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Department of Education
National Capital Region
SCHOOLS DIVISION OFFICE
MARIKINA CITY

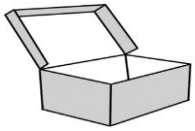
Science

Quarter 2 – Module 2

Applications of EM Waves

Rodelio M. Manuel

City of Good Character
DISCIPLINE • GOOD TASTE • EXCELLENCE



What I Need to Know

The purpose of this module is to help you understand the applications of the different regions of the electromagnetic spectrum. It is divided into two lessons namely:

- Lesson 1 – Applications of Radio waves, Microwaves, and Infrared waves
- Lesson 2 – Applications of Ultraviolet rays, X-rays, and Gamma rays

After going through this module, **you are expected to cite examples of practical applications of the different regions of EM waves, such as the use of radio waves in telecommunications. S10FE-IIcd-48**

Specifically, you are expected to:

- explain how radio waves are generated, transmitted, and received in television and radio communication;
- discuss how microwaves are used in cooking, radar, and satellite communications;
- explain how infrared are used in electronic appliances, night vision goggles, medical diagnosis, and communication;
- discuss how lasers and fiber optics have improved telecommunication;
- discuss the practical application of UV radiation in identifying counterfeit bills, sterilization, and other applications;
- discuss the application of x-ray on medical diagnosis and engineering.

What I Know

Read and understand each item carefully and encircle the letter of the correct answer.

1. Which is the center of transmitting and receiving radio waves towards television and radio communication?
   A. Base Station Antenna C. Speakers
   B. LCD's D. Wires

2. What will happen if the antenna of the analog television is placed inside the house?
   A. Pictures and sound transmitted are strong due to its enclosed location.
   B. Pictures and sound transmitted are weak due to the location of the transmitter
   C. Pictures are clear, but the sound is intermittent due to its enclosed location
   D. Pictures are blurred, but the sound is good due to the transmitter's location

3. Which is NOT included in the group for radio communication?
   A. Antennas
   B. Amplifier
   C. Oscillator
   D. WIFI Router

4. Which causes sugar, water, and fat to vibrate at extremely high frequencies?
   A. Microwave energy
   B. Radiation energy
   C. Cavity magnetron
   D. Kinetic energy

5. Which item must NOT be placed inside the microwave oven?
   A. Foil
   B. Styrofoam
   C. Pyrex cup
   D. Hard-boiled eggs

For Nos. 6-10. Identify the type of electromagnetic wave used in each technology.

A. gamma rays B. infrared C. microwave
D. radio wave E. ultraviolet ray F. x-rays

6. TV remote control
7. Food Irradiation
8. Weather satellite
9. Phototherapy
10. Industrial Radiograph

Lesson 1	Applications of Radio Waves, Microwaves, and Infrared Waves

What's In

Let us now find out how much you remember your previous lessons. The diagram shows the spectrum of the electromagnetic waves with a decreasing wavelength and an increasing frequency from left to right. Name the waves

GAMMA RAYS	RADIO WAVES
INFRARED RADIATION	ULTRAVIOLET RADIATION
MICROWAVES	X-RAYS

represented by letters A to F. Choose your answer from the words inside the box.

A	B	C	VISIBLE LIGHT	D	E	F
DECREASING WAVELENGTH →						
INCREASING FREQUENCY →						

What's New

Activity 1: Wrap and Call

You Will Need:

30 cm x 30 cm aluminum foil
Scotch tape
Short bond paper
2 units of cellular phones
30 cm x 30 cm plastic sheet
Pillow cover

Procedure:

1. Wrap a cellular phone with an aluminum foil together with a scotch tape, then use another phone to make a call on it.
2. Repeat the procedure using the following instead of an aluminum foil:
   a. plastic sheet
   b. bond paper
   c. pillow cover
3. Copy and answer the table below on a separate sheet of paper. Write your observations in the second column.

Material	Observations
a. aluminum foil	
b. plastic sheet	
c. bond paper	
d. pillow cover	

Guide Question:

What did you notice about the connectivity of the two cellular phones? Write your explanation below the table.

Activity 2: Watch and Listen

You Will Need:

Pen and paper
Android phone
Internet connection

Procedure:

1. Use this link, https://www.youtube.com/watch?v=kp33ZprO0Ck ,

to watch the video retrieved from YouTube "engineerguy.com".

2. Then, answer on a separate sheet of paper the questions given below.

Guide Questions:

1. How does the microwave oven heat the food?

2. What are the different components of a microwave oven?

Activity 3: I Am Connected

You Will Need:

Universal 3.5 mm IR sensor
Television
Black cotton cloth
Television remote control
30 cm x 30 cm aluminum foil

Procedure:

1. Plug the television power cord into the electronic wall socket.
2. Use the television remote control and click the power button.
3. Look for an open space in your house and mark 1m, 2m, 3m, 4m, and 5m away from the television screen.
4. Stand on each marked distance from the television. Hold an aluminum foil in between the IR remote controller and press the volume button. Write your observations in the table below
5. Repeat procedure 4 using black cotton cloth in place of aluminum foil.

DISTANCE (m)	**OBSERVATIONS**	
	ALUMINUM FOIL	**BLACK CLOTH**
1		
2		
3		
4		
5		

Guide Questions:

1. How do the infrared waves work on television remote control?

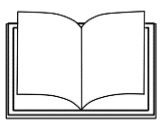
2. How does the IR sensor transmit signal?

What Is It

Applications of EM Radiation: Radio waves, Microwaves, and Infrared waves

ELECTROMANETIC SPECTRUM		**APPLICATIONS**
	Radio Band	
Radio Waves 	Extremely Low Frequency (ELF)	Powerlines, electrical wiring, and common appliances
	Very Low Frequency (VLF)	Underwater communication, geophysical surveys, maritime radio for navigation.
	Low Frequency (LF)	"RFID Tag “Radio Frequency Identification"" Vehicle immobilizers Asset tracking Personnel tracking animal identification ID Badging Automotive control

		Counterfeit prevention"
	Medium Frequency (MF)	Mine communication system, radio navigation, and (AM) broadcasting.
	High Frequency (HF)	Long-distance communications, short-wave broadcasting, RADAR, and amateur radio
	Very High Frequency (VHF)	VHF television, FM radio
	Ultra-High Frequency (UHF)	UHF television, GPS *(Global Positioning System),* Wi-Fi, 4G, mobile phones
	Super High Frequency (SHF)	Satellite communications, Wi-Fi
	Extremely High Frequency (EHF)	Satellite communications, Magnetic Resonance Imaging (MRI), Radio astronomy
Microwaves 		RADAR, marine satellite communication, microwave oven, mobile phone, international broadband, Wi-Fi, GPS, Medical uses, Bluetooth, high-powered microwave (HPM) for military weapon, fixed traffic speed cameras,
Infrared waves 		Night vision goggles, saunas, soothing warm therapy, LASER and fiber optics for communications, TV remote controls, photography, and infrared thermometer gun.



What's More

The use of electromagnetic waves has changed how people work. EM waves are now widely used in wireless communication such as mobile phone calling or Earth-to-satellite communication in space. In your daily experiences, how has the use of electromagnetic waves improved people's way of life? Briefly explain your answer

What I Have Learned

Match each item in column 1 with the kind of ***wave*** in column 2. Items in column 2 can be answered more than once.

Column 1	***Column 2***
_____1. Car alarm and sliding door openers	A. Radio wave
_____2. Used for cellular phone signal	B. Microwave
_____3. Television Remote control	C. Infrared wave
_____4. Global Positioning System	
_____5. Magnetic Resonance Imaging	

What I Can Do

Create a poster showing the positive effects of utilizing radio wave, microwave, and infrared. Use a short bond paper.

Content - 15 pts; Design - 10 pts; Clarity - 10 pts; Representation – 5 pts

Assessment

Write TRUE if the statement is correct. If it is incorrect, replace the underlined part with the words that will make the statement correct.

_____1. Global Positioning System (GPS) uses a very high radio frequency.
_____2. Infrared Light emitting diode (IR LED) is commonly used in Television remote control.
_____3. Firefighters use infrared cameras to locate people in a burning area.
_____4. In the infrared region, the light is transmitted in fiber optic cables.
_____5. FM radio needs a very high frequency of radio waves.

Additional Activities

To understand how a laser is used in communication, visit the YouTube link below and watch the activity entitled *"Lasers Are the Future of Optical Communications in Near Earth and Deep Space Applications'*.
'Lasers Are the Future of Optical Communications in Near Earth and Deep Space Applications' by NASA's Marshall Space Flight Center available at https://www.youtube.com/watch?v=L40atQBBBfk under Creative Commons. After watching, answer the questions below on a separate sheet of paper.

Guide Questions:

1. What is a LASER?
2. Enumerate the benefits of LASER and optical communication?
3. How did the applications of LASER and fiber optics improve telecommunication?

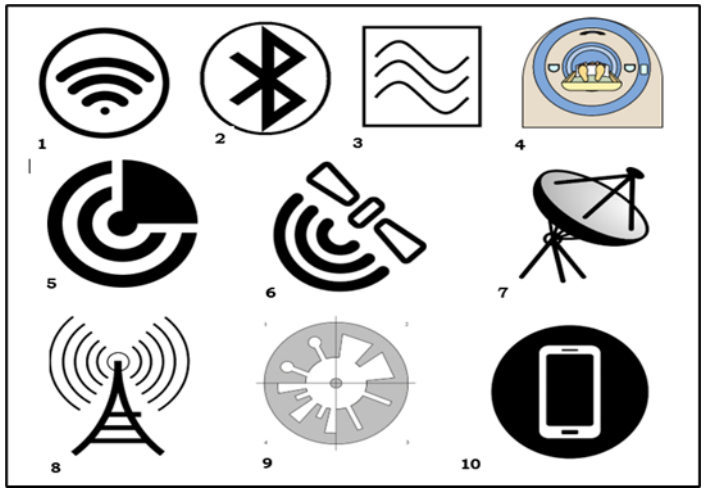
Lesson 2 Applications of Ultraviolet Rays, X-Rays, and Gamma Rays

What's In

In the previous lesson, you have learned about the applications of radio waves, microwaves, infrared, and fiber optics. Can you recall their uses and how they work?

I. Identify the name of each symbol. Get your answers from the word bank below .

Bluetooth	Microwave Oven	Satellite Communication	Wi-Fi
Cellphone	MRI	Transmission Satellite Dish	
Magnetron	Radar	Transmission Tower Communication	



II. Read and understand each statement. Arrange the jumbled letters to identify the given descriptions. Write your answers on a separate sheet of paper.

1. _____ **(TRNONEGAM)** High-powered vacuum tube.
2. _____ **(AVEWUIDEG)** Transfers microwave energy from the magnetron into the metal cavity.
3. _____**(ECOMWVIRA**) Penetrates and heat food.
4. _____**(ADRAR)** Application of microwave and radio frequency used, during World War II for navigation.
5. _____**(PSG or LPS)** Satellite navigation system of a mobile phone used to identify the latest position at the exact time of an object.

What's New

Activity 1: Purple and Blue

You Will Need:

Mobile phone
Scotch tape standard size
Blue and purple color marker
Two different amount of peso bills
You Tube

Procedure:

1. Attach a scotch tape on the flashlight part of the mobile phone. Using a blue marker, apply blue ink on the surface of the scotch tape.
2. Repeat step 1 using purple color.
3. Switch off the light to darken the room. Turn on the flashlight of the cellular phone. Place the peso bills under the mobile phone's flashlight. (use available peso bill)
4. Write your answers on a separate sheet of paper.

Peso bills	Observation
20 pesos	
50 pesos	

5. Visit this link to watch the video.
   "How does UV Light Sanitize Covid - 19 Corona Virus" by Vitaluxeworld available at https://www.youtube.com/watch?v=zn0qPdnRMZo under a Creative Commons Attribution license (reuse allow)

Guide Questions:

1. What are the uses of UV light?

2. How does the UV light eliminate microbes?

3. Explain the applications of UV radiation in sterilization.

4. How does the UV light become more effective than the traditional use of detergent for sanitation?

Activity 2: See the Unseen

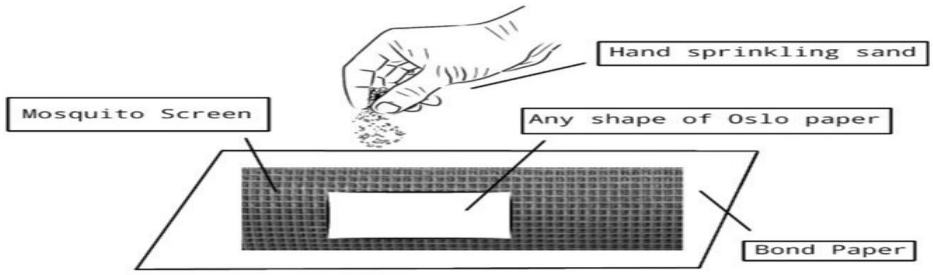
You Will Need:

Bond paper/Oslo paper
Sand
Picture of experiment set-up
scrap screen
YouTube

Procedure:

1. Place a piece of scrap screen over a bond paper.

2. Cut any shape or pattern from the Oslo paper.
3. Place a pattern made of Oslo paper on top of the screen



4. Shower/sprinkle sand over the area of the bond paper.
5. Remove the shape or pattern of Oslo paper from the bond paper.
6. Write your answers on a separate sheet of paper.
   Guide Questions:
   1. Outline the pattern formed on the bond paper.

   2. Can you consider the sand as the X-rays? Why?

7. Visit this link to watch the video.
   "How Do X-rays Work?" by NIBIB gov available at https://www.youtube.com/watch?v=hTz_rGP4v9Y under a Creative Commons Attribution license (reuse allow).
   Guide Questions:
   1. How is the two-dimensional image formed by the x-ray?

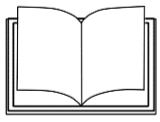
   2. Why does the Radiologist always observe the *"decrease TIME, increase SHIELDING and increase DISTANCING"* when using the X-Ray?

What Is It

Applications of EM Radiation: Ultraviolet ray, X-rays, and Gamma rays

ELECTROMANETIC SPECTRUM		APPLICATIONS
Ultraviolet rays 	*UVA*	Sun tanning, bug zapper, glow -in-the dark lightning and bank note forgery detection.
	UVB	Drying of cloth in the sun, stimulates the production of vitamin D, used for growing plants or keeping reptiles,

		stimulates the production of new melanin, and Phototherapy.
	UVC	Damage the strands of DNA in bacteria and viruses, germicidal bulb, air purification, lamps inactivate COVID-19, water treatment, sterilization, food sanitation, and disinfection.
X-rays 		Establishments security, radio therapy, checking of bone, identifying art forgeries, checking of metal welds and for the internal condition of metals.
Gamma rays 		Irradiated food, scanning metal and weak metal welds, sterilization of medical equipment, tracer in medicine, kills cancer cells, and for astronomy.



What's More

Write TRUE if the statement is correct and False if it is not.

_____1. Radioactive waste remains radioactive forever
_____2. Some radioactive waste remains radioactive for a few seconds.
_____3. Radioactive sources can be found in a glow-in-the-dark items.
_____4. People who visited Baguio City acquired more exposure to cosmic radiation than those who just stayed in Metro Manila.
_____5. Radiation is present since the birth of this planet.
_____6. We are always exposed to cosmic rays and radon gas from the soil.
_____7. You will glow when you are exposed to radiation.
_____8. The higher number of exposures to x-rays, the higher potential of risk.
_____9. Children are more delicate to radiation than the adults.
_____10. "Decrease time, increase shielding and increase distancing" can help us from too much exposure to radiation.

What I Have Learned

Name the symbol and provide their uses. Write your answer on a separate answer sheet.

Symbol	Name	At least five uses
		
		
		

What I Can Do

To avoid too much exposure to radiation, you need to observe the safety health protocol like *"Decrease TIME, Increase SHIELDING and Increase DISTANCING".* On a short bond paper make an Infographic about safety health protocols to avoid too much exposure to radiation.

Content - 15 pts; Design - 10 pts; Clarity - 10 pts; Representation – 5 pts

Assessment

Read each statement carefully and choose the letter of the term that best fits the description. Write your answers on a separate sheet of paper.

A. X-Rays B. Gamma Rays C. Ultraviolet Radiation

_____1. It can kill cancer cells.
_____2. It can easily pass through our skin.
_____3. It can be used to capture the bone images.
_____4. It uses Cobalt 60 or Cesium 137 for food irradiation.
_____5. It can make the food safer, lessen spoilage and prolong shelf life

Additional Activities

Create and present a storyboard that shows how EM waves help facilitate innovations in telecommunications, medicine, etc.

Content - 15 pts; Title - 10 pts; Illustration - 10 pts; Attractiveness – 5 pts

Posttest

Read and understand each item carefully and encircle the letter of the correct answer.

1. Which is common between a microwave oven and RADAR?
   A. waveguide B. chamber C. magnetron D. filament

2. Which type of electromagnetic waves cause sunburns?
   A. gamma rays B. ultraviolet ray C. infrared wave D. microwave

3. What type of electromagnetic waves are used to cook food, predict the weather, and for communications?
   A. gamma rays B. ultraviolet ray C. infrared wave D. microwaves

4. How does a microwave oven work?
   A. Magnetron Blasts → Food Compartment → Wave Guide
   B. Food Compartment → Magnetron Blasts → Wave Guide
   C. Magnetron Blasts → Wave Guide → Food Compartment
   D. Wave Guide → Food Compartment → Magnetron Blast

5. Which type of waves is used on a TV remote control?
   A. gamma rays B. ultraviolet ray C. infrared wave D. radio wave

6. Which is NOT a negative effect of ultraviolet radiation?
   A. Ionizes atoms in the body. C. Damages DNA
   B. Destroys vitamin A. D. Damages collagen

7. What type of electromagnetic radiation is used in mobile phones?
   A. x-rays rays B. ultraviolet ray C. infrared wave D. microwaves

8. Which material can stop gamma rays?
   A. A thick bronze
   B. A thick silver

C. A thick paper
D. A thick slab of concrete with a few inches of lead

9. What type of electromagnetic waves are used to take pictures of bones in medicine?
A. x-rays B. ultraviolet ray C. infrared wave D. microwaves

10. What is the safety protocol for X-ray?
A. Decrease time, increase shielding, and increase distancing
B. Decrease time, decrease shielding, and decrease distancing
C. Increase time, increase shielding, and increase distancing
D. Increase time, decrease shielding, and decrease distancing

Answer Key

Lesson 1

What I Know 1. A 6. B 2. B 7. A or F 3. D 8. B or C 4. C 9. E 5. B 10. F **What's In** A. Radio wave B. Microwaves C. Infra-red radiation D. Ultraviolet radiation E. X-rays F. Gamma rays **What's New** **Activity 1** Only an aluminum foil can block the telephone signal. **Guide Question.** The type of materials affects the connectivity of the two cellular phones. **Activity 2** This activity may be performed only by students with internet connection. **1.** A. The magnetron inside the metal box convert the electricity into power radio waves. B. The high-powered radio waves blast through a wave guide inside the food compartment. C. The microwaves cook the food completely on a turntable. D. Inside the compartment the microwaves reflect and penetrate inside the food. E. The excited state of molecules by the microwaves make the food becomes hotter.	**Chamber** to hold the food and safety contain the microwave radiation. **Activity 3** This activity may be performed only by students with internet connection and andriod phone. Answer varies for the tables. **1**. Uses light to carry signals from the remote to the device it controls. It emits pulses of invisible infrared light that correspond to specific binary codes. **2**.It use LED lights to transmit their infrared signals. **Activity 4** Answers vary. **What I have Learned** 1. A 2. A or B 3. C 4. A or B 5. A	**Assessment** 1. False, Ultra high frequency 2. True 3. True 4. True 5. True **Additional Activities** 1. Light Amplification by Stimulated Emission of Radiation. The optical communication for the future. 2. The optical telescopes can receive and transmit the data not only to the ground stations but also to other geosynchronous satellites, low earth orbit satellites, space station or in the future deep space communication missions. 3. The NASA launched a satellite to the moon called LADDE.

What's In

I.

1. Wi-Fi
2. Bluetooth
3. Microwave Oven
4. MRI
5. Radar
6. Satellite Communication
7. Transmission Satellite Disc
8. Transmission Tower
Communication
9. Magnetron
10. Cellphone

II.

1. MAGNETRON
2. WAVEGUIDE
3. MICROWAVE
4. RADAR
5. GPS LPS

What's New

Activity 1

Observation written inside the box

Luminescent marks seen on paper bills.

Guide Questions

This activity may be performed only by students with internet connection.

1. For disinfection, sterilization of medical equipment or a certain area, and to identify counterfeit bills
2. Light causes thymine dimers to form in the DNA as more thymine dimers are formed damage starts to accumulate inside the DNA bumps also appear in the DNA as a result of the dimers these cellular mutations negatively affect growth and the risk of non-repair increases eventually the damage becomes too extensive and the cell dies DNA replication is stopped.

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3. Used in large scale wastewater treatment medical facilities laboratories manufacturing food processing and hospitals
4. No contact with the surface or device is required when sanitizing with UVC light there is no downtime after sterilization the area or equipment can be used immediately after disinfection

Activity 2

Guide Questions

This activity may be performed only by students with internet connection.

1. Answers vary
2. Yes. because it acts as x-rays and it was blocked by the window/door screen.
1. If you place your hand in front of a flashlight, it will cast a shadow on the wall behind it. In a similar manner, x-rays directed at the body produce 'shadows' on the opposite side that can be registered on film, or on a digital sensor, so that bones are clearly visible while soft tissues, such as muscle, are shadowy.
2. To lessen the amount of radiation received by the body.

What's More

1. FALSE
2. TRUE
3. FALSE
4. TRUE
5. TRUE
6. TRUE
7. FALSE
8. TRUE
9. TRUE
10. TRUE

What I Have Learned

1. Gamma ray
2. X-rays
3. Ultraviolet rays
1. 1-5 Answer Vary
2. 1-5 Answer Vary
3. 1-5 Answer Vary

Assessment

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

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Development Team of the Module

Writer: Rodelio M. Manuel

Content Editors: Alma B. Castaño
Robert J. Gaviola
Maria C. Lising
Jessica S. Mateo
Veronica A. Cena

Language Editors: Lei B. Penaflor
Merian A. Dizon
Catherine C. Paningbatan

Reviewers: PNU External Validator

Illustrator: Loisa D. Tolentino

Cover Illustrators: Keith Angeline N. Alejandro
Guiller P. Belen

Layout Artists: Guiller Belen

Jemwel Dela Paz

Management Team:

Sheryll T. Gayola
Assistant Schools Division Superintendent
OIC, Office of the Schools Division Superintendent

Elisa O. Cerveza
Chief, CID
OIC, Office of the Assistant Schools Division Superintendent

Jessica S. Mateo
EPS-Science

Ivy Coney A. Gamatero
EPS – LRMS

For inquiries or feedback, please write or call:

Schools Division Office- Marikina City
Email Address: sdo.marikina@deped.gov.ph

191 Shoe Ave., Sta. Elena, Marikina City, 1800, Philippines

Telefax: (02) 682-2472 / 682-3989