LIFEPAC®

SCIENCE

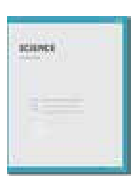
STUDENT BOOK

6th Grade | Unit 6

Alpha Omega
PUBLICATIONS

SCIENCE 606

Light and Sound



LIFEPAC Test is located in the center of the booklet. Please remove before starting the unit.

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Light and Sound

Introduction

Light and sound are very important in our lives. With light, we can see. With sound, we can hear. Both light and sound surround us every day. In fact, they are so common that we can sometimes forget just how important they are to us. Without light, we could not see. Without light, we would have neither food to eat nor oxygen to breathe. Why? Because green plants use light to make food and produce oxygen. If there was no light, then the green plants could not produce food or oxygen, and life would no longer exist! Sound is important because it makes it possible for us to communicate with each other through speech. Sound also brings us information and entertainment through radio, television, music, and other forms of modern communication. Finally, sound makes life more pleasant through music and the sounds of God's creation. For example, the singing of birds, the flowing waters of a clear stream, or the waves coming ashore at the lake or ocean. Truly, light and sound are important in our lives.

In this LIFEPAC® you will learn more about the nature and characteristics of light and sound. You will explore how light and sound are produced. You will learn how light and sound travel from their sources to the organs that allow us to see and hear, the eyes and the ears. The eye and ear are two sensitive organs created by God that allow us to detect light and sound. Scripture says: "The hearing ear, and the seeing eye, the LORD hath made even both of them." (Proverbs 20:12)

As it turns out, we can see only a tiny part of all the different kinds of radiant energy. Visible light is only one part of the radiant energy surrounding us. It is the part that we can see, and we usually refer to this visible light simply as "light." However, in this LIFEPAC, you will also learn more about other kinds of radiant energy outside the range of visible light, such as infrared rays, radio waves, ultraviolet rays, and X-rays.

Finally, you will learn about one of the wonderful characteristics of light: *color*. Color fills our world with beauty and serves us in many ways. God has provided us with great variety in the colors He has given us. You will learn more about color in this LIFEPAC.

Objectives

These objectives tell what you should be able to do when you have completed this LIFEPAC. When you have completed this LIFEPAC, you should be able to do the following:

1. Name the source of all sound and tell how sound waves travel.
2. Describe the parts of a sound wave and a light wave.
3. Explain the difference between amplitude and pitch.
4. Describe how sound waves are received by the ear.
5. List some substances through which sound can travel and through which light can travel.

6. Name the speeds of light and sound.
7. Describe the electromagnetic spectrum.
8. Explain how Sir Isaac Newton discovered that sunlight is composed of colors.
9. List the colors of sunlight's color spectrum in correct order.
10. Tell how raindrops and prisms separate the colors of sunlight.
11. Explain what makes things around us different colors.
12. List the primary colors of sunlight and tell what color is produced when they are mixed.
13. List the primary colors of pigments (colorants) and tell what colors are produced when they are mixed.

Survey the LIFEPAC. Ask yourself some questions about this study and write your questions here.

1. WAVES

If you have ever been to the ocean, you noticed that the water comes onto the beach or shoreline in *waves*. These waves come onto the shore one after another, usually with a few seconds or more between successive waves. Light and sound travel the same way. They travel in *waves*. In this section of the LIFEPAC, starting with sound waves, you will learn more about how sound and light travel in waves.

Section Objectives

Review these objectives. When you have completed this section, you should be able to:

1. Name the source of all sound and tell how sound waves travel.
2. Describe the parts of a sound wave and a light wave.
3. Explain the difference between amplitude and pitch.
4. Describe how sound waves are received by the ear.
5. List some substances through which sound can travel and through which light can travel.
6. Name the speeds of light and sound.
7. Describe the electromagnetic spectrum.

Vocabulary

Study these words to enhance your learning success in this section.

amplitude (am plə tüd). The distance that a vibrating object moves from its position of rest as it vibrates. The larger the amplitude of a vibration, the greater will be the intensity and loudness of the sound.

compressibility (kəm pres ə bil ət ē). A measurement of the ability of a material to be squeezed into a smaller volume.

compression (kəm presh ən). The act or state of being forced into less space.

crest (krest). The top of something, especially of a hill or wave.

density (den sət ē). The mass of a material in a unit volume.

diffused (di fyüzd). A characteristic of being scattered or broken up and distributed.

electromagnetic spectrum (i lek trō mag net ik spek trəm). The entire range of a series of electromagnetic waves including visible light.

frequency (frē kwən sē). The number of times something is repeated in a unit time, such as the number of vibrations per second in a sound source.

intensity (in ten sə te). The amount of energy flowing in the sound waves. The greater the intensity, the greater the energy.

larynx (lar ingks). The upper part of the trachea in the breathing passage that contains the vocal cords.

loudness (loud nes). How strong the sound seems to a person when the sound waves reach the ears.

opaque (ō pāk). Something which does not allow light to pass through.

photons (fō tonz). Particles of light.

pitch (pich). The degree of highness or lowness of a sound.

radiation (rā dē ā shən). Energy emitted in the form of waves or particles.

rarefaction (rãrə fak shən). Thin or far apart (rare). Example: the part of the sound wave where the molecules are far apart.

refraction (ri frak shən). The bending of a ray of light, heat, or sound in passing from one medium into another.

transluscent (trans lü sənt). Allowing light to pass through, but not allowing a clear view of any object. Example: frosted glass.

transparent (trans pãr ənt). Clear; allows light to pass through.

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

visualize (vizh u̇ ə lī z). To form a visual mental image of something.

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

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.*

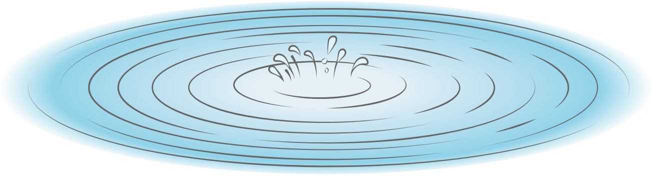
Pronunciation Key: h**a**t, **ā**ge, c**ã**re, f**ä**r; l**e**t, **ē**qual, t**ė**rm; **i**t, **ī**ce; h**o**t, **ō**pen, **ô**rder; **oi**l; **ou**t; c**u**p, p**u̇**t, r**ü**le; **ch**ild; lo**ng**; **th**in; */ŦH/* for **th**en; */zh/* for mea**s**ure; */ə/* represents */a/* in **a**bout, */e/* in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

SOUND WAVES

Sounds surround us all the time. There are many kinds of sounds — whistles, voices, music, animal sounds, etc. However, all these sounds have one thing in common. They are caused by *vibrations*. Every sound is caused by the vibration of an object. When an object vibrates, it causes the surrounding air to vibrate. The air molecules are set in motion by these vibrations, and the vibrations travel out from the vibrating object in all directions. The vibrations travel out from the object in *waves*.

We cannot normally see sound waves, but we can get a picture of their appearance by observing what happens when a pebble is thrown into a still pond. At the point where the pebble strikes the surface, waves are formed. A series of waves begin to move out in all directions from the point where the pebble struck the water. In a similar way, sound waves radiate out in all directions from a vibrating object.

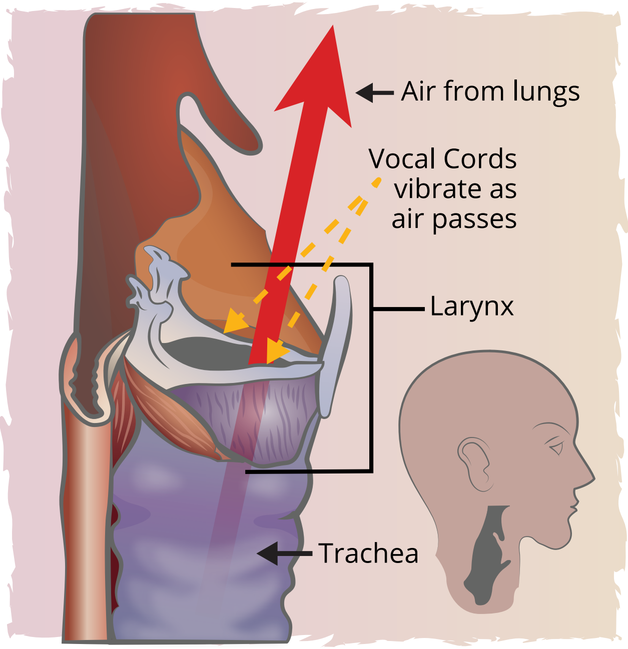
The source of all sounds is a vibrating object. For example, the sound of a human voice is produced in the **larynx**, a section of the throat.



| Sound waves resemble waves caused by a pebble in a pond.

There are two small folds of tissue, called the *vocal cords*, that stretch across the larynx and have a slit-like opening between them. When we speak, air from our lungs rushes across the tightened vocal cords, causing them to vibrate. The vibrations produce the sound of the voice. Birds, frogs, and other mammals have vocal cords or a similar structure that makes the sounds of a “voice” the way that humans do. Other animals use such things as vibrating air sacs or body parts (wings, legs, etc.) to produce sounds.

Musical sounds are produced in a variety of ways, but they all involve a vibrating object

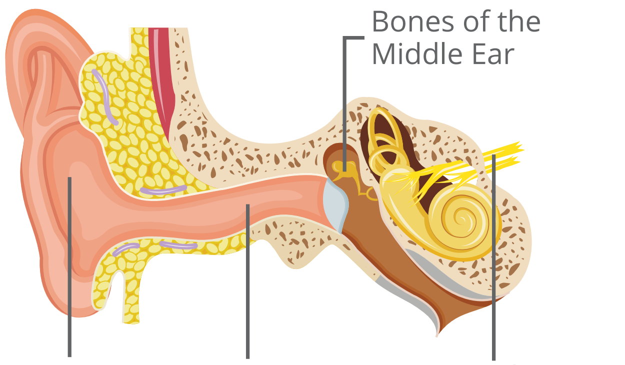


| The human voice is caused by vibrating vocal cords.

| Musical instruments produce sounds through vibrations.

as their source. For example, the membrane of a drum vibrates when it is hit, causing the sound of a drum. A violin or a piano makes sounds when the strings of these instruments are vibrated. A clarinet makes musical sounds when a tiny reed in the mouthpiece vibrates as air is blown across it. A trumpet makes sounds when the lips of the musician vibrate into the mouthpiece! In all of these musical instruments, the sounds are produced by vibrations; and the musical sounds travel out from the instruments in waves.

When air is set into motion by a vibrating object, it can cause other things to vibrate. In fact, this explains how we can hear sound. Sound waves start vibrations on the sensitive part of your ear. As the sound waves reach the eardrum located within the ear, the eardrum begins to vibrate in the same way as the object that originally produced the sound. The vibrating eardrum, in turn, causes the bones of the middle ear to vibrate. These vibrations are transferred to the nerves in the inner ear. The nerves carry the messages to the brain, enabling us to interpret the sounds that we hear.



| The ear

Write the correct letter and answer in each blank.

1.1 Every sound is caused by the ______________________ of an object.
a. ringing   b. vibration   c. radiation

1.2 Sound ____________________ radiate out in all directions from a vibrating object.
a. waves   b. particles   c. notes

1.3 The sound of a human voice is produced in the ______________________ .
a. ear   b. larynx   c. brain

1.4 When we speak, air from our lungs rushes across the ____________________ , causing them to vibrate.
a. teeth   b. gums   c. tightened vocal cords

1.5 In all musical instruments, the sounds are produced by ______________________ .
a. melodies   b. air   c. vibrations

Do the following activity.

1.6 Explain how we can hear sounds from a vibrating object. __________________________

____

____

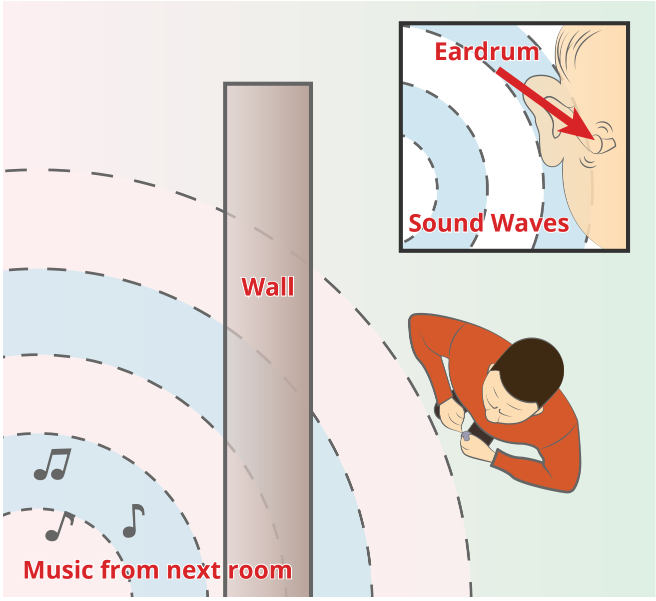
____

SOUND TRAVEL

Sound waves must travel through some sort of *medium*. For most sounds that we hear, the medium is air. However, sound can also travel through water and the earth. You may have seen pictures of Native Americans with their ears to the earth, listening for the sounds of distant hoof beats of buffalo or other animals. They were able to hear distant hoofbeats because sound waves can travel through the earth.

In fact, sound waves can travel through any solids, liquids, or gases. The speed at which sound waves travel in a medium depends upon the **density** and **compressibility** of the medium. *Density* is the amount of mass in a given volume of a material. *Compressibility* measures the ability of a material to be squeezed into a smaller volume. The easier it is to be squeezed, the more compressibility the material has. In mediums that have greater density and compressibility, the sound will travel slower.

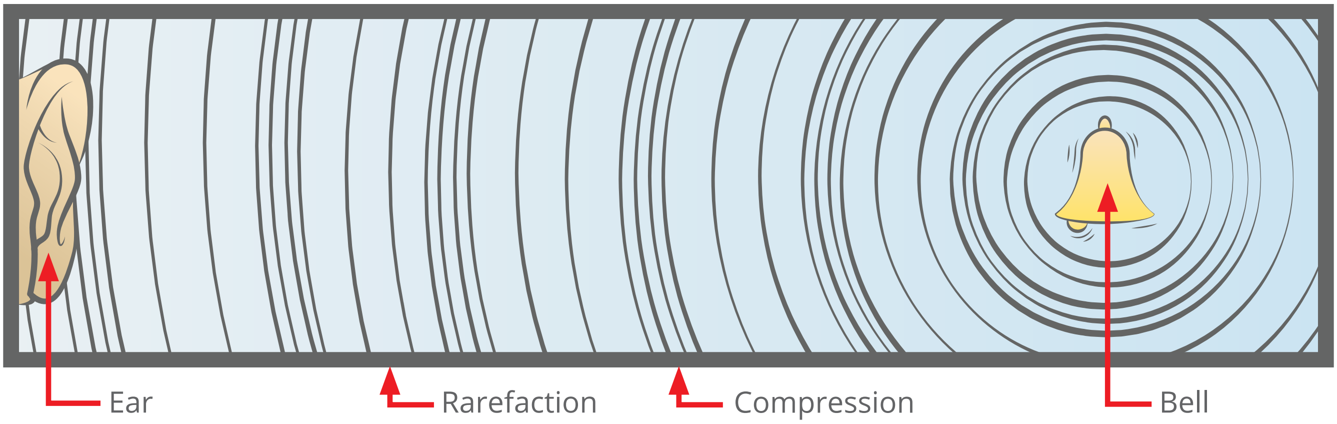
Usually, liquids and solids are denser than air; however, they are far less compressible than air. Therefore, sound travels faster through liquids and solids than it does through air. In fact, compared with its speed through air, sound travels about 4 times faster through water and about 15 times faster through steel. Under normal conditions, sound travels about 1,100 feet per second in air.



| Sound travels through different mediums

Sound cannot travel in a vacuum because there is no medium that can transmit the sound waves. Therefore, sound is absent in outer space where there is no atmosphere or air.

Compressions and rarefactions. Sound waves have two parts: the **compression** and the **rarefaction**. *Compression* describes the part of the sound waves where the molecules of the medium (such as air) are compressed close together. *Rarefaction* describes the part of the



| Sound waves consist of compressions and rarefactions

waves where the molecules are farther apart. Sound waves are a series of compressions and rarefactions.

Frequency and pitch. The number of compressions and rarefactions produced each second by the vibrating object is called the **frequency** of the sound waves. The more rapidly an object vibrates, the greater will be its frequency. The frequency of the sound determines its **pitch**. *Pitch* is the degree of highness or lowness of the sound as heard by the listener. High-pitched sounds have higher frequencies than low-pitched sounds. For example, the lowest-pitched key of a piano vibrates with a frequency of about 27 times per second. The highest-pitched key of a piano has a frequency of about 4,000 times per second. A person's voice produces frequencies from about 85 to 1,100 vibrations per second, allowing for a range of pitches in speaking and singing.

Intensity, amplitude, and loudness. The **intensity** of a sound is related to the amount of energy flowing in the sound waves. The greater the energy, the greater the *intensity*. The intensity depends upon the **amplitude** of the vibrations that produce the waves. The *amplitude* is the distance that a vibrating object moves from its position of rest as it vibrates. The larger the amplitude of a vibration, the greater will be the intensity of the sound.

The **loudness** of a sound refers to how strong the sound seems to a person when the sound waves reach the ears. At a given frequency, the greater the amplitude and intensity of the sound, the louder it will seem to the hearer. However, sounds with the same intensity and amplitude but with different frequencies are not necessarily equally loud. This is because the human ear has lower sensitivity to sound at the lower and upper limits of the range of frequencies that we can hear (from about 20 to 20,000 vibrations per second). Therefore, a high-frequency or low-frequency sound does not seem as loud to us as a sound of mid-frequency that has the same intensity or amplitude.

Noise. *Noises* are unpleasant sounds, particularly if they are loud! Noise results when the source of the sound has uneven or irregular vibrations. For example, the clanging of garbage cans, the sound of a lawn mower, and barking dogs may all be considered noise.

Beautiful sounds. Our world is filled with many pleasant and beautiful sounds. Humans produce beautiful regular sounds through music.

View 606 Sound Waves, from the 6th Grade SCIENCE EXPERIMENTS Video.

Try this experiment to learn about sound waves.

Overview:

You will investigate the production of sound waves in several mediums.

These supplies are needed:

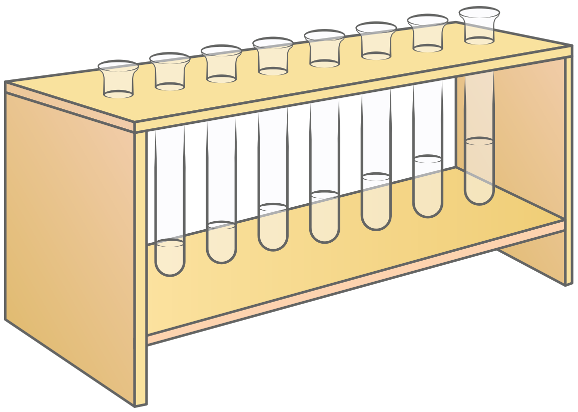
- 8 test tubes (or soda pop bottles)
- test tube holder (if using test tubes)
- tuning fork
- bowl of water (preferably a plastic container)

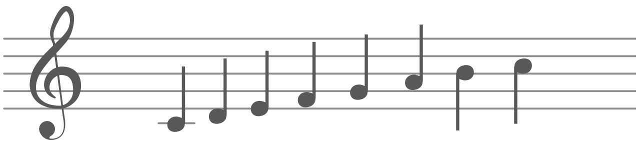
Follow these directions. Place a check mark in the box when you complete each step.

☐ 1. Add water to eight test tubes or soda pop bottles. (The bottles will work just as well, but playing a tune with them will be a little more difficult.) Try to add the water to the test tubes or bottles in the same proportions as shown in the illustration below.

☐ 2. Practice blowing over the bottles in sequence. Note that the sounds are produced by forcing the air in the tubes to vibrate. The difference in pitch is due to the different volumes of air in the test tubes (or bottles). See if you can produce the eight notes in the octave as shown in the illustration.

☐ 3. Using the end of the metal tuning fork, gently tap on the ends or sides of the test tubes. Note if different sounds are produced with each test tube (or bottle).





| Musical sounds from test tubes

Experiment 606. A Sound Waves

(continued on next page)

1.7 Which tube has the lowest sound? ____________________

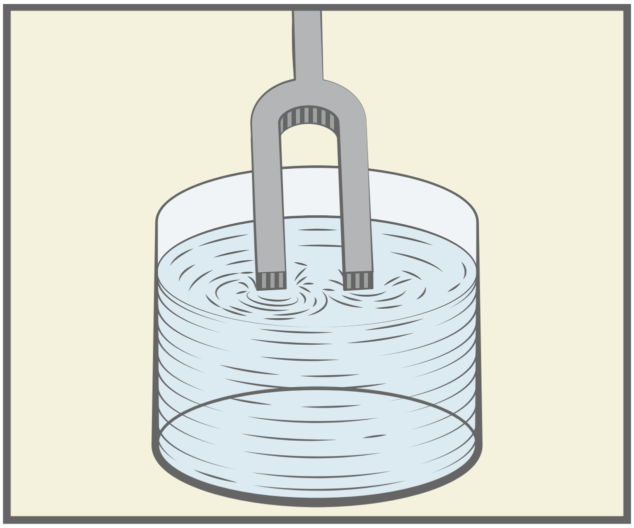
1.8 Which tube has the highest sound? ____________________

1.9 The lowest note on a 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 pop bottles)? ____________________

1.10 How did the sounds compare when you struck the test tubes with the end of the tuning fork? ____________________

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

☐ 5. Strike the tuning fork again. Then place it in the bowl of water as shown in the illustration on the right.



1.11 What evidence shows that vibrations are produced in the tuning fork? ____________________

____

____

☐ 6. Strike the tuning fork again. Gently hold it near your ear. CAUTION: DO NOT TOUCH THE TUNING FORK TO YOUR HEAD OR EAR. (You could get a headache or an earache as a result.) Listen for any sound.

1.12 Did you hear any vibrations? ____________________

TEACHER CHECK ____________ initials ____________ date

Experiment 606. A Sound Waves

Write the correct answers in the spaces below.

1.13 Sound waves must travel through some sort of ______________________________ . For most sounds that we hear, it is air.

1.14 The speed at which sound waves travel depends upon the a. ____________________ and b. ____________________ of the c. ____________________ .

1.15 The normal speed of sound in air is about ______________________________ .

1.16 Sound waves have two parts: the ______________________________ and the ______________________________ .

1.17 The frequency of the sound determines its ______________________________ .

1.18 The intensity of a sound depends upon the ______________________________ of the vibrations that produce the sound waves.

1.19 The ____________________ of a sound refers to how strong the sound seems to a person when the sound waves reach the ears.

1.20 ____________________ results when the source of the sound has uneven or irregular vibrations.

Do the following activities.

1.21 Explain why sound would travel slower through air on a mountain top than it does in a valley. ____

____

1.22 Can sound travel through a vacuum? a. ____________________ Why or why not?

b. ____

____

Use the Internet or library.

1.23 Using the Internet or resources in a library, find some more information on the human ear. Write a brief report on the ear (about 200 words). Include a drawing of the inner parts of the ear, and label the parts. 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. Explain how sounds produced by vibrating objects are heard by the human ear.

TEACHER CHECK ____________ initials ____________ date

LIGHT WAVES

Light is a form of energy that can travel freely through space. The energy of light is called *radiant energy*. Light seen by the human eye is only a small part of the **radiation** given off by bodies in the universe. This part that we can see is called *visible light* or simply *light*.

Light makes it possible for us to see things. Many of the things we see are *sources* of light, such as the sun, light bulbs, or a candle flame. We can see other things that are not sources of light because the light from a source bounces off them and travels to us. The moon is an example of an object that we can see because the light from the sun (a source) bounces off the moon and travels to us.

The electromagnetic spectrum. Ultraviolet light, X-rays, and cosmic rays are examples of radiant energy, or radiation, that cannot be seen by the human eye. These and many other forms of radiation constantly reach the earth. The visible and invisible radiations received by planet earth are collectively called the **electromagnetic spectrum**. All the forms of electromagnetic radiation in the electromagnetic spectrum can be described as *waves*. All of these waves from electromagnetic radiation, including visible light, have certain basic characteristics, which we will now describe.

The following example will help you understand the nature of electromagnetic waves and light waves. If you attach a rope to a post and shake the other end of the rope up and down, regular waves will move along the rope from your hand to the post as the rope rises and falls. Electromagnetic waves are similar to this "wavy" movement of the rope through space.

A graph is helpful to **visualize** a light wave and other forms of electromagnetic waves. Such a graph is shown in Figure 1. Notice the wave form running through the graph. The top of the wave is called the **crest**. The bottom part of the wave is called a **trough**. The **wavelength** is the distance from a point on one wave to a similar point of another. In Figure 1, the *wavelength* is shown as the distance from the crest on one wave to the crest on the next wave.

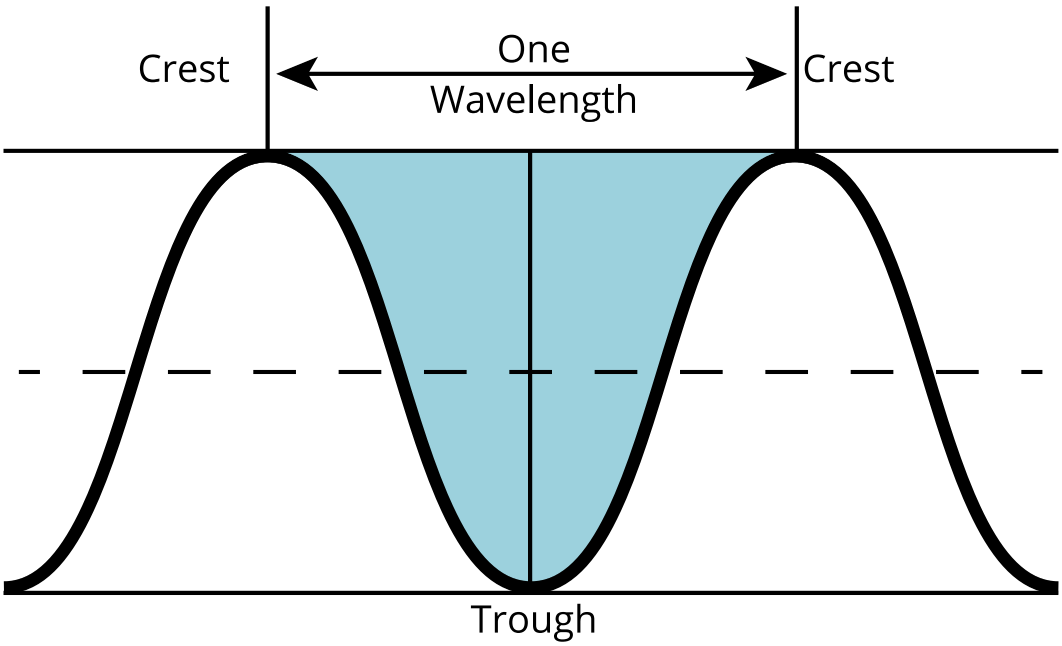
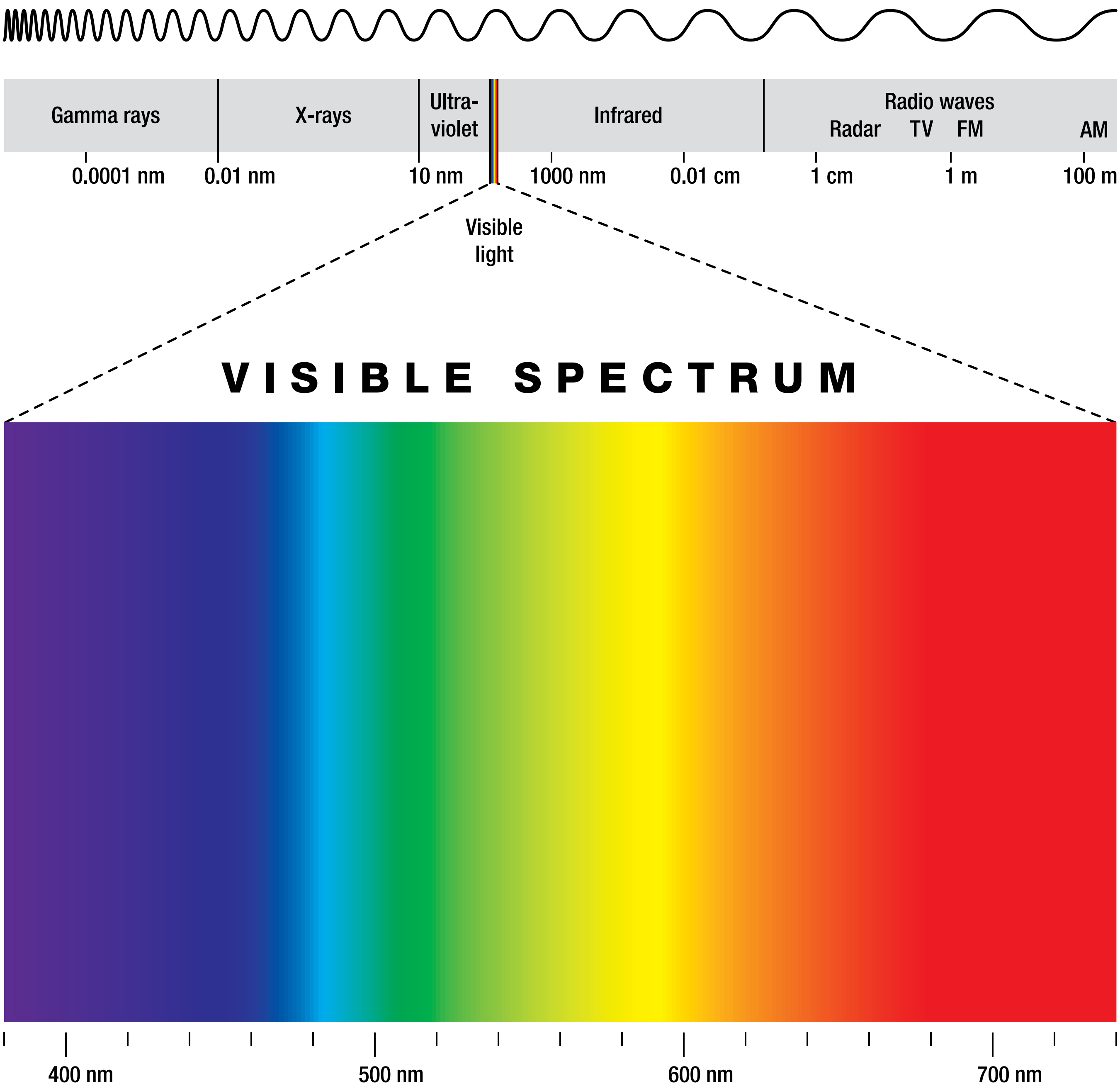


Figure 1 | Characteristics of electromagnetic waves

Different types of electromagnetic radiation have different wavelengths. Visible light is only one part of the electromagnetic spectrum. The electromagnetic spectrum also has invisible radiations that have longer and shorter wavelengths than visible light. Infrared light, microwaves, radio waves, and electrical currents have longer wavelengths than visible light. Ultraviolet light, xrays, gamma rays, and cosmic waves have shorter wavelengths than visible light. All of the waves outside the region of visible light on the electromagnetic spectrum cannot be seen by the human eye. They must be detected by other means.



| The electromagnetic spectrum

Try this experiment to learn more about electromagnetic waves.

Overview:

You will use a rope or cord to generate waves similar to electromagnetic waves.

These supplies are needed:

- piece of rope or cord about 10 feet long (a clothesline is suitable)

Follow these directions. Place a check mark in the box as you complete each step.

☐ 1. Tie one end of the rope to a post or doorknob.

☐ 2. Rapidly shake the loose end of the rope up and down. (The up and down movement of the rope resembles the movement of light and electromagnetic waves.) Observe the waves created in the rope.

Experiment 606.B Rope Wave Formation

Write the correct answers in each space.

1.24 The highest point of the wave of the rope is the same as the ______________________ .

1.25 The lowest point of the wave of the rope is the same as the ______________________ .

1.26 By rapidly moving the rope, can you determine what would be a wavelength? ____________

____ .

TEACHER CHECK ____________ initials ____________ date

Match the following items.

1.27 ________ radiant

1.28 ________ light

1.29 ________ sun

1.30 ________ crest

1.31 ________ trough

1.32 ________ wavelength

1.33 ________ infrared light

1.34 ________ X-rays

a. top of wave

b. a source of light

c. distance from one point on one wave to the same point on the next wave

d. distance from top of wave to bottom of wave

e. bottom of wave

f. shorter wavelengths than visible light

g. the energy of light

h. longer wavelengths than visible light

i. makes it possible to see things

j. middle of wave

LIGHT TRAVEL

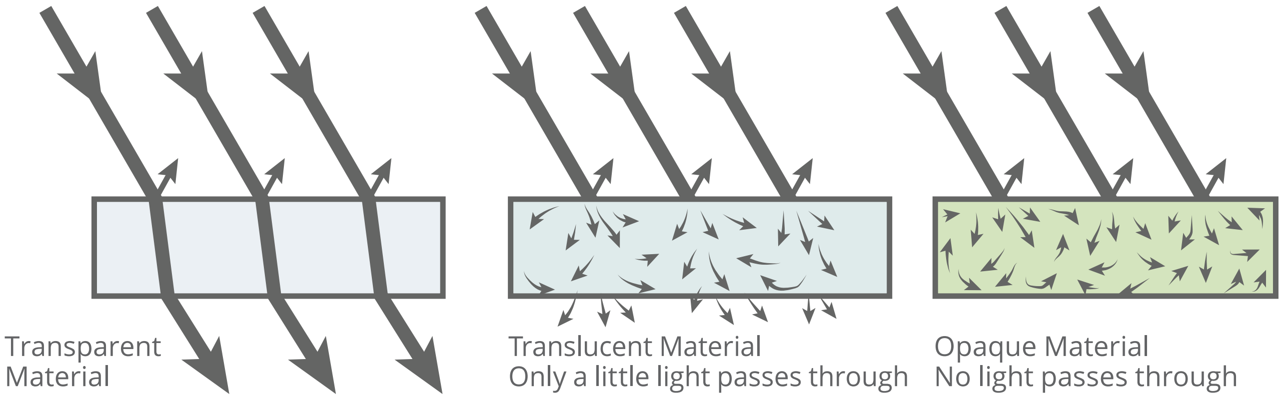
As we have seen, light can be described as traveling through space in electromagnetic waves. It has some characteristics of waves such as wavelength, frequency, and amplitude. But light can also be described as traveling through space in small particles, called **photons**. Each *photon* moves in a straight line. That is why when we shine a flashlight across a dark room, the light seems to go in a straight line.

Is light a wave or a particle? In some experiments, light behaves like a wave. In other experiments, it behaves more like a particle. The best answer to this question is that it is strictly *neither* a wave nor a particle. However, we can use the models of light as a wave or a particle to explain a great many things about light and the way that light travels.

Unlike sound, light *can* travel through a vacuum. In fact, light travels through a vacuum at approximately 186,000 miles per second! That is the fastest that anything can travel! When light runs into a material, it runs into the atoms of the material and its speed is slowed down. Between the atoms of the material, the light travels at its normal speed as in a vacuum. Therefore, as light travels through glass, its speed is slowed down by the atoms in the glass to about two-thirds of its normal speed.

Refraction of light. Light normally travels in a straight line. Its rays can be bent when passing from one substance to another. For example, a pencil placed part of the way in a glass of water appears to be bent. This appearance is due to the bending of light when it passes from air into water. The bending of light is called **refraction**.

| Light refraction



| The three kinds of materials and their transmission of light

Transmission of light. A **transparent** material is one that is clear and allows light to pass through it. Air, clear glass, and some plastics are examples of transparent materials. Most of the light that strikes transparent materials passes through them.

A **translucent** material is one that is only partially clear. Some of the light can pass through the material, but not all. Examples of translucent materials are frosted glass, colored glass or plastic, thin paper or cloth, and parchment. Many of the white or frosted types of plastic are translucent. Light is **diffused** when it passes through translucent material.

An **opaque** material is one that does not allow any light to pass through it. Objects made of opaque materials stop the passage of light. When light strikes an opaque object, some of the light is absorbed and changed to tiny amounts of heat. The rest of the light is reflected away from the object. None of the light passes through an opaque object.

Not all objects are totally transparent or translucent. Some are in-between these categories. For example, a thin piece of onionskin paper may be almost transparent. Many of these sheets together may be translucent. If enough of the onionskin sheets are placed together, they become opaque.

Try this experiment to learn more about refraction.

Overview:

You will examine the way light is refracted in water.

These supplies are needed:

- a shallow glass, water, a coin of any type, and a pencil

Follow these directions. Place a check mark in the box as you complete each step.

☐ 1. Place a coin near the center of a shallow glass.

☐ 2. Gently pour water into the glass until it is about half full. Look down at the coin as you pour the water into the glass.

1.35 What appears to happen to the coin as the water is poured into the glass? ______________

____

1.36 How do you explain this? ______________________________

____

☐ 3. Remove the coin and place a pencil into the glass of water. Add enough water to cover about one-third of the pencil.

1.37 How does the pencil appear when viewed from above? ______________________

____

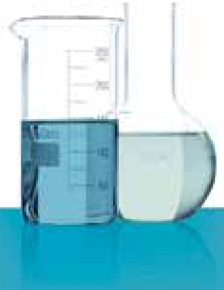
1.38 How does the pencil appear when viewed from the side of the glass? ______________

____

1.39 How do you explain the changed appearance of the pencil in the water? ______________

____

____



Experiment 606.C Refraction of Light

Answer true or false.

1.40 ____________ Light has some characteristics of waves such as wavelength, frequency, and amplitude.

1.41 ____________ *Photons* are particles of light that move in a straight line.

1.42 ____________ Strictly speaking, light is *neither* a wave nor a particle.

1.43 ____________ Like sound, light cannot travel through a vacuum.

1.44 ____________ The fastest speed of anything is the speed of light at 186,000 miles per second.

1.45 ____________ The speed of light does not change as it passes through mediums.

1.46 ____________ The bending of light is called rarefaction.

1.47 ____________ Light is diffused when it passes through translucent material.

1.48 ____________ An opaque material is one that allows only a small amount of light to pass through it.

TEACHER CHECK ____________ initials ____________ date

Review the material in this section in preparation for the Self Test. The Self Test will check your mastery of this particular section. The items missed on this Self Test will indicate specific areas where restudy is needed for mastery.

SELF TEST 1

Match the following items (each answer, 3 points).

1.01	________	speed of sound	a.	20,000 vibrations per second
1.02	________	speed of light	b.	1,100 feet per second
1.03	________	amplitude	c.	186,000 miles per second
1.04	________	vibrations	d.	longer wavelength than visible light
1.05	________	pitch	e.	shorter wavelength than visible light
1.06	________	radiant	f.	particles of light energy
1.07	________	crest	g.	bottom of wave
1.08	________	trough	h.	top of wave
1.09	________	microwaves	i.	determines loudness
1.010	________	photons	j.	the frequency of sound
			k.	the cause of sound
			l.	energy of light

Write true or false (each answer, 2 points).

1.011 ____________ Some animals use vibrating air sacs or body parts (wings, legs, etc.) to produce sounds.

1.012 ____________ A trumpet makes sound when the lips of the musician vibrate.

1.013 ____________ Without light, we would have no food to eat nor oxygen to breathe.

1.014 ____________ Light has some characteristics of waves such as wavelength, frequency, and amplitude.

1.015 ____________ Strictly speaking, light is *neither* a wave nor a particle.

1.016 ____________ Unlike sound, light can travel through a vacuum.

1.017 ____________ The speed of light changes as it passes through different mediums.

1.018 ____________ The bending of light is called refraction.

1.019 ____________ Light is diffused when it passes through translucent material.

1.020 ____________ An opaque material is one that allows no light to pass through it.

Write the correct letter and answer in each blank (each answer, 3 points).

1.021 Sound ______________________________ radiate out in all directions from a vibrating object.
a. waves b. particles c. notes

1.022 When we speak, air from our lungs rushes across ________________________________, causing them to vibrate.
a. taste buds b. gums c. tightened vocal cords

1.023 Musical sounds travel out from the instruments in ________________________________ .
a. melodies b. notes c. waves

1.024 The _________________________________ of a sound is related to the amount of energy flowing in the sound waves.
a. intensity b. compression c. direction

1.025 The speed at which sound waves travel in a medium depends upon the density and _________________________________ of the medium.
a. magnitude b. compressibility c. formation

1.026 The visible and invisible radiations received by planet earth are collectively called ________________________ .
a. quantum materials b. neutrons c. the electromagnetic spectrum

1.027 Different types of electromagnetic radiation have different ________________________ .
a. wavelengths b. periods c. compressibilities

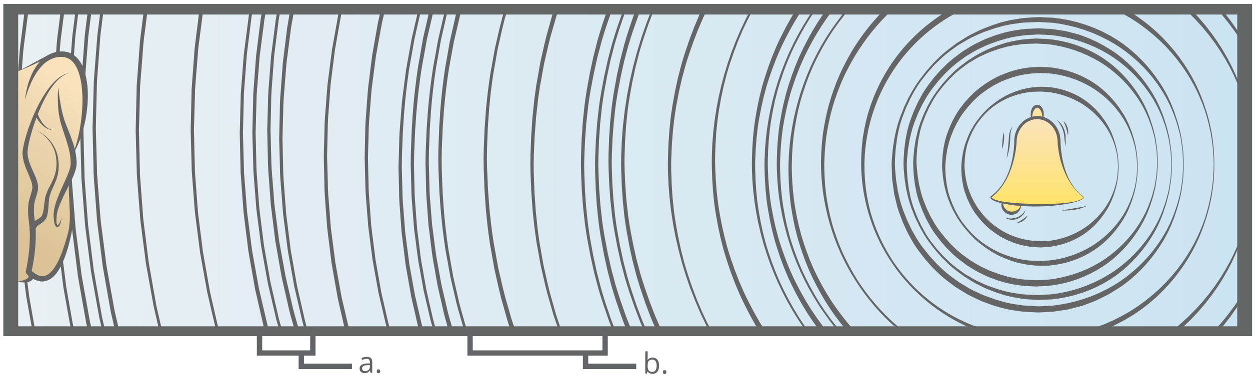
1.028 Air, clear glass, and some plastics are examples of ___________________________ materials.
a. photogenic b. translucent c. transparent

1.029 Visible light is ______________________________________ the electromagnetic spectrum.
a. the same as b. only one part of c. the major part of

1.030 When light strikes an opaque object, some of the light is ____________________________ and changed to tiny amounts of heat.
a. compressed b. absorbed c. redirected

Label the following drawings (each label, 2 points).

1.031 Label the compression and rarefaction in this sound wave.



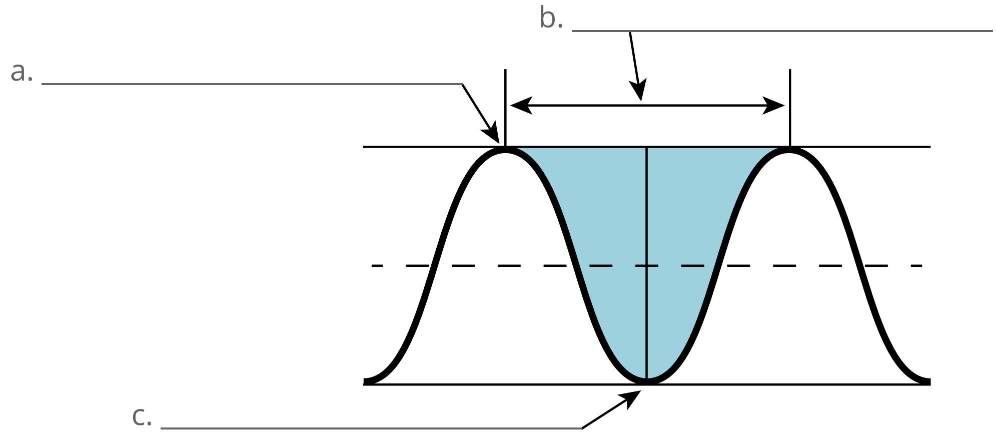
a. ______________________ b. ______________________

1.032 Indicate on the wave graph the location of the following:

crest

trough

wavelength



Answer the following questions (each answer, 5 points).

1.033 How do we hear sounds from a vibrating object? ______________________

____

1.034 Is light a wave or a particle? Explain. ______________________

____

____

80/100 **SCORE** __________ **TEACHER** __________ __________
initials date

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