hear. Sounds with frequencies above 20,000 hertz are called **ultrasound**. Ultrasound is too high-pitched for humans to hear.

Some other animals can hear sounds in the ultrasound range. For example, dogs can hear sounds with frequencies as high as 50,000 Hz. You may have seen special whistles that dogs—but not people—can hear. The whistles produce sounds with frequencies too high for the human ear to detect. Other animals can hear even higher-frequency sounds. Bats, like the one pictured in the Figure below, can hear sounds with frequencies higher than 100,000 Hz!



Figure 12.4.3

**Q:** Bats use ultrasound to navigate in the dark. Can you explain how?

**A:** Bats send out ultrasound waves, which reflect back from objects ahead of them. They sense the reflected sound waves and use the information to detect objects they can't see in the dark. This is how they avoid flying into walls and trees and also how they find flying insects to eat.



Use the Violin simulation below to play different musical notes and observe the graph of Frequency vs Amplitude produced by the violin strings vibrating at different tensions:

## Summary

- How high or low a sound seems to a listener is its pitch. Pitch, in turn, depends on the frequency of sound waves.
- High-frequency sound waves produce high-pitched sounds, and low-frequency sound waves produce low-pitched sounds.
- Infrasound has wave frequencies too low for humans to hear. Ultrasound has wave frequencies too high for humans to hear.

## Review

1. What is the pitch of sound?
2. How is the pitch of sound related to the frequency of sound waves?
3. Define infrasound and ultrasound.

## Additional Resources

Study Guide: Waves Study Guide

Real World Application: Tune-up Time

Videos:



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