Name_____ Date_____

The Science of Sound

Reading and Discussion

Have you ever heard this question: If a tree falls in a forest where there is no one around, does it make a sound? Do you know the answer? Here it is: If no living thing is around to *hear* the sound of the tree falling, then there *is no sound.* Sound unbelievable? It's true! In order for a sound to exist, there must be an ear to hear it.

In this lesson we will explore the science of sound. What is sound? Why are some sounds louder than others? Why are some high and others low? And-how do we hear?

What is sound?
Sound is really energy. The energy is created when any object vibrates. When an object vibrates, or moves quickly back and forth from a center point, it causes the air molecules nearby to vibrate as well. As these air molecules vibrate, they bump into other air molecules and cause *them* to vibrate. This continues until the molecules run out of energy and the vibrations stop.

To understand how air molecules pass along vibration, picture the way dominos fall when they are set up in line. As one domino falls, it knocks over the second domino. The second domino knocks over the third, and this pattern continues until all of the dominos are knocked down and there is no energy left.

How are different sounds made?
If we could see sound, it would look like waves. The length, speed, and direction of each wave determine what kind of sound we hear. Height is also a factor. Each wave has many smaller ripples. The height of each ripple affects the volume, or loudness, of the sound. This is referred to as the **amplitude.** Higher waves, or higher amplitudes, make louder sounds, and shorter amplitudes create softer sounds.

Frequency refers to the speed of the sound waves, or how quickly the waves repeat in a vibration. Picture the ripples that occur in a long wave. The more small ripples that occur in a wave, the higher the frequency of that sound will be. High frequency means a higher sound. Fewer ripples in the wave mean a lower frequency and a lower sound. A violin makes a sound that has a very high frequency, but a tuba has a very low frequency.

In general, larger objects vibrate more slowly, so they have lower frequencies. That is why you have high voice as a child and a lower voice as an adult. As you grow, your vocal chords grow and vibrate more slowly, which creates a lower frequency.

How does sound travel?
Sound travels very much like dominos falling, only much faster. Although it is not as fast as light, sound travels through air at about 1,120 feet a second. In five seconds, sound travels one mile! That's extremely fast, but engineers have built airplanes that can travel

faster than the speed of sound. When one of these planes flies overhead, spectators hear the sound of the plane only after it has gone.

Sound travels very quickly through air, which is a gas. But it can also pass through liquids, solids, and plasmas. How fast it travels depends on the molecules of the matter it is traveling through. There are two kinds of sound waves: **transverse** and **longitudinal.** Longitudinal waves can travel through gas, liquid, and plasma. Transverse sound waves can travel through all matter, including solids.

How do we hear?

Remember the question we started with? If a tree falls in a forest where there is no one around, does it make a sound? The answer is no, because the sound can only be heard when it comes in contact with an eardrum. Humans are not aware of any sound until vibrating molecules reach our eardrums and cause them to vibrate. This vibration also reaches tiny bones inside our ears. A message including the frequency and amplitude of the sound is sent to our brain, and we hear the sound. If the vibrations are regular and create a pleasant frequency, we have sound. If the vibrations are unpleasant or unwanted, we hear **noise**.

Summing Up

Every car horn, human laugh, and telephone ring you hear begins as vibrating molecules. Your ear is only one link in the chain that creates sound. Now that you understand how different sounds can be made, try some experimentation of your own. See what kind of sounds you can make with everyday objects. What makes the highest sound? The lowest? How many ways can you find to shake up some molecules?

Name_____ Date_____

Activities

Activity A: Test Your Knowledge! Circle the letter of the correct answer below.

1. What is sound?
    a. A state of matter
    b. A form of energy
    c. A physical reaction
    d. None of the above

2. What do scientists call the vibration of molecules that creates sound?
    a. Waves
    b. Variables
    c. Amplitudes
    d. Noise

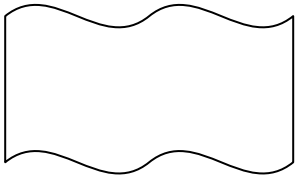
3. What is frequency?
    a. How often we hear sound
    b. The loudness of sound
    c. How quickly sound waves repeat
    d. Volume

4. What are the two types of sound waves?
    a. Transverse and adverse
    b. Kinetic and potential
    c. Longitudinal and transverse
    d. Longitudinal and transitional

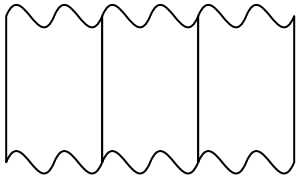
5. What does amplitude measure?
    a. Volume
    b. Frequency
    c. Speed of the sound wave
    d. Length of the sound wave

Name_____ Date_____

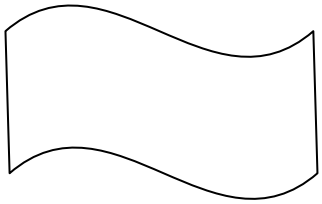
Activity B: Look at the pictures of the sound waves below and answer the questions.



Sound wave A



Sound wave B



Sound wave C

1. Does sound wave B have a higher or lower frequency than sound wave A?_____
2. Does sound wave B make a higher or lower sound than wave A? _____
3. Does sound wave C have a higher or lower frequency than sound wave A?_____
4. Does sound wave C make a higher or lower sound than wave A? _____
5. Use the lines below to explain how humans hear sound.

_____

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Name_____ Date_____

Answer Key

Activity A

1. B
2. A
3. C
4. C
5. A

Activity B

1. higher
2. higher
3. lower
4. lower
5. When an object vibrates, it causes the air molecules nearby to vibrate. This begins a chain reaction, and the vibrating molecules eventually reach our eardrums and cause them to vibrate. This vibration also reaches tiny bones inside our ears. A message including the frequency and amplitude of the sound is sent to our brain, and we hear the sound.