Coahoma County Jr-Sr High School

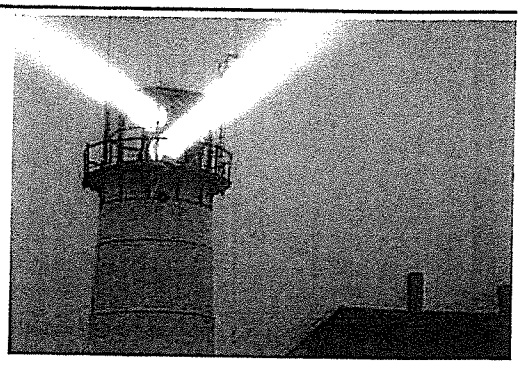
8th Science

Week 1

March 23-27, 2020

Properties of Light

By Cindy Grigg



[1] Light is one form of energy that travels in electromagnetic waves. This energy is both magnetic and electrical.

[2] There are many different types of electromagnetic (EM) waves. Most of them cannot be seen by humans. Our eyes see only a small portion of EM waves called visible light. Visible light is made up of different colors. The colors are red, orange, yellow, green, blue, indigo, and violet. The colors are due to the different wavelengths of light. The longer the wavelength, the less energy the wave has. The shorter the wavelength, the more energy it has. The longest wavelength of visible light looks red to us. The shortest wavelength of visible light looks violet to us.

[3] Here are some **properties of light**:

[4] **Light travels out in all directions from its source.** What are some sources of light? The sun is our main source of light on Earth. Some other sources are other stars and fire.

[5] **Light is made of little particles called photons.** A photon is the smallest possible particle of electromagnetic radiation. These particles travel in waves.

[6] **Light travels in straight lines called rays.**

[7] **Light travels "at the speed of light."** This speed is about 186,000 miles per second (670 million miles per hour), or about 300,000 kilometers per second. The speed of light is sort of a galactic "speed limit." So far, nothing has been found that can travel faster than light.

[8] **Light can travel in a vacuum.** A vacuum is empty space. There are no molecules of air or anything else in a vacuum. Like all forms of electromagnetic waves, light can travel through empty space, as well as through matter.

[9] **Light can be absorbed.** Absorbed light energy is converted into some other form, such as thermal or heat energy. You can test this by putting a piece of black construction paper and a piece of white construction paper on a sunny windowsill. Place a thermometer for measuring outdoor or room temperature under each piece of paper. Wait a few hours, and then check the two temperatures. The thermometer underneath the black paper should be hotter than the one under the white paper. This is the reason people tend to wear dark colors in the wintertime and white or light colors in the summer. Dark colors absorb light, helping us keep warmer in the winter. In the summer, light colors absorb little of the sun's energy, keeping us cooler.

[10] **Light can be reflected.** If you shine light on a surface, some of that light will bounce off, or be reflected by, the surface. The *law of reflection* tells us that light will always be reflected by a surface at the same angle at which it hits the surface.

[11] **Light can be refracted.** Light always travels in straight lines. But when it passes from one medium into another, it changes direction slightly. Refraction occurs because light travels at different speeds through different materials. When light passes through air into water, for example, it slows down. The light rays are bent slightly. You can see this if you put a pencil into a half-glassful of water. The pencil looks bent or broken at the water line. This is due to refraction. Objects that we see get their color from the light they reflect. A green object looks green because it absorbs all other colors but reflects green.

[12] **Light can be transmitted.** Sometimes light passes through matter. This is called transmission. Light is transmitted through some matter more easily than through other kinds of matter. Light is transmitted through water, air, and glass very easily. These materials are said to be transparent. *Transparent* materials allow light to be transmitted through them easily. Some matter transmits some, but not all, of the light that hits it. This material is called *translucent.* Some examples of translucent material are waxed paper or glass blocks. *Opaque* matter does not transmit any light. You cannot see through it because light doesn't pass through it. A book and a brick wall are two examples of opaque materials.

Name _____ Date _____

Properties of Light

1. What is the smallest possible piece of electromagnetic radiation? (A) Waves (B) Photons (C) Rays	2. How does light travel? (A) In straight lines (B) In rays (C) In waves (D) All of the above
3. What is the speed of light? (A) All of the above are correct (B) About 670 million miles per hour (C) About 186,000 miles per second (D) About 300,000 kilometers per second	4. Light cannot be absorbed. (A) False (B) True
5. Light can be reflected. (A) False (B) True	6. Light can be transmitted through matter. (A) False (B) True
7. These materials allow light to be transmitted through them easily. (A) Translucent (B) Transparent (C) Opaque	8. Something that transmits some, but not all, of the light that hits it is called: (A) Opaque (B) Translucent (C) Transparent

Name _____ Date _____

Properties of Light

Write a paragraph about a time when you observed some of these properties of light. What did you see?

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Describe in your own words some of the properties of light.

Properties of Light

longest	outdoor	lines	refraction
materials	galactic	helping	portion
waxed	wavelength	wavelengths	allow
possible	longer	magnetic	line
wintertime	material	cooler	

Directions: Fill in each blank with the word that best completes the reading comprehension.

Light is one form of energy that travels in electromagnetic waves. This energy is both *(1)* _____ and electrical.

There are many different types of electromagnetic (EM) waves. Most of them cannot be seen by humans. Our eyes see only a small *(2)* _____ of EM waves called visible light. Visible light is made up of different colors. The colors are red, orange, yellow, green, blue, indigo, and violet. The colors are due to the different *(3)* _____ of light. The *(4)* _____ the wavelength, the less energy the wave has. The shorter the wavelength, the more energy it has. The *(5)* _____ wavelength of visible light looks red to us. The shortest *(6)* _____ of visible light looks violet to us.

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piece of white construction paper on a sunny windowsill. Place a thermometer for measuring *(9)* _____ or room temperature under each piece of paper. Wait a few hours, and then check the two temperatures. The thermometer underneath the black paper should be hotter than the one under the white paper. This is the reason people tend to wear dark colors in the *(10)* _____ and white or light colors in the summer. Dark colors absorb light, *(11)* _____ us keep warmer in the winter. In the summer, light colors absorb little of the sun's energy, keeping us *(12)* _____ .

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Light can be transmitted. Sometimes light passes through matter. This is called transmission. Light is transmitted through some matter more easily than through other kinds of matter. Light is transmitted through water, air, and glass very easily. These materials are said to be transparent. *Transparent* materials *(16)* _____ light to be transmitted through them easily. Some matter transmits some, but not all, of the light that hits it. This *(17)* _____ is called *translucent*. Some examples of translucent material are *(18)* _____ paper or glass blocks. *Opaque* matter does not transmit any light. You cannot see through it because light doesn't pass through it. A book and a brick wall are two examples of opaque *(19)* _____ .

Name _____ Date _____

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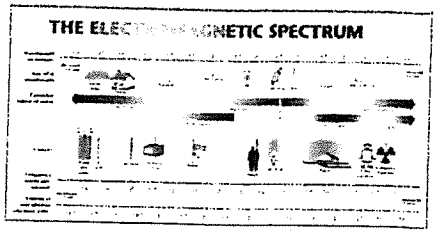
Name: _____

Waves and Rays, Part I



Have you ever played in the ocean? The waves can push you around. They can pull the sand out from under your feet. As far out as you can see, there are more waves coming at you all the time.

There are other kinds of waves all around you all the time. You can't see most of them, but they can warm you, burn you, and go right through your body. These are the waves of the electromagnetic spectrum.

These waves come from the same kind of electric force that makes your TV work and from the same kind of magnetic force that holds the picture you drew in art class on your kitchen refrigerator with a magnet. When these two forces act together, they make electromagnetic radiation. This is a kind of energy that is both electric and magnetic. This energy travels in waves.

In some ways, these waves and ocean waves are alike. They have tops called crests. They have bottoms called troughs. The distance from one crest to the next is called a wavelength. Wavelengths can also be measured from one trough to the next. Another way electromagnetic (EM) waves are like ocean waves is that they both move energy from one place to another.

The biggest difference between ocean waves and EM waves is that ocean waves move across water. Energy moves through the water. EM waves don't need anything to move through. They can move across the emptiness of outer space. In outer space where there is nothing for the waves to move through, the waves travel at the speed of light. EM waves can also travel through things. They can travel through air inside a room, around the earth, or through food. Some EM waves can even travel inside your body!

Let's learn more about these mysterious waves. When you turn on a radio, you're using part of the EM spectrum. Radio waves have the longest wavelengths of any of the waves in the EM spectrum. Radio waves can be several miles long, or they can be about the length of a one-foot ruler.

When you turn the dial on the radio, you are changing from one radio frequency to another. Frequency means how many waves pass a certain point in one second. If you could see radio waves, you could stand on the street outside your house and count them. Imagine there is a radio tower at the end of your street. The tower sends out radio signals. If you could see the radio waves, you could count how many of them pass a point in front of you in one second. A single wave from one crest to the next (or one trough to the next) is called a cycle. If five thousand waves passed the point in front of you in one second, the radio signal would have a frequency of five thousand cycles per second. You'd have to be able to count pretty fast!

Another name for cycle per second is hertz. It is abbreviated Hz. Radio waves are used to broadcast radio and

Name: _____

TV shows and signals for cellular phones. They carry signals here on Earth and through outer space.

There are seven different types of EM waves. The frequency of the waves makes each type different. Frequency is the number of cycles that pass a given point in one second. The example above (where you counted radio waves from a tower) had a frequency of five thousand cycles per second. Waves in the EM spectrum that have the lowest frequencies have the least amount of energy. Waves with the highest frequencies have the most energy. The first type we learned about is radio waves. The other six types are microwaves, infrared, visible light, ultraviolet, X rays, and gamma rays.

Microwaves are shorter waves than radio waves - shorter than 11.8 inches. The ones used in microwave ovens to cook food are about five inches long. How do microwaves cook food? When you put food into a microwave, the plate stays cool and the food gets hot. Inside food is water. Plates don't have water inside them. When the microwaves hit the food, the water inside the food begins to vibrate from the energy. Microwaves have a frequency of two billion four hundred fifty million waves per second. The water molecules vibrate with that same frequency. When molecules vibrate, they move. The movement releases heat inside the food. The heat cooks the food very quickly.

Two billion four hundred fifty million waves per second is a really big number. Scientists needed a shorter way to say it. A million cycles is a megahertz, abbreviated MHz. A thousand megahertz, or 1000 MHz, is the same as saying one billion cycles per second. The frequency of a microwave can be written as 2450 MHz. Microwaves are also used for communication and TV satellites and for radar. These have shorter waves than those used for microwave ovens. Communications satellite microwaves can be as short as four hundredths of an inch. When a wavelength is that short, the frequency is high - three hundred billion cycles per second. This can be written as 300 GHz, or 300 gigahertz. "Giga-" means one billion.

Infrared waves are the next ones in the band of EM radiation. If you stand in the sunlight, you can feel warmth from the sun's infrared radiation. Your TV remote works on infrared waves. When you push a button on your TV remote, a microchip in the remote starts a vibration. It produces waves in the infrared range. Infrared waves have frequencies of 100 billion to 100 trillion cycles per second. Here's another prefix to learn: "tera-" means one trillion. One terahertz (THz) is one trillion hertz or cycles per second. Since the frequencies of infrared beams are so high, the wavelengths are short-from four hundredths of an inch to only four hundred thousandths of an inch.

These infrared beams carry codes. Inside the TV set, another microchip identifies each code and sends a signal to raise or lower the volume, change channels, turn the set on or off, record a program, or do whatever you want it to do. Firefighters use infrared cameras to look through smoke and find survivors. They are used in building construction to find heating and cooling system leaks. They are also used in medicine to diagnose cancers and injuries, similar to X-rays.

Radio, microwaves, and infrared are only part of the waves that make up the EM spectrum. Read *Waves and*

Name: _____

Rays, Part II to find out more.

Waves and Rays, Part I

Questions

_____ 1. All waves need some material to travel through.

A. false
B. true

_____ 2. Electromagnetic radiation is:

A. energy that is magnetic and solar
B. energy that is created only by the sun
C. energy that is electric and magnetic
D. energy that is created by atoms and electricity

_____ 3. EM waves have crests, troughs, and wavelengths.

A. false
B. true

_____ 4. Radio waves:

A. carry the most energy in the EM spectrum.
B. are the shortest waves in the EM spectrum.
C. need water to travel through.
D. are the longest waves in the EM spectrum.

_____ 5. What does frequency mean?

A. how many waves or cycles pass a certain point in one hour
B. how many waves or cycles exist at one time
C. how many waves or cycles pass a certain point in one second
D. how many waves or cycles pass a certain point in one minute

_____ 6. A cycle measures:

A. how much time it takes the wave to travel from its source to Earth
B. how long the wavelength is
C. the number of waves passing a certain point in one second
D. a single wave from one crest or trough to the next

_____ 7. Another word for cycles per second is:

A. hertz
B. EM radiation
C. frequency
D. waves

_____ 8. Which waves have the highest frequencies?

A. waves with the lowest energy
B. waves with the highest energy
C. microwaves
D. UV

Name: _____

_____ 9. Radio waves are used for:

A. TV broadcasting
B. cell phones
C. radio broadcasts
D. all of the above

_____ 10. In general, if a wavelength is short:

A. the energy and frequency are low.
B. It tells us nothing about the energy and frequency.
C. the energy and frequency are high.
D. the energy and frequency are medium.

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How many of these can you write about? Think! Write! Check all the ones you answered.

- ☐ How are EM waves like ocean waves? How are they different?
- ☐ Explain how microwaves work to cook food.

Don't stop writing. Use a blank piece of paper to continue.

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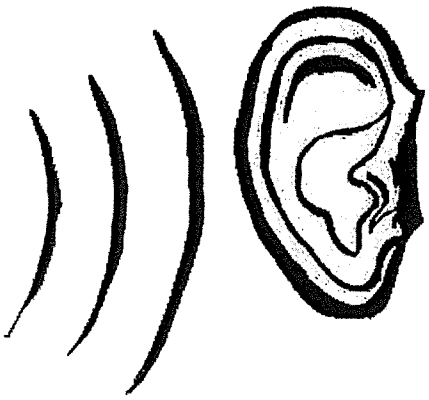
The Language of Sound



Sound is a form of energy. An object makes sound when it vibrates matter. Matter could be a solid (earth), a liquid (water), or a gas (air). Most of the time, we hear sound that travels through air. Sound energy is transported through waves. A wave travels from one place to another with a certain velocity. Velocity is the speed and direction of the movement.

Sound waves must travel through matter. You cannot hear anything in space where there is little or no air. Waves that travel through matter are called mechanical waves. When something vibrates in the atmosphere, it moves the air particles around it. Those air particles move other air particles in front of them. This carries the wave of energy through the air and away from its source. An echo happens when the sound wave hits a solid surface and bounces back toward the source.

The **amplitude** of a sound is the greatest distance the particles in a wave rise or fall from their rest position. A sound wave with large amplitude will carry a loud sound.

The **intensity** (loudness) of a sound depends on the amplitude of the sound waves. The bigger the amplitude, the more intense the sound will be. The loudness of a sound can differ for different people. Loudness describes the way a person responds to a sound's intensity. A sound that seems loud to one person may not be loud enough for someone else.

A **decibel (dB)** is the unit used to measure loudness or intensity of a sound. Normal talking has a loudness of about sixty dB. Any sound above eighty-five dB can cause hearing loss. The loss is related to both the intensity of the sound as well as the length of exposure. You know that you are listening to an eighty-five dB sound if you have to raise your voice to be heard by somebody else. Eight hours of listening to ninety dB sound can cause damage to your ears. Any exposure to one hundred forty dB sound will cause immediate damage and causes actual pain to the human ear. On the decibel scale, the smallest sound you can hear is zero dB. A sound ten times more powerful than that is ten dB. A sound one hundred times the smallest sound is twenty decibels. A sound one thousand times more powerful than the smallest audible sound is thirty dB.

The **frequency** of a sound is the number of waves that pass a certain point in one second. Frequency is measured in hertz (Hz). Humans can hear sounds ranging from twenty to twenty thousand hertz. Some animals can hear sounds with frequencies higher than those we can hear. As the frequency of a sound wave increases, the wavelength decreases. The higher the frequency is, the greater the energy of the wave. Sounds above twenty thousand Hz are called ultrasound.

Name: _____

The **pitch** is the highness or lowness of a sound. The pitch of a sound is related to its frequency. Sounds with high pitches have high frequencies, and sounds with low pitches have low frequencies.

The **velocity** of a sound wave is the speed and direction the sound travels. Velocity depends on the kind of matter the sound is traveling through. Sound travels faster through liquids and solids than it does through gases. Sound travels at about 332 meters per second through dry air at zero degrees Celsius. Have you ever seen people in a movie putting their ear to the ground to hear if someone is chasing them? They can hear sound traveling through the solid ground before they could hear it traveling through air. The velocity of sound increases as the air temperature increases. Sound travels faster through warm air than through cold air.

Tone quality has to do with the differences among sounds that have the same pitch and loudness. Tone qualities differ depending on the source of the sound. The tone quality of a note played on a piano is different from the tone of the same note played on a tuba.

Noise is sound that has no definite pitch or regular wave pattern. Noise can also be defined as unpleasant sound. Different people have different ideas about what sounds are pleasing.

White noise is a type of noise that is made by combining sounds of all different frequencies together. It's called white noise because of the way that light works. When you combine all the colors of light, you see the color "white." A prism can separate white light into its separate colors. If you take all of the sounds that a human can hear and combine them, you would get white noise. Because white noise contains all frequencies of sound, it is used to mask other sounds. People use white noise to help them get a better night's sleep.

The Language of Sound

Questions

_____ 1. What is sound?

A. a form of energy
B. a form of movement
C. a form of loudness

_____ 2. How is sound made?

A. by the sun
B. by a vibration of matter
C. by an amplifier

_____ 3. What unit is used to measure sound?

A. the wave
B. the decibel
C. the Richter scale

Name: _____

_____ 4. What level of sound will cause immediate damage to the human ear?

A. 85 dB
B. 200 dB
C. 140 dB

_____ 5. What happens to the wavelength of a sound when the frequency increases?

A. It stays the same.
B. It decreases.
C. It increases.

6. Waves that have high frequency also have high _____.

_____

_____

_____ 7. What two things does velocity tell us?

A. amplitude and pitch
B. pitch and tone quality
C. speed and direction

_____ 8. Sound travels faster through a solid than through a gas.

A. true
B. false