SCIENCE 3D

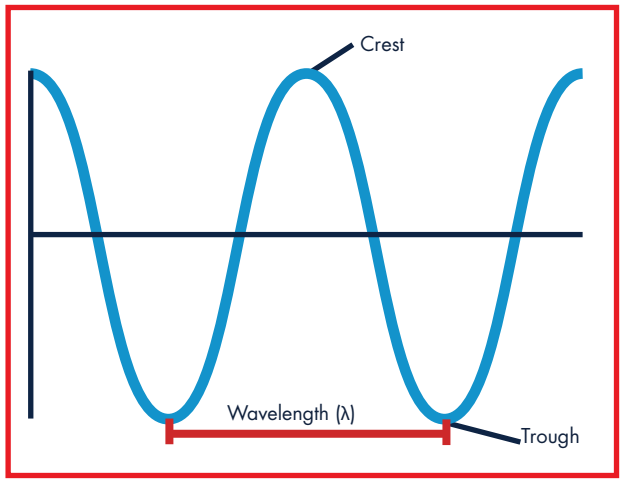
RAINFOREST BIODIVERSITY

In this packet, sample student answers are provided in red and notes to teachers are in blue.

In this **Mission Research**, students will investigate the components of waves, how frequency and wavelength are related, and explore waves in their daily lives.

Waves are all over in the rainforest. They are important for both organisms and scientists! Two of the most important waves are sound waves and light waves. Let's explore these waves some more before we head to the Costa Rican rainforest to join a scientific study.

1. Use the information in your **Mission Reader** to **draw** a wave. **Label** the **crest, trough,** and **wavelength**.



One important aspect of a wave is its frequency. Frequency is the number of waves that pass a location every second. Another important feature of waves is wavelength. You can calculate the wavelength of a sound when you know the frequency using the equation:

$$\lambda = \frac{v}{f}$$

Where,
λ (Lambda) = wavelength in meters
v = velocity of wave
f = frequency (in Hz, or cycles per second)

For questions 2 through 5, fill in each blank with one of the following words or phrases: **increase, decrease, shorter, longer, the same length**. You may use some more than once and some not at all

2. As the frequency of a sound increases, the wavelength of a sound will __decrease___.

3. As the speed at which a sound wave increases, the wavelength of a sound at a particular frequency will ___increase ___.

The speed at which sound moves underwater (about 1,500 m/second in the ocean) is much higher than through air (about 345 m/second at room temperature).

4. The wavelength of a sound at a particular frequency will be _shorter_ in air than underwater.

5. Rearrange the equation for calculating wavelength from velocity and frequency to calculating frequency from velocity and wavelength.

$$\lambda = \frac{v}{f} \longrightarrow f = \frac{v}{\lambda}$$

6. As wavelength gets longer, frequency will ___decrease___.

The speed of sound changes with temperature. At temperatures found in the rainforest, sound travels at about 350 m/sec. One Hz is one cycle of a wave per second. A cycle is the time between one crest or trough of a wave and the next crest or trough. There are 1,000 Hz in a kHz.

7. Use this information and a calculator to fill in the Table 1 below.

Optional Lesson Extension: Before students fill in the Table, have them use a spreadsheet to make a calculator. Have them make a calculator from determining wavelength for frequency. Then have them make one for determining frequency from wavelength.

Note: Converting between Hz and kHz could be a challenge for some students. Make sure they calculate the frequency in Hz before calculating the wavelength!

Table 1. Wavelengths and frequencies of calls by several species in the Costa Rican rainforest

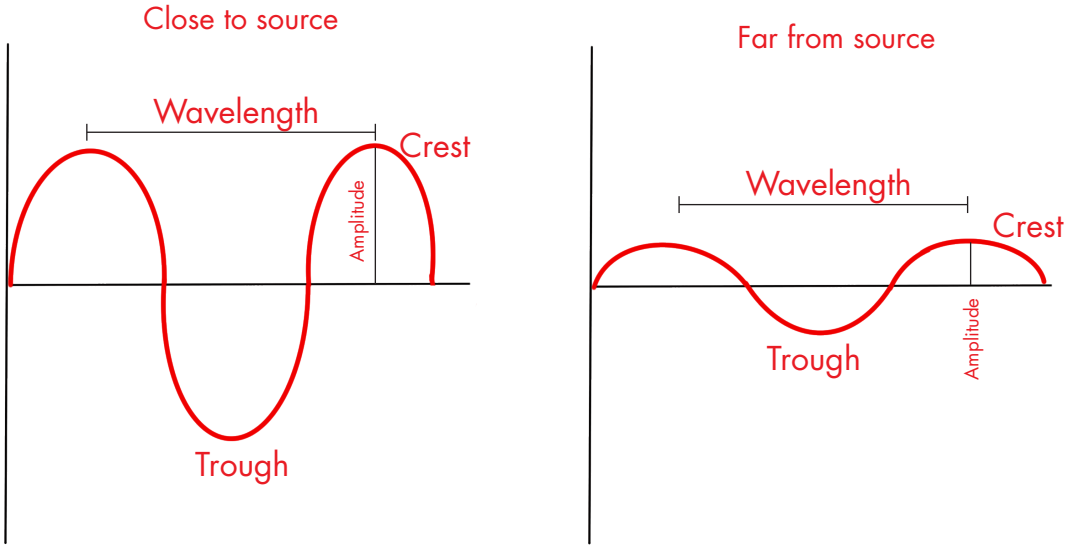
Common name	Wavelength	Frequency (Hz)	Frequency (kHz)
Howler monkey	0.7	500	0.5
Greater white-lined bat	0.007	50,000	50
Cicada	0.39	9,000	9
Toucan	0.35	1,000	1
Red-eyed tree frog	0.14	2,500	2.5
Clay-colored thrush (Costa Rica's national bird)	0.175	2,000	2

8. **Describe** whether or not you think you could tell species apart by their calls based on the data in Table 1.

I believe that I could tell species apart based on their calls. Each species in the table calls at a different frequency.

Another important aspect of sound waves is their amplitude. The amplitude is half the distance from the crest of the wave to the trough of the wave. Waves with greater amplitudes have more energy. More energy means louder sounds. But, the energy in the wave dissipates as it moves further and further away from where it was produced. That means that the amplitude of a wave decreases as the distance increases. Other aspects of sound waves, like frequency and wavelength, don't change with distance.

9. **Draw** a sound wave at two different distances from where it was produced. Label your diagram with the following terms: **wavelength, amplitude, crest, trough**.



10. **Compare** and **contrast** the features of the two waves you drew.

Close to where the sound was produced, the crest is higher and the trough is lower. Further away from the source, the crests are lower and the troughs are higher, so the amplitude is less. The wavelength of the two sounds is the same at both distances.

Extend the lesson: Have students list the ways that "waves" or "frequencies" influence their daily lives. Have them use the internet to research these waves. Have them create a digital presentation or poster to describe the wave, how it is used, and the importance of its frequency, wavelength, or energy. If you want to extend further, have students investigate the differences between transverse, longitudinal, and surface waves. Have them find examples of each and describe how they are affected by these types of waves.

Extend the lesson: Have students explore the mathematical relationship of amplitude and distance for shapes that propagate in all directions (inverse square law). You could also have them use online resources to investigate how changes in volume, measured in decibels (dB), relate to changes in wave amplitude. They could then use this information to explore the effects of different dB levels on human hearing or the distance sounds can travel through the rainforest.