SCIENCE 706

LIGHT AND SOUND

CONTENTS

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translucent (trans lü′ sunt). A material that is only partially clear; that allows some light to enter. Example: frosted glass.

transparent (trans păr′ unt). Clear; allows light to pass.

trough (trôf). The lowest part, valley. Example: the bottom or lowest part of a light wave.

universal (yü′ nu vėr′ sul). Existing everywhere.

wavelength (wāv′ length). The distance from a point on one wave to a similar point on another wave.

Note: All vocabulary words in this LIGHTUNIT appear in **boldface** print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.

Pronunciation Key: h**a**t, **ā**ge, c**ă**re, f**ä**r; l**e**t, **ē**qual, t**ė**rm; **i**t, **ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u**t, r**ü**le; **ch**ild; lo**ng**; **th**in; /*TH*/ for **th**en; /*zh*/ for mea**s**ure; /*u*/ represents /*a*/ in **a**bout, /*e*/ in tak**e**n, /*i*/ in penc**i**l, /*o*/ in lem**o**n, and /*u*/ in circ**u**s.

I. WAVES

The ability to see and hear is important to every human being. Man is able to know about his surroundings through the light he receives and the sound he hears. God wonderfully has provided man with eyes and ears, the organs of sight and sound. These organs receive light waves and sound waves. By receiving waves of light and sound, we are able to communicate with others. We are able to hear and see the things that God has created.

SECTION OBJECTIVES

☐ **Read these objectives.** When you have completed this section, you should be able:

1. To name the source of all sound and to tell how sound waves travel.
2. To describe the parts of a sound wave and a light wave.
3. To explain the difference between amplitude and pitch.
4. To describe how sound waves are received by the ear.
5. To list some substances through which sound can travel and through which light can travel.
6. To name the speeds of light and sound.
7. To describe the electromagnetic spectrum.
8. To find how light and sound are mentioned in Scripture and how these verses are related to science.

☐ **Restudy these words.**

amplitude	photons	translucent
compression	pitch	transparent
crest	radiation	trough
electromagnetic spectrum	rarefaction	wavelength (of light)
opaque	refraction	

SOUND WAVES

Sound waves are started by vibrations. When you strike a drum or a cymbal, the objects vibrate. These vibrations cause the air molecules to vibrate. The air molecules nearest the vibrating object are set into motion. The sound waves are carried on air molecules. This may help you understand the silence of outer space where there is no air.

When you drop a rock into a pond of water, the waves move outward in circles. Sound waves move in a similar manner. They spread out in all directions from whatever is making the sound. When air is set into motion by a vibrating object, it can cause other things to vibrate. Sound waves start vibrations on the sensitive part of your ear. The eardrum begins to vibrate in the same manner as the object that started the sound wave. This enables you to hear different sounds. The little bones within the ear transfer the vibrations to the nerves. The nerves carry the messages to the brain.

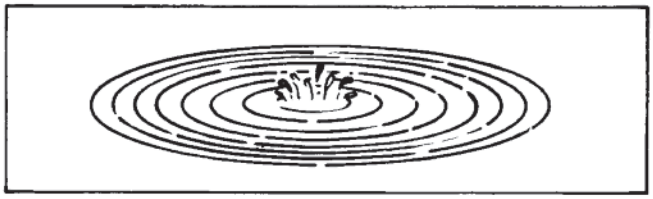

Figure 1: Sound Waves

Sound waves spread out from the vibrating source in a way that resembles the waves on a pond when a pebble is thrown into the water.

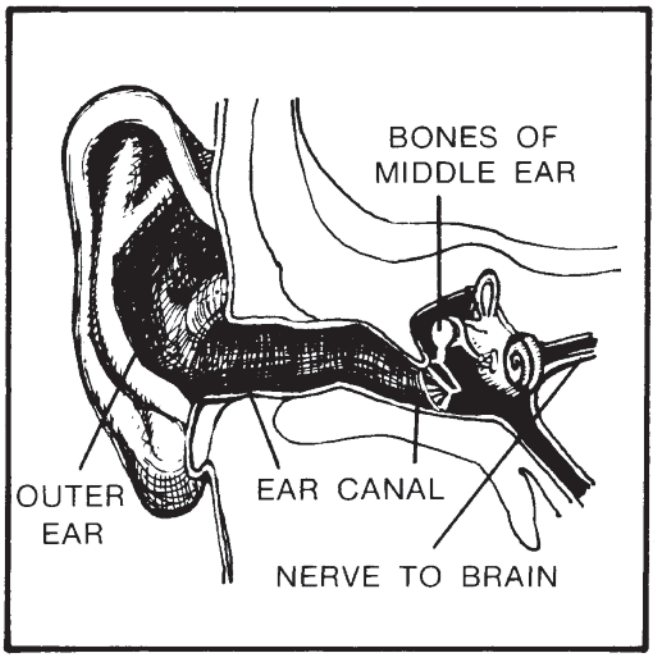

Figure 2: The Ear

Notice how the ear receives the sound waves. They start the eardrum vibrating. This vibration, in turn, causes the bones of the ear to vibrate, exactly like the source of the vibration that started the sound.

Compression, rarefaction. Sound waves have two parts: the **compression** and the **rarefaction.** Compression describes the part of the wave where the molecules of air are pushed close together. Rarefaction describes the part of the wave where the molecules are farther apart. Sound waves are a series of compressions and rarefactions.

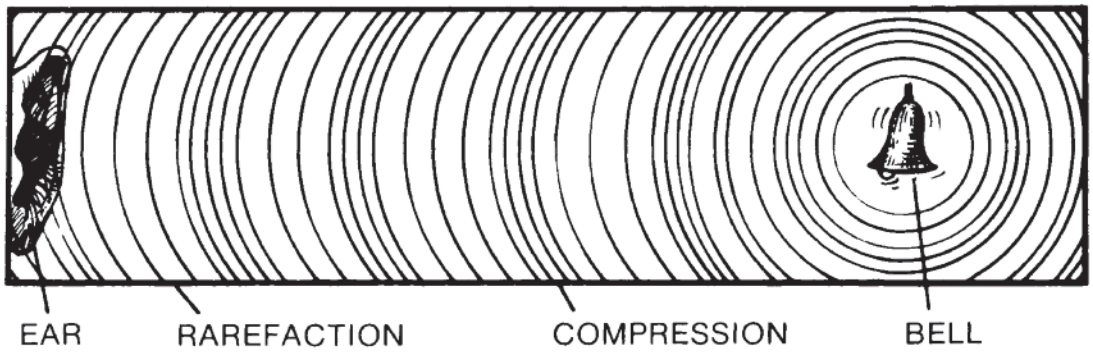

Figure 3: A Sound Wave

A sound wave consists of compressions where air molecules are pushed together and rarefactions where molecules are far apart.

Sound waves can travel through liquids, solids, and gases. They can travel through water faster than in air. They travel even faster in solids such as stone, iron, and steel. Sound travels 1,100 feet per second (one-fifth of a mile) in the air.

Pitch and amplitude. When you hear the sound of music, you may wonder why some sounds are low and some are high. **Pitch** means whether the sound is a high sound or a low sound. The lowest key on the piano vibrates 27 times per second. The highest key vibrates 4,000 times per second. Middle C vibrates 256 times per second. The number of vibrations per second determines the pitch. Striking the key harder will not change the pitch. It merely makes the sound louder. The loudness of the sound is called the **amplitude.**

The difference between musical tones and noise is the evenness of the vibrations. Noise results when a sound has irregular vibrations. Uneven vibrations are unpleasant, particularly if they are loud.

Perform the following experiment as a home project.

These supplies are needed:

8 test tubes or bottles

water

Follow these directions. Place a check in each box when the step is completed.

- ☐ 1. Add water to eight test tubes or bottles. The bottles will work just as well, but playing a tune will be a little more difficult.
- ☐ 2. Try to add the water in the proportions shown in the illustration.

☐ 3. Practice blowing across the bottles in sequence. The eight notes in an octave can be produced.

☐ 4. The sounds are produced by forcing the air in the tubes to vibrate.

Answer these questions.

1.1 Which tube has the lowest sound? _____

_____

1.2 Which tube has the highest sound? _____

_____

1.3 The lowest note on the piano has the longest string to vibrate. How does the lowest note compare if you consider the column of air that is vibrating in the test tubes (or bottles)?

_____

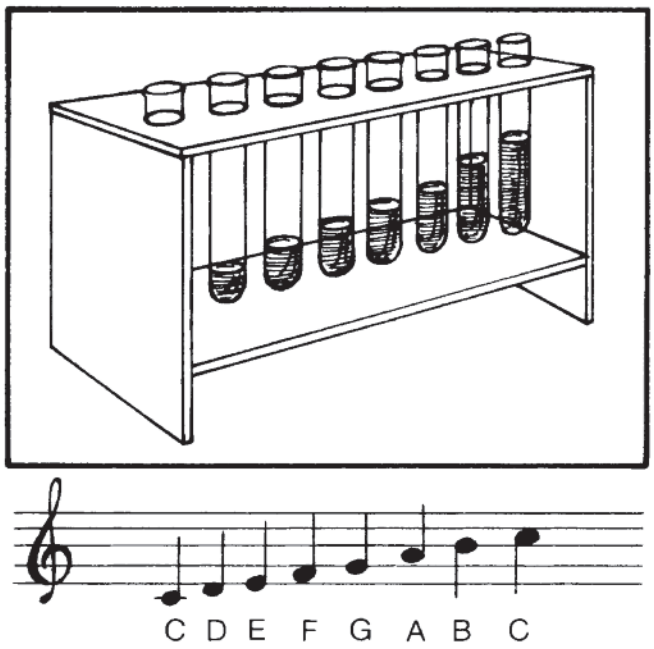

Figure 4: Musical Scale

The musical scale is made from test tubes partially filled with water.

Perform the following investigation.

These materials are needed:

a tuning fork
a bowl of water (preferably a plastic container)

Follow these directions and answer the questions. Place a check in each box when the step is completed.

☐ 1. Gently strike the tuning fork against something to start it vibrating. Then lay the end of the handle on a wooden or metal table or desk. Notice the vibrations.

☐ 2. Strike the tuning fork again. This time, place it in the bowl of water.

1.4 What evidence shows that vibrations are produced?

_____

☐ 3. Strike the tuning fork again. Gently hold it near your ear. DO NOT TOUCH YOUR EAR OR HEAD (you could get a toothache or earache).

1.5 Do you hear the vibrations? _____

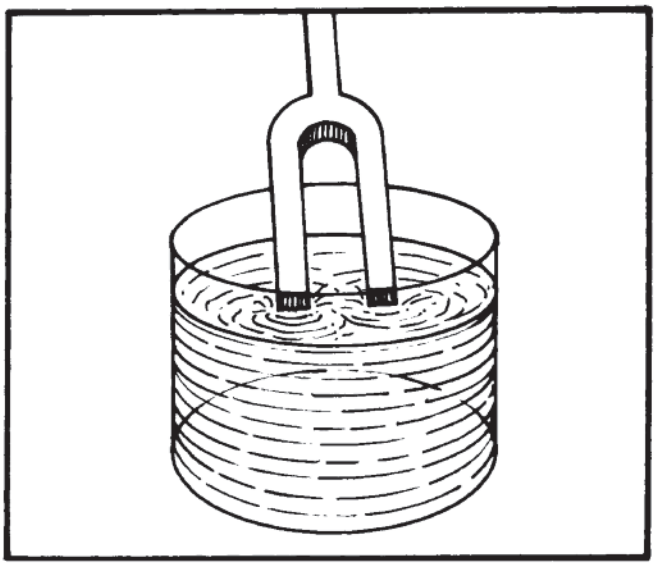

FIGURE 5:
A tuning fork vibrates in water.

Complete these activities.

1.6 Sound waves are started by _____.

1.7 Sound waves are carried on air _____.

1.8 Sound waves have two parts. The part of the wave where the air molecules are pushed together is called the a. _____, and the part of the wave where the molecules of air are farther apart is called the b. _____.

1.9 Noise results when a sound has irregular _____.

1.10 Outer space is an area of _____ because it lacks _____ _____.

1.11 Name three substances through which sound can travel.
a._____ b._____ c._____

1.12 *Pitch* means whether a sound is a._____ or b._____.

1.13 Striking a piano key harder will not change the pitch, but will make it sound _____.

1.14 Amplitude is the_____.

1.15 The difference between musical tones and noise is the_____
_____.

1.16 **Solve this problem. Sound travels more slowly on a mountaintop than it does down in a valley. Why? (Remember the density of air molecules.)**
_____

1.17 Write Proverbs 20:12. _____

_____

_____

1.18 Sound waves do not travel through space. (Clue: Notice the substances through which they travel.) Write why they cannot travel through space. _____

1.19 Through which substance will sound travel fastest, a solid, a liquid, or a gas?_____

1.20 Through which substance do they travel slowest? _____

1.21 Go to the library to find some information on the ear. Consult an encyclopedia or a biology book. Write a brief report about the ear. Include in your report the names of the tiny bones in the ear. Also indicate the name of the nerve that carries messages from the ear to the brain. First, make a rough draft, then write it in your best handwriting in this space.