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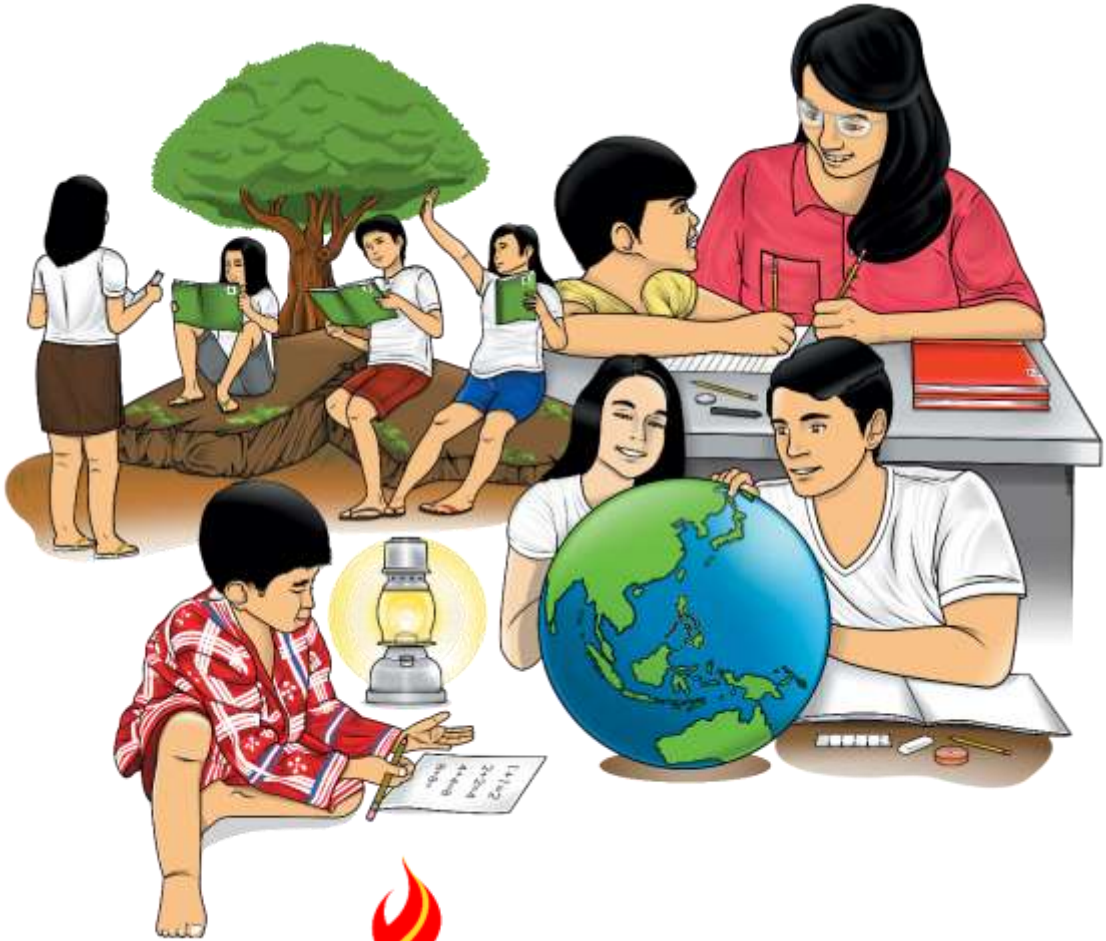
Science

Quarter 3 – Module 5

Your Light is My Life!



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Science

Quarter 3 – Module 5

Your Light is My Life!

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

Our environment is surrounded by different forms of energy that travel through a wave such as sound energy and groups of electromagnetic spectrums. These forms of energy differ in their characteristics and properties. One part of the electromagnetic spectrums is visible light that travel also in a form of wave just like other forms of energy.

Most Essential Learning Competency:

Demonstrate an understanding on how to explain color and intensity of lights in terms of its wave characteristics (S7LT-IIIh-i-12).

This module is divided into two lessons:
Lesson 1: Nature and Sources of Light
Lesson 2: Characteristics of light

After going through this lesson 1, you are expected to:
1. identify different sources of light,
2. determine the best kind of light source to produce the brightest light,
3. infer that the brightness of light is dependent on the distance of the light source,
4. identify the characteristics and properties of visible lights, and
5. explore and describe the characteristics of color lights.

What I Know

Directions: Read each item carefully. Write only the letter of your answer for each question. Use a separate sheet for your answers.

1. How do you call objects that emit light?
   A. luminous
   B. non-luminous
   C. opaque
   D. transparent

2. Which of the following items best describes the nature of light?
   A. current and wave
   B. mass and particle
   C. point and wave
   D. wave and particle

3. The following are natural sources of light in the surroundings, **EXCEPT**_____
   A. fire
   B. flashlight
   C. jellyfish
   D. lightning

4. Which of the following are the correct reasons why we see a clear image of our face when we look on the mirror?

I.	A mirror has plane and smooth surface.
II.	Incident light rays to a mirror get diffracted when it strikes a mirror.
III.	Incident light rays to the mirror get refracted on the surface of mirror.
IV.	Incident light rays to a mirror get reflected when it strikes on plane surface.

   A. I and II only
   B. I and III only
   C. I and IV only
   D. III and IV only

5. According to Louis de Broglie, why is light said to have a dual nature?
   A. It shows the properties of wave only.
   B. It exhibits the properties of reflection.
   C. It has both interference and polarization effect.
   D. It displays the properties of both wave and particle.

6. Who among the scientists below formulated the wave theory of light?
   A. Isaac Newton
   B. Louis de Broglie
   C. Christian Huygens
   D. James Clerk Maxwell

7. Which of the following is **NOT** a property of light?

A. Direction
B. Frequency
C. Intensity
D. Width

8. Which of the following materials would reflect light the most?

A. black rock
B. dark brown carpet
C. flat sheet of aluminum foil
D. piece of red construction paper

9. The distance of an observer from two identical kinds of light sources varies. Light source A is 200 centimeters away while the light source B is 300 centimeters away from the observer. Does light source A give higher light intensity than light source B?

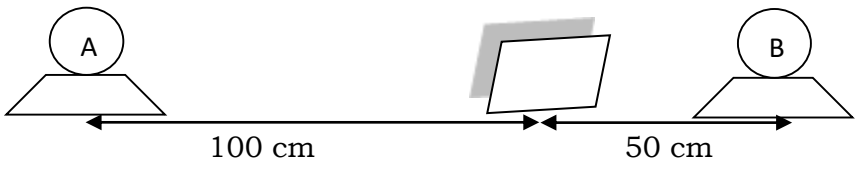
A. Yes, because it is away from the observer
B. Yes, because it is much closer to the observer
C. No, because the distances of light source vary
D. No, because its distance is closer from the observer

10. The intensity of light is inversely proportional to the distance from the eye of the observer. Which of the following statements explain the relationship between intensity and distance?

I.	As the distance increases, the intensity of light decreases because it spreads out over a larger surface area.
II.	When the distance increases, the intensity of light increases because the light rays compressed in larger surface area.
III.	If the distance increases, the intensity of light decreases because light waves spread out more in its surrounding.

A. I, II, and III
B. I and II only
C. I and III only
D. II and III only

For items 11 to 13, refer to the illustration below. Suppose two identical kinds of light sources, A and B, shines on a surface of a board when placed 100 cm to the left and 50 cm to the right of the board, respectively.



11. Will the light intensity measured on the cardboard facing light source A is higher than the side facing light source B?

A. No, because light source A is farther from the cardboard than light source B.
B. Yes, because light source A is farther from the cardboard than light source B.
C. Yes, because light source B is much closer to the cardboard than light source A.
D. No, because the distance of light sources has no effect on their light intensities.

12. How does the amount of light intensity of light source B compare to light source A as measured on the surface of the cardboard?

A. They have equal light intensities.
B. They have varying light intensities per time.
C. The side facing light source A has greater light intensity.
D. The side facing light source B has greater light intensity.

13. Which of the following statements correctly describes the brightness of light sources A and B?

I. Light source A is brighter than light source B. II. Light source B is brighter than light source A. III. Light sources A and B produce unequal brightness. IV. No differences in brightness between light sources A and B.

A. I, and II only
B. II and III only
C. III and IV only
D. I, II, and III only

14. Which of the following terms best describes an object that emit energy in the form of light?

A. Fluorescence
B. Incandescence
C. Luminous
D. Phosphorescence

15. The following objects are luminous, **EXCEPT**_____**.**

A. sun
B. moon
C. burning wood
D. flashlight switched on

Lesson 1

Nature and Sources of Light

What's In

Activity 1: Find Me!

Directions: The statements on the left are from famous scientists listed with their names on the right. Match the statements with the correct scientists who authored them. Write your answer on a separate sheet of paper.

1. He was a mathematician, physicist and astronomer who formulated the wave theory of light that postulated that the more light was "bent" or refracted by a substance, the slower it would move while propagating across that substance.

Louis de Broglie

2. An English physicist and mathematician, who pointed out in his 1704 book Optics, that "Light is never known to follow crooked passages nor to bend into the shadow". This concept is consistent with the particle theory, which proposes that light particles must always travel in straight lines.

Isaac Newton

3. Born in Dieppe, France on 15 August in 1892, grew up in a rich, aristocratic family and came up with what is now known as the dual Nature of Light. He explained that light can behave like a particle and can also as a wave.

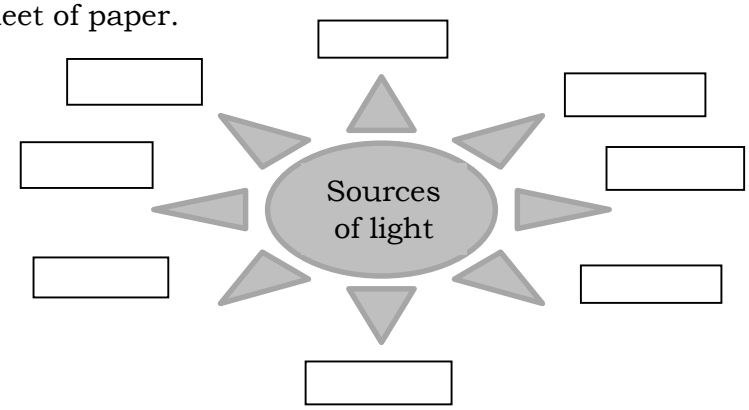
James Clerk Maxwell

4. He was born on June 13, 1831 at Edinburgh, Scotland and died November 5, 1879, Cambridge, Cambridge shire, England. He was a Scottish Physicist best known for his formulation of electromagnetic theory of light.

Christian Huygens

Activity 2: Sources of light

Directions: Using the Sun's diagram pattern, identify different sources of light in our surroundings. Make a similar diagram and write your answer on a separate sheet of paper.



Illustrated by: Ma. Sheila S. Manila

Questions:

1. What do you think are the sources of light?
2. Which of these sources of light are natural?
3. Which of these sources of lights are artificial?
4. How will you differentiate natural and artificial sources of light?

What's New

Directions: Study and perform the activity given below by following the procedures properly. Provide the materials needed and take note of the precautionary measures. Do the activity with the supervision of an adult.

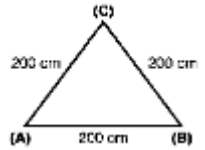
Materials:

- Rechargeable light bulb (Incandescent Bulb)
- Candle/ Kerosene lamp
- ½ size index card/ cardboard (5 inches by 8 inches)
- Ruler
- Match box and stick

Caution!
Please be extremely careful when using candles, kerosene lamp and rechargeable incandescent bulb. Avoid unattended or careless use of candles. Put off the candle /kerosene lamp after using. Do your activity seriously to avoid any accident. Set up your experiment away from easily burning materials. The activity needs the assistance of your parents, guardian, or adult.

Procedures:

1. Prepare a ½ size index card/ cardboard (5 inches by 8 inches).
2. Make a hole at the center of your ½ size index card of about 5 cm diameter.
3. Arrange your light bulb (A) and candle (B) in a straight line a distance of 200 cm from each other. Place your index card (C) 200 cm away from the two sources of light forming an equilateral triangle similar to the diagram given.



Illustrated by: Ma. Sheila S. Manila

4. Switch on your light bulb and observe the light passing through the hole of the index card.
5. Switch off the light bulb and light on your candle, observe the light passing through the hole of the index card.
6. Move the candle (B) to about 50 cm closer to the index .
7. Repeat steps # 4 and 5 and observe the brightness of light in different positions.
8. Write your observations from steps # 4, #5, and #6 on a separate sheet of paper.
9. Answer the following guide questions using a separate sheet of paper.

Guide Questions:

1. Which of the two produced brighter light during same position?
2. Why did the light bulb and candle differ in brightness?
3. Did the brightness of light from the incandescent bulb and candle change with distance?
4. How is the brightness of light affected by distance from the light source?
5. From your observation, how does light travel?
6. Which source of light will you prefer to use at night; candle or incandescent bulb? Why?

Rubric Scoring

Criteria	5	3	1	Score
Knowledge	Provided detailed explanation and complete response to the question.	Provided clear explanation but incomplete response to the question.	Provided unclear explanation and incomplete response to the question.	
Quality of Observation	Provided very good observations in steps number 4, 5, 6 and 7.	Provided good observations in steps number 4, 5, 6, and 7.	Provided poor observations in steps 4, 5, 6, and 7.	

What is It

The Nature of Light

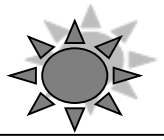
Centuries ago, light was studied by several well-known scientists. Let's consider four scientists whose contributions to understanding light are valuable. First, was **Sir Isaac Newton**, one who believed that light behaves like a particle and pointed out in his 1704 book Optics, that "Light is never known to follow crooked passages nor to bend into the shadow". This concept is consistent with the particle theory of light, which proposes that light particles must always travel in straight lines. Second, was **Christian Huygens** who believed that light behaves like a wave. He believed that there is a medium called ether that carried light waves. Third scientist was, **Louis de Broglie** who came up with what is now known as the Dual-Nature of Light. He explained that light can behave like a particle and as a wave. Fourth scientist was **James Clark Maxwell** who proposed the Electromagnetic Theory of Light. Through their thorough study of light along with their contemporary scientists, we understand the characteristics of light.

What is light?

Light is a form of energy found in our surroundings. Light from the sun is a source of energy that can run different technologies throughout the world. Light can be natural or man-made, but no matter how it was formed, we utilize it in different ways in every single day of our lives. It has wavelike nature and particle-like nature and it travels in a straight-line path with or without medium. When light waves strike an object, some light might be reflected, and a portion may be absorbed. For example, when light rays are incident to the surface of a plane mirror, it will reflect and form images. **Opaque** materials do not allow light to pass through instead it will be absorbed and converted into heat. **Transparent** materials allow light to get through and **translucent** materials partly allow light to get through.

Sources of light

Natural sources of light include the **sun,** which is the main source of energy, **stars** very far from the planet earth, **fire** that provides heat and l**ightning** that occurs from our atmosphere during bad weather. These sources of lights are present naturally in the universe and are not made by human beings.



Sun

Star

Lightning

Fire

Illustrated from laptop basic shapes

Photo: Courtesy of Ma. Sheila S. Manila

There are also artificial or man-made sources of light such as incandescent bulb, candle, matches, and gas lamps. These are man-made sources of light which are very useful during the nighttime.

Kerosene lamp

Incandescent bulb

Candle

Match sticks

Photos: Courtesy of Ma. Sheila S. Manila

All objects that are capable to emit light are known as **luminous objects** such as the sun, incandescent bulb, candle, flashlight, matches, and gas lamps. **Non-luminous objects** are those that cannot produce light such as moon, rocks, water, and soil.

Q1. Do you know other things that can be classified as luminous objects? Cite examples.

The brightness of light depends on the light source and the distance from the light source. However, its quality is dependent in the person's perception. Brightness can be measured using luminous intensity and expressed with a unit known as candela (cd). **Luminous intensity** is a measure of the radiant power emitted by any source of light in a given direction and is dependent on the wavelength of light being emitted. It is weighted to the sensitivity of the human eye, by what is called the standard luminosity function. There are special instruments that can be used luminous intensity such as a **photometer.**

Q2. How will you calculate the luminous intensity of incandescent bulb and candle or kerosene lamp?

Below is the formula in computing the luminous intensity of incandescent bulb. Please refer to the given values in What's New activity.

$$\text{Illuminance of incandescent bulb} = \frac{\text{Luminous intensity of candle x distance of bulb}^2}{\text{Distance of candle}^2}$$

$$l_1 = \frac{l_2 x\ d_1^2}{d_2^2}$$

Where

l_1 – luminous intensity of the first source (e.g., Incandescent Bulb)
l_2- luminous intensity of the second source of light (e.g., candle)
d_1- distance of the first source of light from the index card
d_2- distance of the second source of light from the index card

Given:	Formula	Solution
1. Distance (d_1) of bulb from index card = 200 cm 2.Distance (d_2) candle from the index card= 50 cm	$\frac{l_1}{d_1^2} = \frac{l_2}{d_2^2}$ $l_1 (d_2^2) = (l_2 d_1^2)$ $l_1 = \frac{l_2 x\ d_1^2}{d_2^2}$	$l_1 = \frac{l_2 x\ d_1^2}{d_2^2}$ $l_1 = \frac{l_2 (200\ cm)^2}{(50\ cm)^2}$ $l_1 = \frac{l_2 (40000 cm^2)}{2500\ cm^2)}$ $l_1 = 16\ l_2$

Based on the result of the computation, the intensity of the incandescent bulb is 16 times greater than the candle.

The nature of light as a particle explains why its intensity changes with distance. The particles of light are also called photons. At the source, photons are closer. The number of photons is another factor that affects the intensity of light.

Q1. What does the Brightness of light mean?
Q2. What is luminous intensity of light?

Light intensity refers to the strength or amount of light produced by a specific lamp source. **Light intensity** it is the measure of the wavelength-weighted power emitted by a light source. Intensity is defined to be the power per unit area, and it has the units of Watt per square meter (W/m^2).

Intensity=Power/Area or I = P/A

Where:
I= Intensity
P= Power (Watts)
A= Area of sphere ($4 \pi r^2$)
Π= 3.14
r = radius (distance of light source from the center of sphere)

Sample Problem: Suppose a light source (bulb) has 300 Watts. What is the intensity of light if the distance from the light source is 20 meters?

Given:
Power= 300 Watts
r= 20m

Solution:
Intensity (I) = Power/Area
$I = 300\ W/\ 4\ (3.14)\ (20m)^2$
$I = 300\ W/\ 12.56\ (400\ m^2)$
$I = 300\ W/5{,}024\ m^2$
$I = 0.06\ W/m^2$

What's More

Directions: Study the table given and enhance your mathematical ability in computing the luminous intensity of the two sources of light. Apply the equation of light intensity from the "What is it" part of the module. Use separate sheet of paper for your answer.

Source of light	Distance from the light
Incandescent bulb (100Watts)	1.5
Incandescent bulb (200Watts)	3

Guide Questions:

1. What is the intensity of each bulb?
2. Which of the incandescent bulbs produce higher luminous intensity? Support your answer
3. Which is brighter, a 100 Watts or 200 Watts incandescent bulb? Why?

What I Have Learned

Activity 3: Natural or Man-Made?

Directions: Identify the following objects as Natural or artificial source of light. Write your answers on a separate sheet of paper.

Object/Matter	Natural source of light/ artificial source of light
1. Flashlight	
2. Star	
3. Fireflies	
4. Led light	
5. Lightning	

Activity 4: Luminous or Non-luminous?

Directions: Classify the following objects as luminous or non-luminous. Write your answers on a separate sheet of paper.

Object/Matter	Luminous or Non-luminous
1. Sun	
2. Star	
3. Moon	
4. Kerosene lamp	
5. Incandescent bulb	

Activity 5: Complete Me!

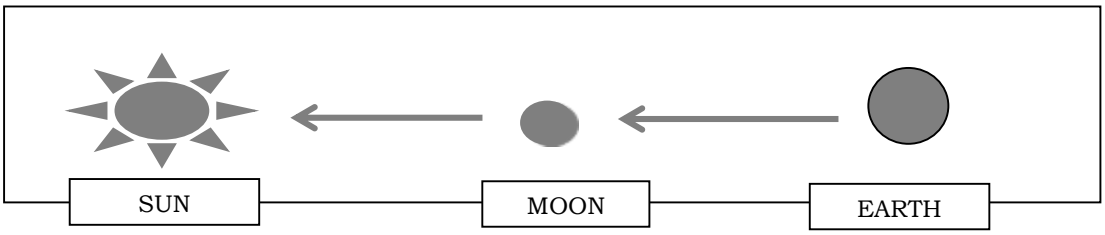
Directions: Read and analyze the following statements given. Choose your answer inside the box and fill in words/phrases in the blanks that will make the statements correct. Use a separate sheet of paper for your answers.

luminous intensity	Christian Huygens	Isaac Newton	luminous
natural sources of light	electromagnetic theory of light		non-luminous

1. The one who explained that light behaves like a particle and a wave was_____.
2. The one who formulated the wave theory of light was _____
3. James Clark Maxwell was the scientist who proposed the _____
4. Objects that are capable to produce light are known as _____
5. A measure of the radiant power emitted by any source of light in a given direction is known as_____

What I Can Do?

Directions: During total solar eclipse, the moon passes between the sun and earth. During this astronomical event, the moon totally blocks out the sun's light on a specific surface of earth. Using the concepts, you have learned about light, draw a diagram similar below, add color, label, and describe the illustration including which of the heavenly bodies emit light (luminous) and does not emit light (non-luminous). Write your answer on a separate of paper.



Illustrated by: Ma. Sheila S. Manila

RUBRICS

Criteria	5	3	1	Score
Application	All directions followed	Some directions are not followed	Few directions are followed	
Knowledge	Provides detailed explanation	Provides explanation	Provides unclear explanation	

Assessment

Directions: Read each item carefully. Write only the letter of your answer for each question. Use a separate sheet for your answers

1. Which of the following terms best describes an object that emit energy in the form of light?
   A. Fluorescence
   B. Incandescence
   C. Luminous
   D. Phosphorescence

2. Which of the following objects is non-luminous?
   A. sun
   B. moon
   C. burning wood
   D. flashlight switched on

3. Choose which of the following reasons correctly explain why we can able to see objects from our surroundings?

I. Our eyes give out light to our surroundings II. Light refraction which makes the light bends into our eyes III. Light from any sources can move through space and reach our eyes. IV. When light strikes on smooth and plane surface it will reflects to form image

   A. I and II only
   B. II and III only
   C. III and IV only
   D. I, II, and III only

4. Which of the following describes the nature of light according to Louis de Broglie?
   A. wave and point
   B. wave and energy
   C. particle and wave
   D. particle and energy

5. Which forms of energy enable us to see the beauty of our nature and appreciate the colors of objects through our eyes?
   A. Chemical
   B. Heat
   C. Light
   D. Sound

6. When light hits an object like an opaque object, it will not pass through. Which of the following statements are **TRUE** about light based on this statement?

I. Light is reflected on an object II. Light is absorbed and converted to heat III. Light will bend and reflect to form a clear image IV. Light energy passes through and will transform to another form.

A. I and II only
B. II and III only
C. III and IV only
D. I, II, and III only

7 Which of these examples inside the box are natural sources of light?

I. Sun, moon, stars, and fire II. Sun, stars, lightning, fire, and fireflies III. Sun, lightning, and incandescent bulb. IV. Fire, lightning, candle, stars, and fireflies

A. I & II only
B. II & III only
C. I, II & III only
D. I, II, III and IIV

8. The nature of light depends on what type of theory?
A. Wave theory
B. Particle theory
C. Photon theory
D. Wave and particle theory

9. Louis de Broglie was one of the scientists who said that light have a dual nature. Which of the statements are true regarding the nature of light?

I. Light exhibits the properties of wave. II. Light exhibits the properties of particle. III. Light has both interference and polarization effect. IV. Light doesn't reflect the properties of both wave and particle.

A. I and II only
B. II and III only
C. III and IV only
D. II, III, and IV only

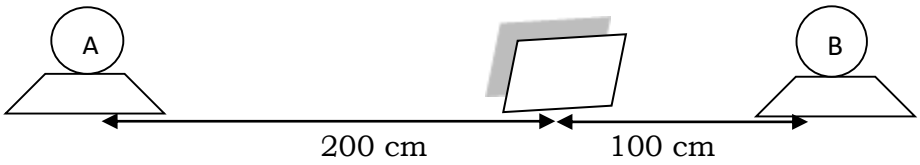
10. Which of the following objects would reflect light the most?
A. bottle
B. glass
C. mirror
D. paper

11. The following are sources of light capable to convert electrical energy into light energy, **EXCEPT**_____
A. fireflies
B. flashlight
C. fluorescent lamp
D. incandescent bulb

12. When you look in a mirror, which of the following will cause formation of an image?
    A. Absorption
    B. Reflection
    C. Refraction
    D. Transmission

13. The following are natural sources of light, **EXCEPT**_____
    A. fire
    B. fireflies
    C. lightning
    D. incandescent bulb

For items 14 and15, refer to the illustration below. Suppose two identical kinds of light sources, A and B, shines on a surface of a board when placed 200 cm to the left and 100 cm to the right of the board, respectively.



Illustrated by: Ma. Sheila S. Manila

14. Based on the illustration, does the light intensity observed from the side of the cardboard facing light source B higher than that of the side facing light source A?
    A. No, because source A and B are the same kind of light.
    B. Yes, because source B is farther from the cardboard than source A
    C. Yes, because source B is much closer to the cardboard than source A
    D. No, because the distance of light sources has no effect on their light intensities

15. How does the amount of light intensity of light source B compare to light source A as measured on the surface of the cardboard?
    A. The have equal light intensities.
    B. They have varying light intensities per time.
    C. The side facing light source A has greater light intensity.
    D. The side facing light source B has greater light intensity.

Additional Activities

Activity 6: Color Spectrum Wheel

Materials Needed

- Spectrum Wheel Pattern
- Cardboard or illustration board
- Button fastener
- Glue or Paste
- Scissor
- Crayons

Procedures:

1. Cut out a circular cardboard with a diameter of 6 inches making up a wheel as shown in Figure A.
2. Cut out two rectangular shaped "windows" on the cardboard as shown in Figure A.
3. Prepare another circular cardboard with the same size as the first wheel.
4. Divide the circle creating a "pie" into eight equal parts. Make your own spectrum wheel on the wheel by putting colors (Red, Orange, Yellow, Green, Blue, Indigo, Violet, and the words Frequency and Wavelength) in your cut-out wheel similar to Figure B.
5. Put the first wheel on top of the second. Punch a hole into the center of the two wheels together. You may use a button fastener to hold the two cardboard wheels securely in place, one on top of the other, but they should be free to rotate relative to each other.
6. When you see a region of the EM spectrum show up in the open window and the "W, F, E" that correspond to that region showing up under the flaps then you know that you have done it right.

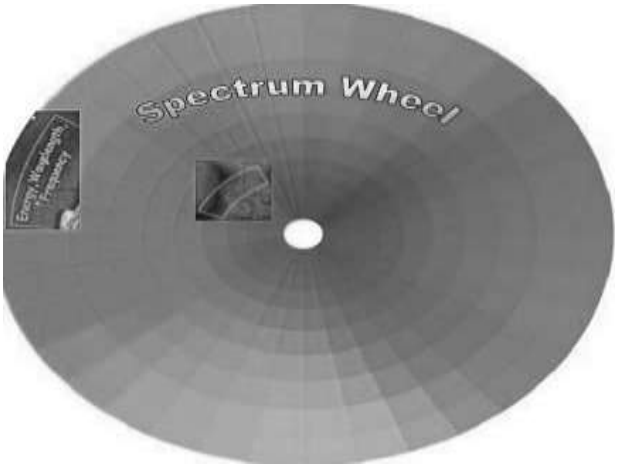
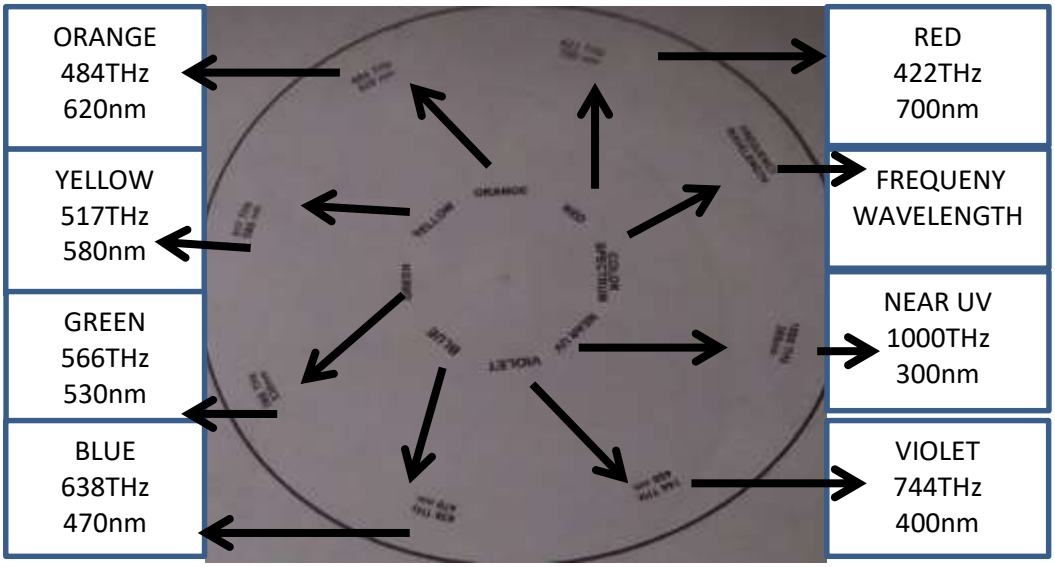


Figure A: Spectrum Wheel

K to 12 Science 7 Learner's Material (Page 227)



Illustrated by: Ma. Sheila S. Manila

Figure B: Spectrum Wheel

Rubric Scoring

Criteria	10	7	4	Score
Application	All procedures were followed	Some procedures were not followed	Few procedures were followed	
Output	Completed outputs and the same with the given example	Completed outputs but not the same with the given example	Incomplete outputs	

Guide Questions:

1. What is a spectrum wheel?
2. What is the purpose of these two spectrum wheels?

What I Know

Directions: Read each item carefully. Write only the letter of your answer for each question. Use a separate sheet for your answers.

1. Which of the following colors comes between blue and violet in the visible spectrum of light?
   A. green
   B. indigo
   C. orange
   D. violet

2. What are the three additive primary colors of light?
   A. green, red, and blue
   B. red, green, and violet
   C. Red, blue, and yellow
   D. Orange, green, and indigo

3. What do we call the range of light frequencies that we can see?
   A. visible spectrum
   B. audible spectrum
   C. chromatic spectrum
   D. electromagnetic spectrum

4. Which of the following characteristics will describes a red light spectrum which has a low frequency?
   A. longer wavelength
   B. shorter wavelength
   C. lower in amplitude
   D. higher in amplitude

5. The following electromagnetic waves are invisible to the human eye, **EXCEPT**_____
   A. infrared
   B. microwave
   C. visible spectrum
   D. X-rays

6. Which combinations of light colors to form white light color?
   A. red, green, and blue
   B. indigo, blue and violet
   C. blue, green and yellow
   D. blue, yellow and orange

7. A red apple is under a blue light source. What color will the apple reflect?
   A. black
   B. blue
   C. red
   D. yellow

8. The infrared (IR) radiation and ultraviolet radiation are both electromagnetic waves (EM). Infrared has longer wavelength compared with ultraviolet radiation. Does infrared have higher frequency than ultraviolet radiation?
   A. Yes because infrared has longer wavelength than ultraviolet
   B. No because the electromagnetic wave with longer wavelength has lower frequency.
   C. Yes because wavelength and frequency of electromagnetic waves are directly proportional.
   D. No because wavelength and frequency of infrared and ultraviolet radiations are directly proportional

9. Choose which of the following order of the Electromagnetic waves shows the increasing order of frequency and wavelength respectively?

I. Gamma, X-ray, Ultraviolet, Visible light, Infrared, Microwave, Radio II. Visible light, Microwave, Infrared, Ultraviolet, X-ray, Gamma, Radio III. Microwave, Radio, Visible light, Infrared, Ultraviolet, X-ray, Gamma IV. Radio, Microwave, Infrared, Visible light, Ultraviolet, X-ray, Gamma

A. I and II only
B. I and III only
C. I and IV only
D. I, II, III and IV

10. Which of the following statements are **TRUE** about the behavior of light?

I. Light can travel through vacuum. II. Light can travel in a straight line. III. Light does not need a medium in order to propagate. IV. Light does not bend when crossing the boundary of two media.

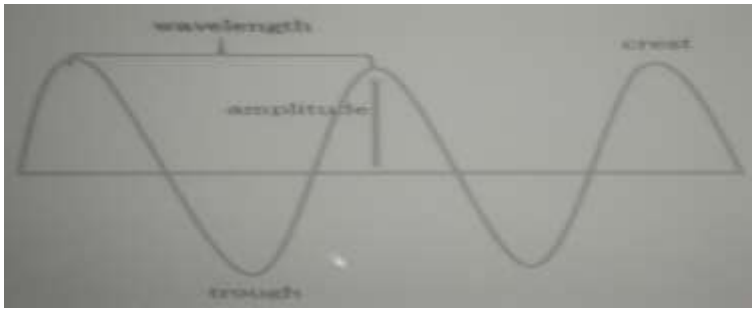
A. I, and II only
B. II and III only
C. I, II and III only
D. II, III, and IV only

11. Choose which of the following order of the visible spectrum show the increasing order of frequency and wavelength respectively?

I. Red, Orange, Yellow, Green, Indigo, Violet, Blue II. Violet, Red, Orange, Yellow, Green, Indigo, Blue III. Red, Orange, Yellow, Green, Blue, Indigo, Violet IV. Violet, Indigo, Blue, Green, Yellow, Orange, Red

A. I and II only
B. II and III only
C. III and IV only
D. I, II, III and IV

For items12and13 refer to the illustration below.



Illustrated by: Ma. Sheila S. Manila

12. From the illustration, which of the following are the correct parts of the wave?
    A. Upper, bottom, crest, and trough
    B. Trough, wavelength, width, and crest
    C. Trough, Crest, wavelength, and amplitude
    D. Wavelength, amplitude, trough, and distance

13. Based on the illustration, which of the following statements correctly describes the following parts of a wave?

I. Wavelength is the distance between two crests or trough. II. Upper and bottom are parts found on top and lower parts of wave. III. Trough indicates lowest point while crest is the highest point of the wave. IV. Amplitude is the distance between the center of the wave tothe crest or trough.

    A. I and II only
    B. I and III only
    C. I, II and IV only
    D. I, III, and IV only

14. Which of the following visible light colors have the longest wavelength and highest frequency?
    A. Blue and red
    B. Red and violet
    C. Red and green
    D. Orange and violet

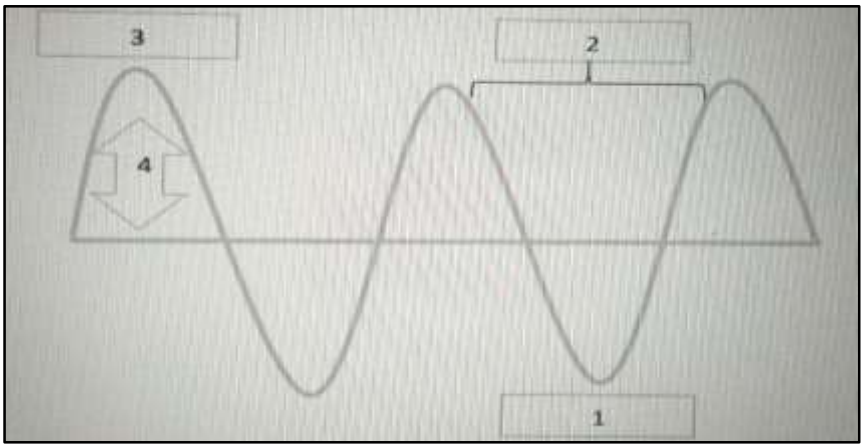
15. Violet light has the highest frequency among the visible light colors. Is its frequency directly proportional to its wavelength?
    A. No, because the longer wavelength the higher its frequency
    B. No, because wavelength is always inversely proportional to frequency.
    C. Yes, because the longer the wavelength the higher the frequency of visible light colors
    D. Yes, because the wavelength and frequency of visible light colors are directly proportional to each other

Lesson 2 Characteristics of Light

What's In

Activity 1: The wave parts!

Directions: From your previous lesson in module 1, try to recall the following parts of a wave. On a separate sheet of paper, draw similar diagram in Figure 1 and identify the labelled parts of the wave.

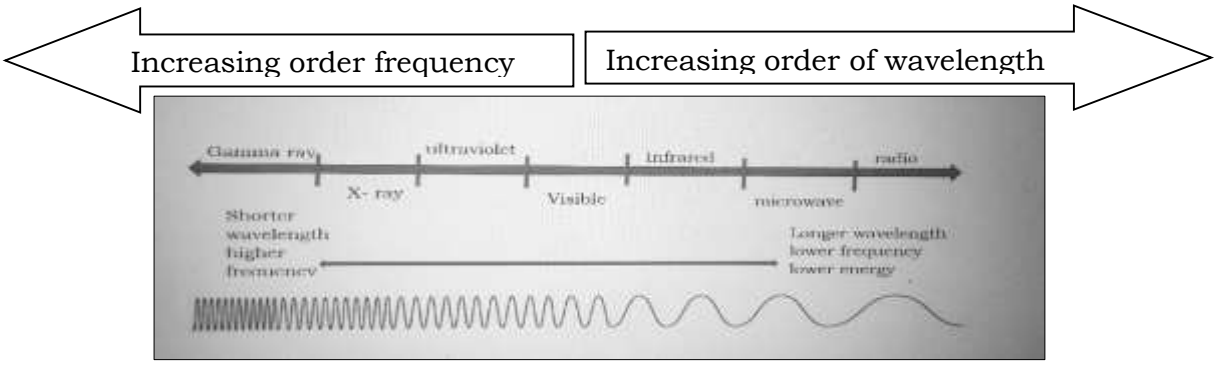


Illustrated by: Ma. Sheila S. Manila
Figure 1: Parts of Wave

Q1. What are the parts of the wave?
Q2. What is the highest peak of the wave called?
Q3. How does you call the lowest part of the wave?
Q4. What do you call the part between two highest and lowest points of the wave?

Activity 2: The shorter, the higher one!

Directions: Examine Figure 2 the Electromagnetic Waves and Table 1 the characteristics of electromagnetic waves. Analyze the order of different EM waves in terms of wavelength and frequency. Answer the following questions on a separate sheet of paper.



Illustrated by: Ma. Sheila S. Manila

Figure 2: Electromagnetic Spectrum

Directions: Complete the Table 1 below by getting the product of frequency and wavelength. Write your answer on a separate sheet of paper.

Table 1: Characteristics of Electromagnetic Wave

EM Spectrum	Energy	Frequency	Wavelength	Frequency x wavelength
RADIO WAVE	10^{-7}	$3x\ 10^{7}$	10	
MICROWAVE	10^{-4}	$3x10^{10}$	10^{-2}	
INFRARED	10^{-3}	$3x\ 10^{11}$	10^{-3}	
VISIBLE LIGHT	1 or10	3x10	10^{-5}	
ULTRAVIOLET	10	$3x\ 10^{15}$	10^{-7}	
X-RAY	10^{3}	$3x10^{17}$	10^{-9}	
GAMMA RAY	10^{6}	$3x10^{20}$	10^{-12}	

Q1. What are the different EM waves?

Q2. What are the characteristics of the EM waves?

Q3. How are the frequency and wavelength related for a specific region of the spectrum?

Q4. What have you observed with the values of the product of frequencies and wavelengths of the different spectra?

Q5. How is energy related to frequency of a wave?

Q6. Which of the electromagnetic waves is most visible to human eye?

Q7. How many colors observed in a light?

Q8. What do you think are the characteristics and properties of light spectrum?

Rubric Scoring

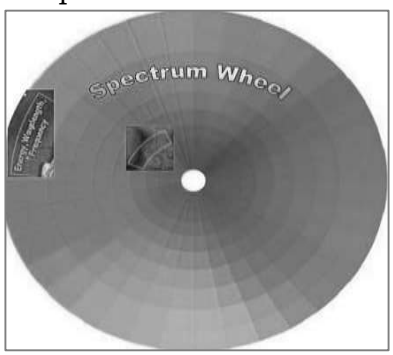
Criteria	3	2	1	Score
Knowledge	Provided detailed explanation and complete response to the question	Provided clear explanation but incomplete response to the question	Provided unclear explanation and incomplete response to the question	

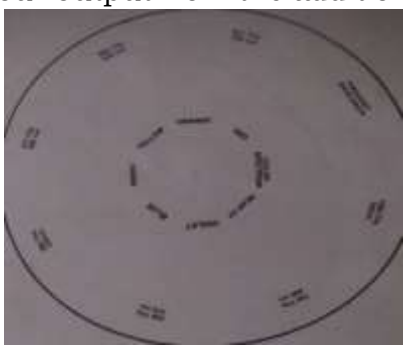
What's New

Directions: Perform the activity and answer the question on a separate sheet of paper.

Materials Needed

- Color Spectrum Wheel Pattern (Refer to your output from the additional activity)





K to 12 Grade 7 Science Learner's Material (Pages :227-231)

Procedures:

1. Punch a hole at the center of the two wheels. You may use a button fastener to secure the two wheels together one on top of the other, but they should be free to rotate relative to each other.
2. When you see a region of the Color spectrum show up in the open window and the "W, F, E" that correspond to that region showing up under the flaps then you know that you have done it right.
3. Try out your Color Spectrum Wheel by positioning the inner most of the flaps on COLOR SPECTRUM. This will simultaneously position the other flaps to ENERGY, WAVELENGTH & FREQUENCY.
4. Turn the upper wheel and observe the combinations.
5. Fill in the Table 2 with the corresponding combinations you have observed using your Spectrum Wheel and compute for the product between frequency and wavelength in a separate sheet of paper.

TABLE 2: Characteristics and properties of lights

Color Spectrum	Wavelength (x 10^{-9} m)	Frequency (x 10^{12}/ s)	Frequency x wavelength (m/s)
Red	700	422	(422x10^{12}m) (700X10^{-9}s) = 295,400 x 10^{3}m/s
Orange			
Yellow			
Green			
Blue			
Violet			

Q1. Which color registers the highest frequency?
Q2. Which color has the shortest wavelength?

Q3. Which color registers the lowest frequency?
Q4. Which color has the longest wavelength?
Q3. Explain the relationship between the wavelength and frequency of light?
Q4. What did you observe with the product of wavelength and frequency for each color?

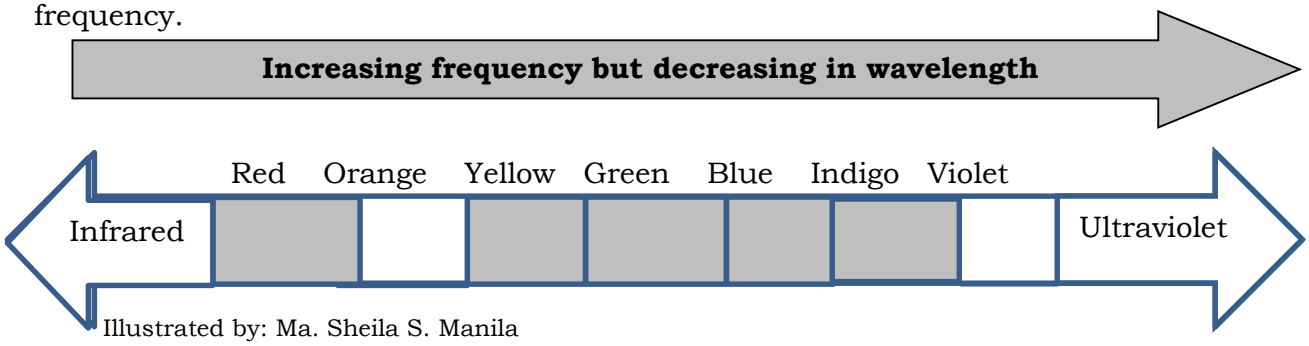
Rubric Scoring

Criteria	3	2	1	Score
Knowledge	Provided detailed explanation and complete response to the question	Provided clear explanation but incomplete response to the question	Provided unclear explanation and incomplete response to the question	

What is It

Light is one of the electromagnetic waves with a wavelength which can be perceived by the human eye. It is given off by stars like the sun or other luminous objects from our surroundings. Visible spectrum is made up of different colors called as rainbow of colors such as red, **orange**, yellow, **green**, blue, indigo, and violet (an acronym of ROYGBIV). Colors of light or the visible spectrum can be described according to their wavelength and frequency.

The **wavelength** of **light** is the distance between corresponding points in two adjacent **light** cycles, and the **frequency of light** is the number of cycles of **light** that pass a given point in one second. The unit 1 per second or Hertz (Hz) is the unit of frequency.



Illustrated by: Ma. Sheila S. Manila

VISIBLE SPECTRUM

Based on the diagram given, wavelength is inversely proportional to frequency of the wave. Waves with higher frequencies have shorter wavelengths, and lower frequencies have longer wavelengths. When the frequency of visible light increases, the wavelength decreases. From the seven colors of light, the red color has the longest wavelength, but it has the lowest frequency among the light spectrum. However, the violet color has the shortest wavelength, but it has the highest frequency. Therefore, the amount of frequency or the wavelength of light will be determined by its characteristic like color.

From Table 2 in what's new activity, the product between the wavelength and frequency of each color of light is its speed. The speed of light depends on its frequency and wavelength. Each color travels at different speeds when they travel through a medium such as air, water, and solid materials. All colors of light as well as the members of the EM spectrum travel at common sped, called the speed of light (c). The speed of light in vacuum is $3x10^8$ m/s. However, the violet color of light carries the highest energy due to its high frequency.

Light of any color can be made by mixing the three additive primary colors: RED, BLUE, and GREEN light colors. White light is produced when the light beams of primary colors will overlap. Yellow is projected when green and red-light overlap. Similar with the magenta color, it is produced between overlapping red and blue light colors. Cyan color is produced between blue and green light.

What's More

Directions: Study further about light and its characteristics. What are the primary colors of light? Is it possible to mix different colors of light to create another color? Perform the activity given and answer the table and questions on a separate sheet of paper.

Activity 3: Amazing colors

Materials needed:

- Different colors of Plastic filter (Green, Blue, Red)
- Three flashlights (same kind and sizes)
- Rubber bands
- White board/bond paper

Procedures:

1. Cover each lens of the three flashlights with different colors of plastic filter or colored cellophanes; Blue, Green, and Red color.
2. Try to explore the colors of light. Shine these flashlights covered by different colors of plastic filter on the white board or bond paper and note the projected color.

Table 3: Color that you see

Color of Plastic Filter	Color that you see projected on the screen
Green	1.
Blue	2.
Red	3.

3. Ask two persons to hold the two other flashlights while you are holding one of it.
4. Let two color lights from the flashlights overlap. Follow the color combination in the Table 4.

Table 4: Resulting color

Color Combination	Resulting Color
Green + Blue	1.
Blue + Red	2.
Red + Green	3.
Red + Green + Blue	4.

Guide Question

1. Describe the resulting colors of light mixed in Table 4
2. What color is projected on white or bond paper by each flashlight covered in blue, red, and green plastic filter different colors of plastic filter?
3. What happens when you mix two or three primary colors of light?

Rubric Scoring

Criteria	5	3	1	Score
Knowledge	Provided good and detailed explanation	Provided good explanation	Provided not clear explanation	

What I Have Learned?

Directions: Fill in the blanks with the missing word/phrases on the blanks to make the statements correct. Choose your answer inside the box and write your answer on a separate sheet of paper.

brightness frequency violet blue red inversely directly visible light

1. _____it is part of the electromagnetic spectrum that can be detected by human eye.
2. _____light has the shortest wavelength but highest frequency in the visible spectrum while (3) _____light has the longest wavelength and lowest frequency.
4. The wavelength of light is the distance between corresponding points in two adjacent light cycles, and the _____ of light is the number of cycles of light that pass a given point in one second.
5. The wavelength and the frequency of the visible spectrum are _____ proportional to each other.

II. **Directions:** Determine the color produced from the different combination of light colors. Select your answer inside the box. Write your answer on a separate sheet of paper.

Violet Yellow White Magenta Cyan

Color combination of light colors	Resulting color
Green + Blue	1.
Blue + Red	2.
Red + Green	3.
Red + Green + Blue	4.

What I Can Do

Activity 4: Lights in a straight path

Materials:

- Ruler
- Puncher/Pair of Scissors
- Flashlight (any size)/laser
- Modeling Clay or any sticky material
- Cardboard/index card at least 3 pcs with the same sizes

Procedures:

1. Prepare all materials needed for the activity.
2. Punch a hole at the center in each of your index card or cut out cardboard.
3. Position your 3 index cards or cut out cardboards in a straight line of at least one-foot equal distance.
4. Use your clay to form a stand for index cards or cut out cardboards to support it standing. Arrange the hole of 3 cards in a straight line.
5. Position your flashlight at one end of the row of your index cards or cutout cardboards.
6. Switch on your flashlight pointing the hole of one of the index cards or cut out cardboard but see to it that light will not be covered by surface of the first card.

Guide Questions:

Q1. What happens to the light as it passes through the hole of the first index card or cardboard?
Q2. Does light travel in a straight line?
Q3. How will you prove that the light travels in a straight line?

Rubric Scoring

Criteria	5	3	1	Score
Knowledge	Provided detailed explanation and complete response to the question	Provided clear explanation but incomplete response to the question	Provided unclear explanation and incomplete response to the question	

Assessment

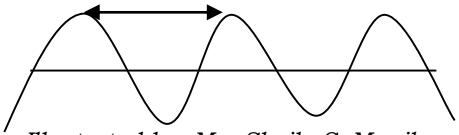
Directions: Read each item carefully. Write only the letter of your answer for each question. Use a separate sheet for your answers.

1. Which of the following colors will result if the primary colors of light will be mixed?
   A. black
   B. pink
   C. white
   D. yellow

2. What color of the visible spectrum has the highest energy?
   A. orange
   B. green
   C. red
   D. violet

3. White light goes through a red filter, what color do we observed?
   A. cyan
   B. green
   C. red
   D. yellow

4. Based on the illustration, what does the arrow section of the wave show?
   A. Amplitude
   B. Crest
   C. Trough
   D. Wavelength



Illustrated by: Ma. Sheila S. Manila

5. Choose which of the following orders of the Electromagnetic waves show the increasing order of frequency and wavelength respectively?

I. Gamma, X-ray, Ultraviolet, Visible light, Infrared, Microwave, Radio
II. Visible light, Microwave, Infrared, Ultraviolet, X-ray, Gamma, Radio
III. Microwave, Radio, Visible light, Infrared, Ultraviolet, X-ray, Gamma
IV. Radio, Microwave, Infrared, Visible light, Ultraviolet, X-ray, Gamma

   A. I and II only
   B. I and III only
   C. I and IV only
   D. III and IV only

6. Which of the following is **NOT** an electromagnetic wave?
   A. Infrared
   B. Radio
   C. Sound
   D. X-ray

7. The following statements are related to the frequency and wavelength of visible light. Which of the statements are **TRUE**?

I. Red light has the longest wavelength among visible lights
II. Violet light has highest frequency compared to green and blue light.
III. Yellow light has shorter wavelength compared to red and orange light.
VI. Red light has longer wavelength but lower in frequency, while violet light has shorter wavelength but higher in frequency.

   A. I and II only
   B. I, II.III, and IV
   C. I, II, and IV only
   D. I, II, and III only

For items 8 -10 refer to the table below.

Color of light	Wavelength (x 10^{-9} m)	Frequency (x 10^{12}/ s)
Violet	400	744
Green	580	566
Yellow	530	517
Red	700	422

8. Which of the following is **NOT** true based on the table?
   A. Different colors of light have different frequency.
   B. Different colors of flight has different wavelengths.
   C. When the wavelength is long, the frequency is low.
   D. When the frequency is high, the wavelength is high

9. The table shows the number of wavelengths and frequencies of some visible lights. Are wavelength and frequency of visible light inversely proportional to each other?
   A. No, because the longer the wavelength the longer its frequency
   B. No, because the wavelength and frequency of visible light are not equal
   C. Yes, because the lower the frequency of visible light the longer its wavelength
   D. Yes, because the higher the frequency of visible

10. Which of the following statements is **TRUE** regarding the relationship between wavelength and frequency?
    A. Wavelength of light is similar to its frequency
    B. Wavelength and frequency are directly proportional to each other
    C. Wavelength and frequency are inversely proportional to each other
    D. Wavelength and frequency both directly and inversely proportional to each other

11. Which of the following statements are **TRUE** about the behavior of light?

I. Light can travel through a vacuum. II. Light can travel in a straight line. III. Light does not need a medium in order to propagate. IV. Light will always travel in a straight line even if they contact with another surface.

    A. I, and II only
    B. II and III only
    C. I, II and III only
    D. II, III, and IV only

12. What are the three colors of light when combined will produce white light?
    A. red, green and blue
    B. red, yellow and blue
    C. red, yellow and green
    D. red, orange and yellow

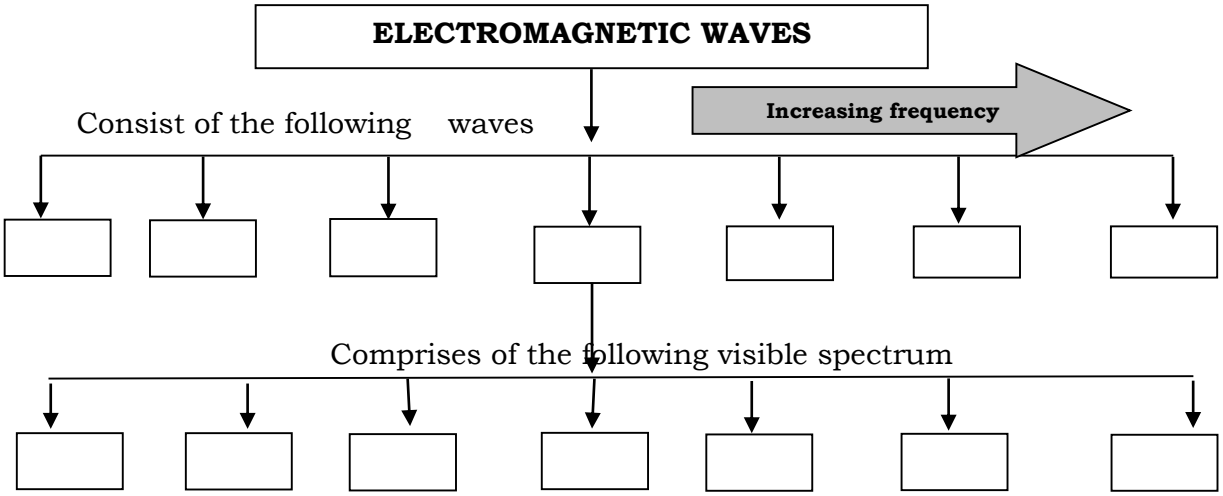
13. The red and violet lights are both visible lights. Red light has longer wavelength compared with violet light. Does violet light have higher frequency than red light?
    A. No, because violet light has shorter wavelength than red light.
    B. Yes because violet light with shorter wavelength has higher frequency
    C. No because the wavelength of visible light has no relations to its frequency.
    D. Yes because wavelength and frequency of electromagnetic waves are directly proportional.

14. What do you call the rainbow of colors with a range of values of wavelengths and frequencies; Red, Orange, Yellow, Green, Blue, Indigo, and Violet?
    A. prism
    B. shades
    C. reflection
    D. spectrum

15. When you combine all the colors of the visible light what color will we see?
    A. black
    B. green
    C. red
    D. white

Additional Activities

Directions: Make a concept map similar below on a separate sheet of paper and complete by supplying the correct sequence of electromagnetic waves and visible spectrum. The sequence must be in increasing order of the frequency



Rubric Scoring

Criteria	10	7	5	Score
Knowledge	With complete answer	Lacking two correct answers	Lacking more than five correct answers	

Answer Key

LESSON 1

What I Know

1.A
2.D
3.B
4.C
5.D
6.D
7.D
8.C
9. B
10. C
11. A
12. D
13. B
14. C
15. B

Assessment

1. C
2. B
3. C
4. C
5. C
6. A
7. A
8. D
9. A
10.C
11.A
12.B
13.D
14. C
15.D

What's In
Activity 1
1.Christian Huygens
2. Isaac Newton
3. Louis de Broglie
4. James Clerk Maxwell

Activity2
(Possible Answers)
1.Sun
2. stars
3. Lightning
4. Fireflies
5. Candle
6. Flashlight
7. Glow worms
8. Incandescent bulb

What's In
Activity 2:
Possible answers for Guide Questions
1.The sources of lights are Sun, fire, candle, incandescent bulb, and others.
2.Natural sources of lights are sun, stars, lightning, fireflies, and glow worms.
3. Artificial lights are flashlights, candle, and incandescent bulb.
4. Natural lights produces heat and lights which are not made by human, while artificial lights are lights made or created by human.

What's New
Possible answers for Guide Questions
1.Light bulb
2.Light bulb and candle differ in luminous intensity.
3. Yes
4. As the distance increases, the light spread out over a larger surface then brightness of light will decrease.
5. The light travels as a wave and it is always in a straight path.
6. The incandescent bulb because it will produce brighter light.

What's More?
Possible answers for Guide Questions
1.The light intensity of a 100 watts bulb is 3.54 W/m^2 while the light intensity of a 200 Watts is 1.74 W/m^2
2. From the problem, a 100 Watts bulb produced higher intensity of light because the distance from a 100 watts source of light is much closer compared to the distance from 200 Watts bulb.
3. Regardless of the distance, a 200 Watts bulb produced brighter light compared to a 100 Watts bulb because the higher the amount of power in Watts, the brighter light it will produce.

What I Have Learned
Activity 3
1.Artificial light
2. Natural light
3. Natural light
4. Artificial light
5. Natural Light

Activity 4
1.Luminous
2.Luminous
3.Non-luminous
4. Luminous
5. Luminous

Activity 5
1.Louis de Broglie
2. Christian Huygens
3. Electromagnetic theory of light
4. Luminous
5. Luminous intensity

What I Can Do
Possible answer
Answer: The sun emits light because it is luminous.

Answer: The earth and the moon are not capable to emit light because both are non-luminous.

Additional activities
Answers may vary:
1.Spectrum Wheel is a circular diagram where the rainbow colors of light arranged in the natural order.
2.Spectrum wheel is used to show the arrangement of light colors and the relationships between colors of light.

LESSON 2

What I Know

1. B
2. A
3. A
4. A
5. C
6. A
7. A
8. B
9. C
10. C
11. C
12. C
13. D
14. B
15. C

What's In

Activity 1

1. The parts of the wave are Crest, trough, wavelength, and amplitude.
2. Crest
3. Trough
4. Wavelength

Activity 2

1. 3.0×10^9 m/s
2. 3.0×10^9 m/s
3. 3.0×10^9 m/s
4. 3.0×10^9 m/s
5. 3.0×10^9 m/s
6. 3.0×10^9 m/s
7. 3.0×10^9 m/s

What's In

Activity 2

Answer for Guide Questions

1. Radio Wave, Microwave, Infrared, Visible light, Ultra violet, X-ray, and Gamma ray.
2. Frequency, Wavelength, wave speed, and energy.
3. Frequency and wavelength are inversely proportional to one another.
4. EM spectrum have the same values in the product of their frequency and wavelength.
5. Energy of wave is directly proportional to frequency.
6. Visible light
7. There are seven colors.
8. Intensity, frequency, speed, and energy.

What's New

Table 2

1. 2.95×10^8 or 3.0×10^8 m/s
2. 3.0×10^8 m/s
3. 3.0×10^8 m/s
4. 3.0×10^8 m/s
5. 3.0×10^8 m/s
6. 3.0×10^8 m/s

Answer for Guide Questions

1. Violet color
2. Violet color
3. Red color
4. Red color
5. The relationship between wavelength and the frequency of lights is inversely proportional to each other because the shorter the wavelength of light, the higher its frequency or vice versa.

What's More

Table 3

1. Green
2. Blue
3. Red

Table 4

1. Cyan
2. Magenta
3. Yellow
4. White

Guide Questions: Answers may vary

1. The resulting color between Blue light and green light is Cyan; Blue light and red light resulting to Magenta color; Red light and green light the resulting color is Yellow; and for the Blue light, Red light and Green light the resulting color is white.
2. Green light – green color; red light-red color; blue light-blue color.
3. Mixing of two or three primary colors will generates new color or what we called complementary color.

What I Have Learned?

Part I

1. Visible light
2. Violet
3. Red
4. frequency
5. Inversely

Part II

1. Cyan
2. Magenta
3. Yellow
4. White

What I Can Do?

Answers may vary

Activity 4

1. The light can be seen in the other side of the index card forming a ray.
2. Yes
3. Through the shadow that formed when light passes through the hole of an index card.

Assessment

1. C
2. D
3. C
4. D
5. C
6. C
7. D
8. C
9. C
10. C
11. C
12. A
13. B
14. D
15. D

Additional activities

Radio wave, Micro wave, Infrared, Visible light, Ultraviolet, X-ray, and Gamma ray

References

Ferido, M. B., Gutierrez, J. R. M., Asuncion, A. J., Catalan, M. H. D. H., & Catris, L. V. (2017). *K to 12 grade 7 science learner's material.* Department of Education. FEP Printing Corporation.

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