PEAC
PRIVATE EDUCATION ASSISTANCE COMMITTEE
Trustee of the Fund for Assistance to Private Education

DepED
DEPARTMENT OF EDUCATION

2017

LEARNING MODULE

Science G10| Q2

Force, Motion and Energy

PEAC
PRIVATE EDUCATION ASSISTANCE COMMITTEE
Trustee of the Fund for Assistance to Private Education

PEAC National Secretariat
Units 2505-2507, 25th Floor Philippine AXA Life Centre
1286 Sen. Gil Puyat Avenue corner Tindalo St., Makati City
Tel No.: (02) 8-570-7322
Fax No.: (02) 8-511-7695

NOTICE TO THE SCHOOLS

This learning module (LM) was developed by the Private Education Assistance Committee under the GASTPE Program of the Department of Education. The learning modules were written by the PEAC Junior High School (JHS) Trainers and were used as exemplars either as a sample for presentation or for workshop purposes in the JHS In-Service Training (INSET) program for teachers in private schools.

The LM is designed for online learning and can also be used for blended learning and remote learning modalities. The year indicated on the cover of this LM refers to the year when the LM was used as an exemplar in the JHS INSET and the year it was written or revised. For instance, 2017 means the LM was written in SY 2016-2017 and was used in the 2017 Summer JHS INSET. The quarter indicated on the cover refers to the quarter of the current curriculum guide at the time the LM was written. The most recently revised LMs were in 2018 and 2019.

The LM is also designed such that it encourages independent and self-regulated learning among the students and develops their 21st century skills. It is written in such a way that the teacher is communicating directly to the learner. Participants in the JHS INSET are trained how to unpack the standards and competencies from the K-12 curriculum guides to identify desired results and design standards-based assessment and instruction. Hence, the teachers are trained how to write their own standards-based learning plan.

The parts or stages of this LM include Explore, Firm Up, Deepen and Transfer. It is possible that some links or online resources in some parts of this LM may no longer be available, thus, teachers are urged to provide alternative learning resources or reading materials they deem fit for their students which are aligned with the standards and competencies. Teachers are encouraged to write their own standards-based learning plan or learning module with respect to attainment of their school's vision and mission.

The learning modules developed by PEAC are aligned with the K to 12 Basic Education Curriculum of the Department of Education. Public school teachers may also download and use the learning modules.

Schools, teachers and students may reproduce the LM so long as such reproduction is limited to (i) non-commercial, non-profit educational purposes; and to (ii) personal use or a limited audience under the doctrine of fair use (Section 185, IP Code). They may also share copies of the LM and customize the learning activities as they see fit so long as these are done for non-commercial, non-profit educational purposes and limited to personal use or to a limited audience and fall within the limits of fair use. This document is password-protected to prevent unauthorized processing such as copying and pasting.

SCIENCE 10

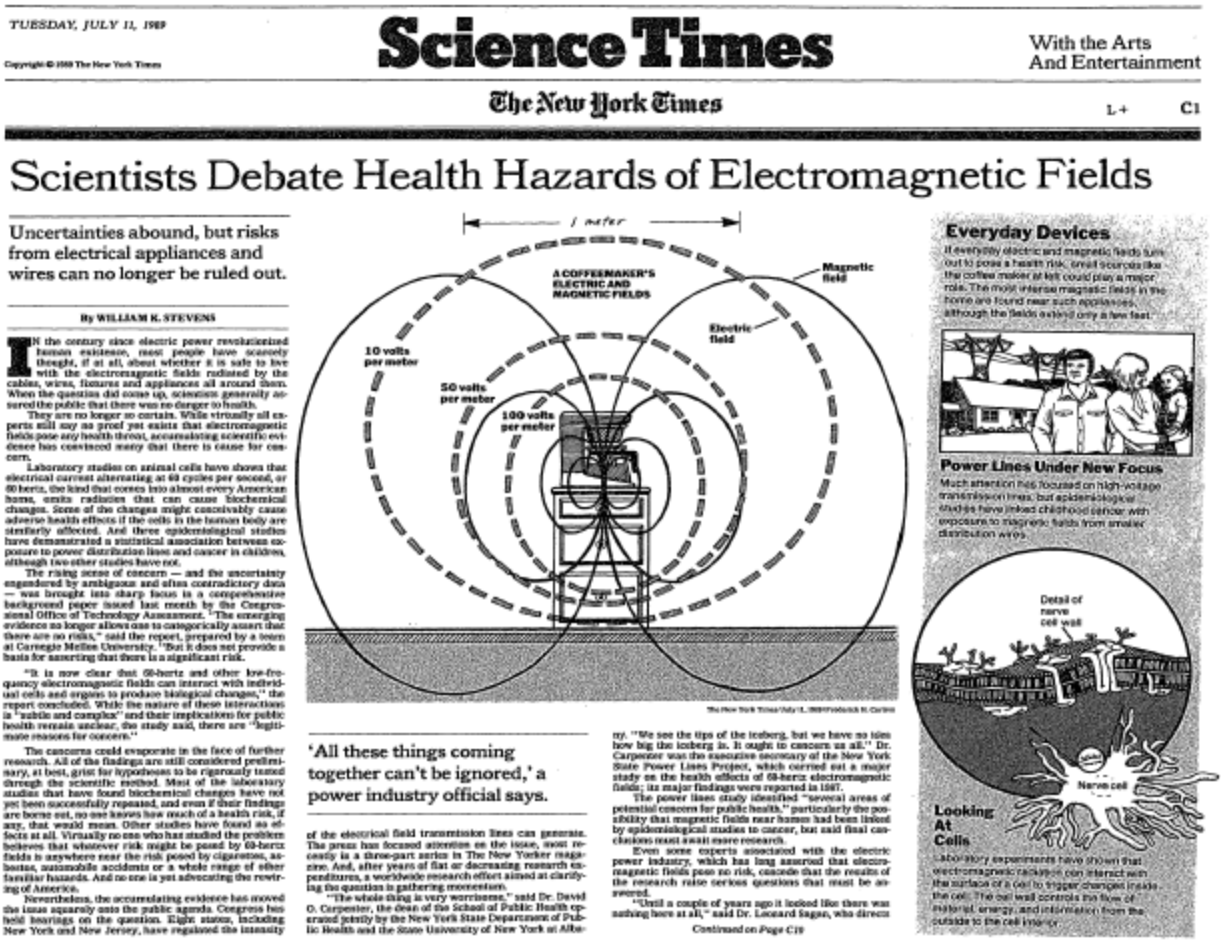
Module No. 2: Force, Motion and Energy

Lesson 1. Electromagnetic Spectrum

INTRODUCTION AND FOCUS QUESTION(S):

The New York Times- Science Times, Tuesday, July 11, 1989

Topic: Scientists Debate Health Hazards of Electromagnetic Field



TUESDAY, JULY 11, 1989

Science Times

With the Arts And Entertainment

The New York Times

C1

Scientists Debate Health Hazards of Electromagnetic Fields

Uncertainties abound, but risks from electrical appliances and wires can no longer be ruled out.

By WILLIAM K. STEVENS

In the century since electric power revolutionized human existence, most people have scarcely thought, if at all, about whether it is safe to live with the electromagnetic fields radiated by the cables, wires, fixtures and appliances all around them. When the question did come up, scientists generally assured the public that there was no danger to health.

They are no longer so certain. While virtually all experts still say no proof yet exists that electromagnetic fields pose any health threat, accumulating scientific evidence has convinced many that there is cause for concern.

Laboratory studies on animal cells have shown that electrical current alternating at 60 cycles per second, or 60 hertz, the kind that comes into almost every American home, emits radiation that can cause biochemical changes. Some of the changes might conceivably cause adverse health effects if the cells in the human body are similarly affected. And three epidemiological studies have demonstrated a statistical association between exposure to power distribution lines and cancer in children, although two other studies have not.

The rising sense of concern — and the uncertainty engendered by ambiguous and often contradictory data — was brought into sharp focus in a comprehensive background paper issued last month by the Congressional Office of Technology Assessment. "The emerging evidence no longer allows one to categorically assert that there are no risks," said the report, prepared by a team at Carnegie Mellon University. "But it does not provide a basis for asserting that there is a significant risk.

"It is now clear that 60-hertz and other low-frequency electromagnetic fields can interact with individual cells and organs to produce biological changes," the report concluded. While the nature of these interactions is "subtle and complex" and their implications for public health remain unclear, the study said, there are "legitimate reasons for concern."

The concerns could evaporate in the face of further research. All of the findings are still considered preliminary, at best, grist for hypotheses to be rigorously tested through the scientific method. Most of the laboratory studies that have found biochemical changes have not yet been successfully repeated, and even if their findings are borne out, no one knows how much of a health risk, if any, that would mean. Other studies have found no effects at all. Virtually no one who has studied the problem believes that whatever risk might be posed by 60-hertz fields is anywhere near the risk posed by cigarettes, asbestos, automobile accidents or a whole range of other familiar hazards. And no one is yet advocating the rewiring of America.

Nevertheless, the accumulating evidence has moved the issue squarely onto the public agenda. Congress has held hearings on the question. Eight states, including New York and New Jersey, have regulated the intensity

'All these things coming together can't be ignored,' a power industry official says.

of the electrical field transmission lines can generate. The press has focused attention on the issue, most recently in a three-part series in The New Yorker magazine. And, after years of flat or decreasing research expenditures, a worldwide research effort aimed at clarifying the question is gathering momentum.

"The whole thing is very worrisome," said Dr. David O. Carpenter, the dean of the School of Public Health operated jointly by the New York State Department of Public Health and the State University of New York at Albany. "We see the tips of the iceberg, but we have no idea how big the iceberg is. It ought to concern us all." Dr. Carpenter was the executive secretary of the New York State Power Lines Project, which carried out a major study on the health effects of 60-hertz electromagnetic fields; its major findings were reported in 1987.

The power lines study identified "several areas of potential concern for public health," particularly the possibility that magnetic fields near homes had been linked by epidemiological studies to cancer, but said final conclusions must await more research.

Even some experts associated with the electric power industry, which has long asserted that electromagnetic fields pose no risk, concede that the results of the research raise serious questions that must be answered.

"Until a couple of years ago it looked like there was nothing here at all," said Dr. Leonard Sagan, who directs

Continued on Page C10

Everyday Devices

If everyday electric and magnetic fields turn out to pose a health risk, small sources like the coffee maker at left could play a major role. The most intense magnetic fields in the home are found near such appliances, although the fields extend only a few feet.

Power Lines Under New Focus

Much attention has focused on high-voltage transmission lines, but epidemiological studies have linked childhood cancer with exposure to magnetic fields from smaller distribution wires.

Looking At Cells

Laboratory experiments have shown that electromagnetic radiation can interact with the surface of a cell to trigger changes inside the cell. The cell wall controls the flow of material, energy, and information from the outside to the cell interior.

"Because the oscillations are very slow (just 60 hertz, or cycles per second), this type of radiation is called "extremely low-frequency." It was long thought harmless because it is too weak to knock out electrons and directly damage molecules in the body.

But on July 11, 1989, Science Times reported the uncomfortable possibility that this ubiquitous background radiation might cause cancer."

The New York Times- Science Times, Monday, July 7, 2014 ***(25 years after July 11, 1989)***
Topic: Debate Continues on Hazards of Electromagnetic Waves

"This occasional column explores topics covered in Science Times 25 years ago to see what has changed — and what has not.

25 YEARS LATER, Dr. Carpenter is still at the State University of New York in Albany, as the director of the Institute for Health and the Environment. He still finds 60-hertz radiation worrisome.

Dr. Carpenter: "The whole thing is very worrisome. We see the tips of the iceberg, but we have no idea how big the iceberg is. It ought to concern us all."

Source: http://www.nytimes.com/2014/07/08/science/debate-continues-on-hazards-of-electromagnetic-waves.html

Have you ever heard the word electromagnetic waves? What words or groups of words come in to your mind when you hear this word? Are you aware of its existence? Do you have to be alarmed in the presence of electromagnetic waves around you? Are these harmful to living things and the environment? What does the article on Science Times in New York Times tell us on the risks and hazards in the presence of electromagnetic waves?

We live in a modern world where the throb of alternating current generates electromagnetic waves — from the television, the blender, the computer, the light bulbs, the wires in the wall. We enjoy seeing things around us because of the presence of electromagnetic waves. Some important breakthroughs in technology such as mobile communications, radar, television, microwave ovens and many more are made possible because of electromagnetic waves. We enjoy life because of electromagnetic waves.

As you sit and read this module, you are surrounded by electromagnetic waves you cannot see or hear. Thus, part of our everyday undertaking is the exposure to the different forms of electromagnetic radiations.

In this module, you will have a closer look again on electromagnetic waves, the role it plays in the electromagnetic spectrum, the practical applications of the different regions of

electromagnetic spectrum and the effects of electromagnetic radiation to living things and environment.

Remember to search for the answer to the following question(s):

- How are the electromagnetic waves produced?
- What are the components, properties and uses of the different regions of the electromagnetic spectrum?
- How safe are electromagnetic waves?

These are some of the questions that you will need to find the answers in this module.

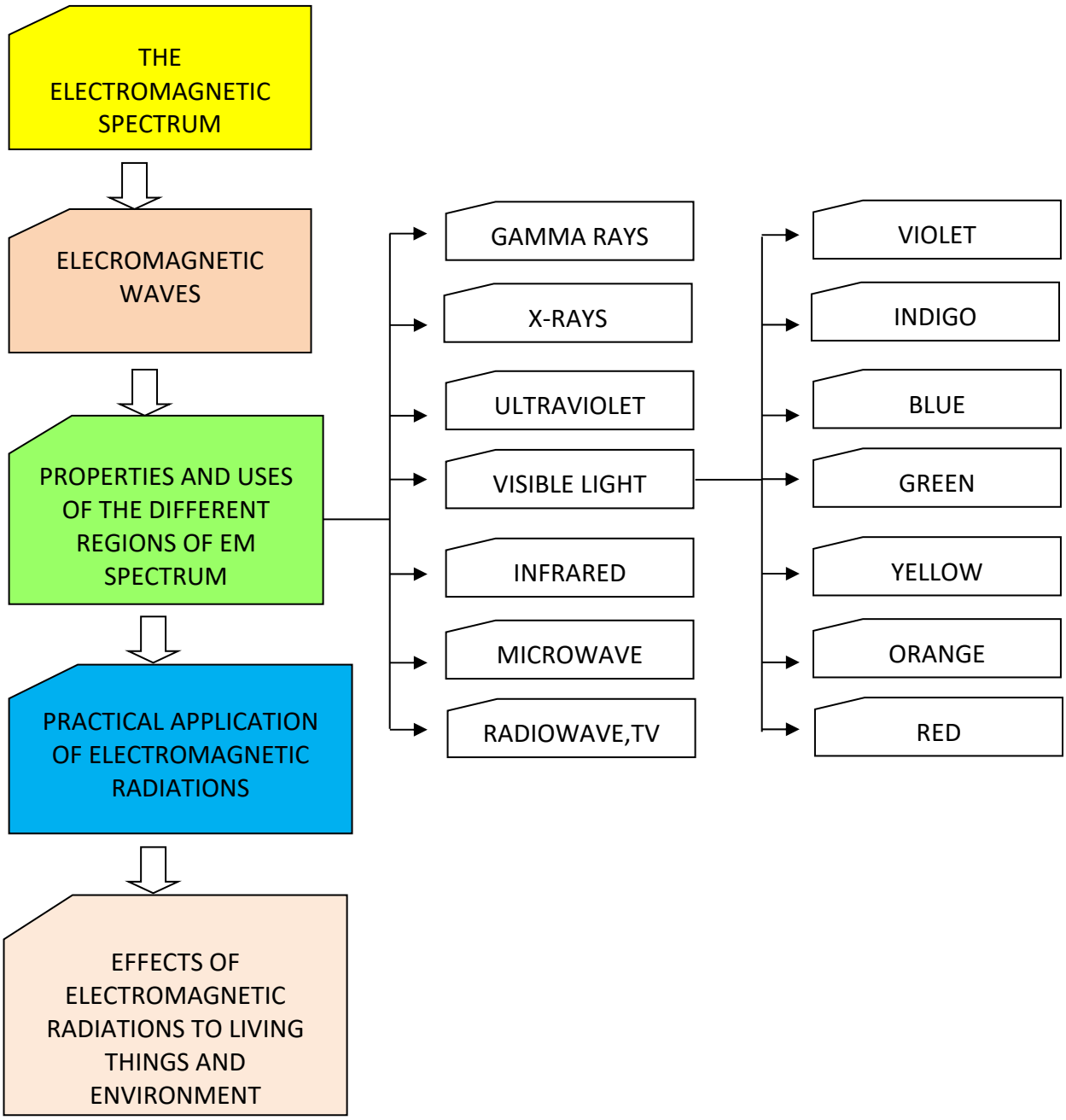
LESSONS AND COVERAGE:

In this module, you will examine these questions when you take the lesson on electromagnetic spectrum:

In this lesson, you will learn the following:

1. Explain how electromagnetic waves are produced
2. Compare the relative wavelengths of different forms of electromagnetic waves
3. Cite examples of practical applications of the different regions of EM waves, such as the use of radio waves in telecommunications
4. Describe the regions of the electromagnetic spectrum, their properties and uses
5. Explain the effects of EM radiation on living things and the environment

MODULE MAP:
Here is a simple map of the above lessons you will cover:



EXPECTED SKILLS:

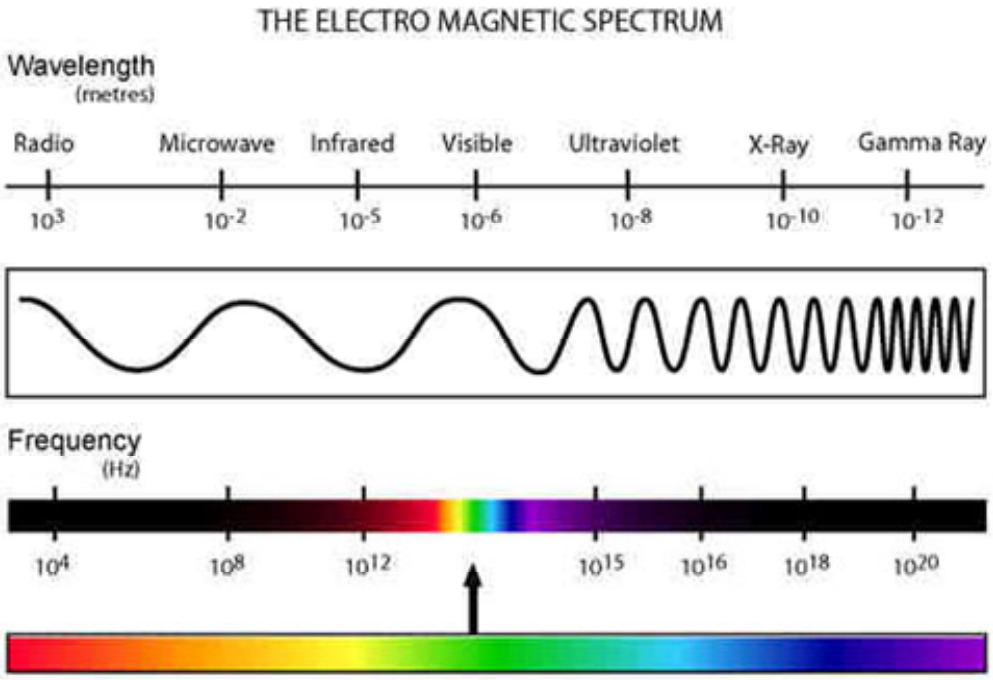
To do well in this module, you need to remember and do the following:

1. Read and follow the instructions very carefully before starting anything.
2. Read each lesson and do activities that are provided for you.
3. Complete all the activities and worksheets. Follow instructions on how to submit them.
4. Look up the meaning of words that you do not know.
5. You will frequently come across process questions as you go through different lessons. Keep a notebook (or use the Notepad) where you can write (and revise) your answers to these questions. Use also the notebook to jot down short notes, draw diagrams, and summarize what you have just read.
6. Perform all the activities diligently to help and guide you in understanding the topic.
7. For worksheets and reports that need to be submitted, use the provided checklist and rubric to evaluate your work before submission.
8. Allow time for relaxation and recreation when you are mentally tired. Make a timetable to schedule your study and recreation.
9. Good luck and enjoy learning.

PRE-ASSESSMENT

Let's find out how much you already know about this module. Click on the letter that you think best answers the question. Please answer all items. After taking this short test, you will see your score. Take note of the items that you were not able to correctly answer and look for the right answer as you go through this module.

1. The diagram below shows an electromagnetic spectrum:

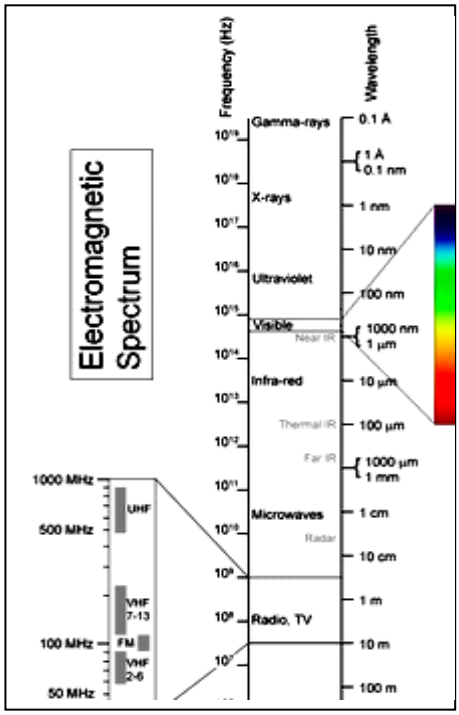


The electromagnetic spectrum shows the complete range of frequencies of electromagnetic waves from the lowest to the highest, including, in order, radio, infrared, visible light, ultraviolet, X-ray, and gamma ray waves. Which of the following statements below explains how the electromagnetic waves are produced?

A. Electromagnetic waves are produced when some kind of energy moves a substance, a material, or a "thing" within a medium that will conduct the mechanical energy of motion away from the source.
B. Electromagnetic Waves are longitudinal waves that are produced when the motion of the individual particles of the medium is in a direction that is parallel to the direction of energy transport.
C. Electromagnetic waves are transverse waves that can be created by accelerating charges; moving charges back and forth will produce oscillating electric and magnetic fields, and this travel at the speed of light.

D. Electromagnetic waves are produced whenever two waves of identical frequency interfere with one another while traveling opposite directions along the same medium.

Refer to the illustration below.



2. Which description is true about the radio waves in the electromagnetic spectrum?

A. It has the shortest wavelength and highest frequency.
B. It has the longest wavelength and lowest frequency.
C. It has the longest wavelength and higher frequency.
D. It has the wavelength and lower frequency.

3. Which of the following is a description of the ionizing electromagnetic radiations (Ultraviolet, gamma and x-ray)?
   A. Low frequency form of electromagnetic waves.
   B. High frequency form of electromagnetic waves.
   C. Long wavelength form of electromagnetic waves.
   D. Low energy form of electromagnetic waves.

Refer to the table below.

Category	Uses
gamma rays	used to kill the bacteria in marsh-mallows
X-rays	used to image bone structures
ultraviolet light	bees can see into the ultraviolet because flowers stand out more clearly at this frequency
visible light	used by humans to observe the world
infrared	night vision, heat sensors, laser metal cutting
microwave	microwave ovens, radar
radio waves	radio, television broadcasts

4. Which of the following descriptions is true about the use of microwave?

   A. Microwave is used in radio detection and ranging.
   B. Microwave is used to observe event.
   C. Microwave is used to image bone structures.
   D. Microwave is used in heat sensors.

5. What kind of waves do cellular telephones use to transmit and receive signals?

A. Microwaves
B. Radio waves
C. Gamma rays
D. Ultraviolet rays

6. How do the wavelength, frequency and speed of ultraviolet rays in vacuum compare with those of visible light?

	Wavelength	**Frequency**	**Speed**
A	Longer	Higher	Slower
B	Longer	Lower	Same
C	Same	Lower	Slower
D	Shorter	Higher	Same

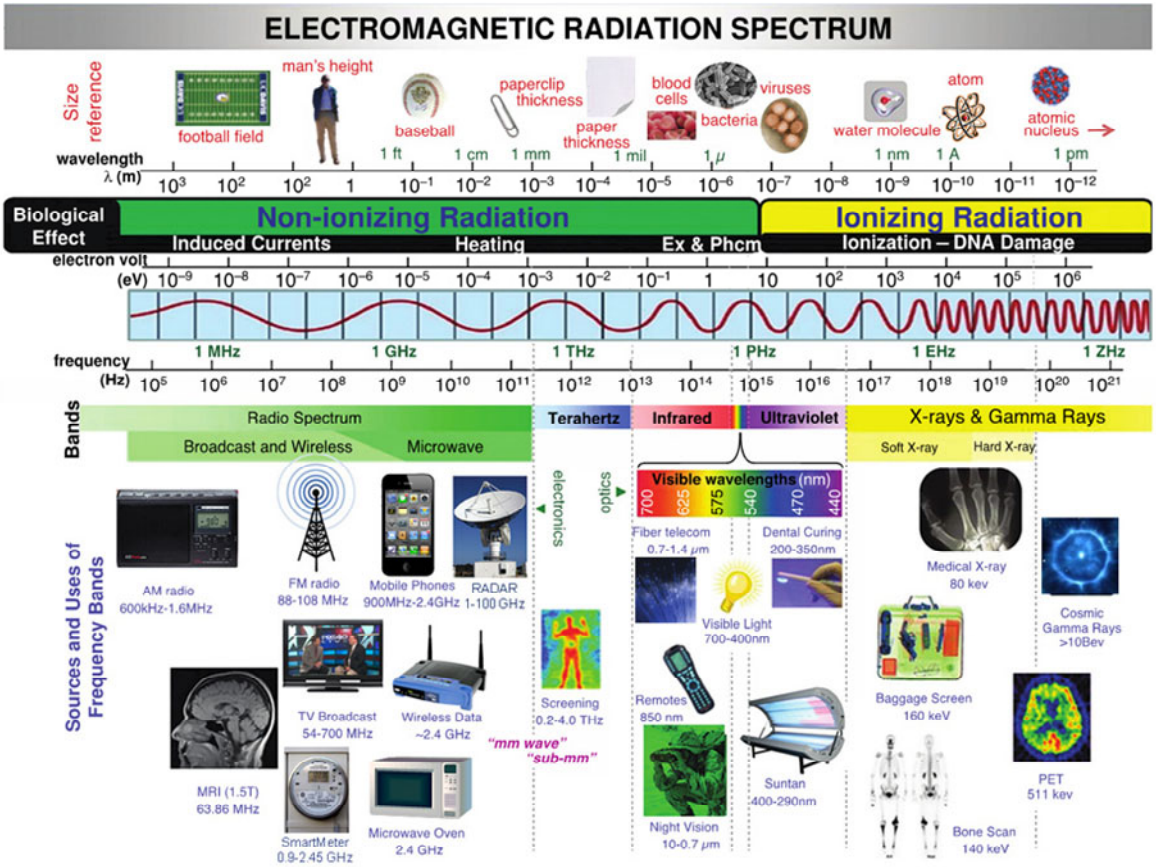
7. Most dermatologists recommend using sunblock as a defense to Ultraviolet radiation. Which of the following describes the ability of UV ray which explains the idea of using sunblock?

A. UV radiation is highly penetrating which can cause suntan.
B. UV radiation is deeply penetrating which can cause skin cancer.
C. UV radiation has the highest velocity that can damage the skin.
D. UV radiation is impermeable to skin which can cause skin cancer.

8. X rays are electromagnetic radiation that differentially penetrates structures within the body and creates images of these structures on photographic film or a fluorescent screen. These images are called diagnostic x rays. Which among the statements below is NOT true?

A. Diagnostic x rays are useful in detecting abnormalities within the body.
B. They are created when an electric current is passed through a vacuum tube.
C. They are a non-invasive way to help diagnose problems such as broken bones, tumors, dental decay, and the presence of foreign bodies though only painful.
D. X rays are a form of radiation similar to light rays except that they are more energetic than light rays and are invisible to the human eye.

9. Juan, Pedro, Kiko and Inday are observing and studying the illustration of electromagnetic radiation spectrum below given by their Physics Teacher, Mr. Alberto de La Cruz.

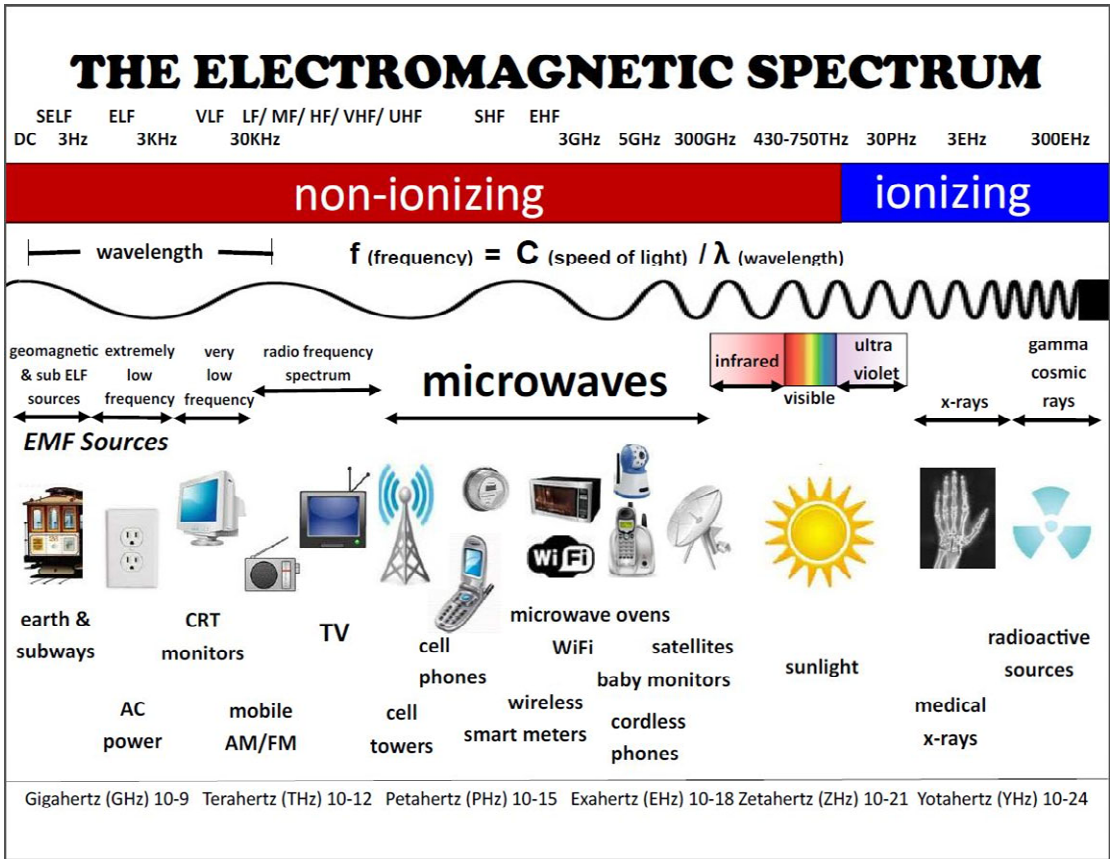


Sir Alberto asked the four students to give an inference on the varying effects of electromagnetic waves around us based from the illustration on electromagnetic radiation spectrum above.

Which of the following students gives a correct inference?

A. Juan: *"Exposure to radio wave is not harmful because radio wave has shorter wavelength therefore it has low energy".*
B. Pedro:*"The greater the size reference of an electromagnetic wave, the higher the frequency and therefore the higher the energy".*
C. Kiko:*" Exposure to ionizing radiation is a greater worry because it can tear molecules apart and therefore potentially damage DNA".*
D. Inday: *"Exposure to non-ionizing radiation can be more harmful than exposure to ionizing radiation because there are too many non-ionizing radiations around us".*

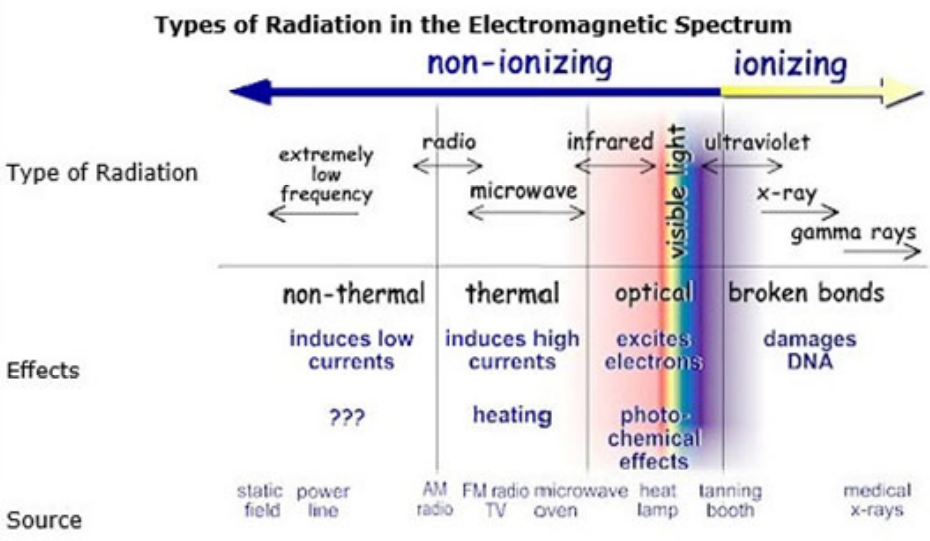
10.Refer to the given picture below:



Which of the following sets of sources are arranged in a way that will pose an increasing risk to humans when exposed to the different sources of electromagnetic radiations at the same time duration and distance?

A. cellphones → microwave ovens sunlight medical X-rays
B. medical X-rays → cordless phones TV → CRT monitor
C. WIFI → sunlight → subways → radioactive sources
D. sunlight → microwave ovens → cellphones → radioactive sources

Refer to the given picture below:



11. What type of radiation can be more harmful to living things and environment when exposed at the same duration and distance based from the illustration above?

A. Non-ionizing radiation because we use and are exposed to non-ionizing radiation every day.
B. Non-ionizing radiation because it has enough energy to move atoms in a molecule around or cause them to vibrate, but not enough to remove electrons.
C. Ionizing radiation because it has enough energy to change atoms in tissues and can tear molecules apart and therefore potentially damage DNA
D. Ionizing radiation because we take advantage of the properties of ionizing radiation to produce high-quality images of the inside of our body, to generate electric power, and for many manufacturing processes.

12. Which of the following statements is NOT true when you are exposed to electromagnetic fields?

A. At low frequencies, external electric and magnetic fields induce small circulating currents within the body.
B. The main effect of radiofrequency electromagnetic fields is heating of body tissues.
C. Short-term exposure to very high levels of electromagnetic fields can be harmful to health
D. Exposure to low level electromagnetic fields is harmful to human health.

13. World Health Organization released a statement with regard to electromagnetic radiation and field.

Health concerns

> *"Everyone is exposed to a complex mix of weak electric and magnetic fields, both at home and at work, from the generation and transmission of electricity, domestic appliances and industrial equipment, to telecommunications and broadcasting."*
>
> *- World Health Organization*

14. Knowing that electromagnetic radiations are all around us, which of the following factors will NOT be considered when exposed to the different forms of electromagnetic radiations?

A. Distance from the source because electromagnetic radiation is greatest close to the source and decreases quickly with distance from the source.
B. The frequency of the electromagnetic wave because the higher the frequency, the higher the energy.
C. The type of electromagnetic wave because it has its own properties and uses.
D. The size of the electromagnetic wave because the longer the wavelength, the higher the energy.

15. There are three ways that electromagnetic radiation can cause harm within to living bodies. Each effect is particular to a certain range of frequencies. Our main exposure to dangerous electromagnetic radiation is from direct sunlight.

Study the table below:

Effect	Range	Effects	Disclaimer
Induced voltage gradients and/or electric currents	Low frequencies (0-3 KHz)	Magnetic fields might do weird things to our bodies.	Normal human technologies do not produce frequencies in this range, and, the Earth itself has a magnetic field.
Thermal effects Absorption causes heating	30 MHz - 300 GHz Microwaves	Absorption of energy causes heating, which if enough happens at once, can damage tissue.	Energy has to specifically and intentionally focused to have an effect.
Ionizing effects Molecules are damaged	Ultraviolet light, X-rays, gamma rays	Carcinogenic due to occasional DNA damage.	We are exposed to these from space and from the sun, but not from human technology.

Based from the table above, it shows that the higher the frequency, the higher the risk when exposed to this type of radiation. Which of the following statements explains the possible reason for this?

A. As frequency increases so as the energy.
B. As frequency increases, energy decreases.
C. As energy decreases, frequency remains the same.
D. As energy increases, frequency remains constant.

16. You are working for a broadcasting network and the evening news program will air in 15 minutes. One of the segments of the show is a trivia on different topics that are relevant to the times. It so happens that the current news is about the rise of several high profile individuals suffering from cancer. Hence, you were asked to come-up with a presentation on the different effects of electromagnetic exposure as this has been cited by a lot of individuals as the key carcinogenic factor.

As a journalist, you are tasked to write a script for the news show explaining the effects of electromagnetic exposure to living things. Which of the following statements on electromagnetic exposure can be a possible consideration when you will make the script?

A. The greater the frequency of electromagnetic radiation, the lesser is the penetrating power.
B. Exposure to very high levels of electromagnetic fields can be harmful to health
C. Despite extensive research, to date there is no evidence to conclude that exposure to low level electromagnetic fields is harmful to human health.
D. Exposure to electromagnetic field levels in the living environment is extremely high.

17. The Philippine Skin Cancer Foundation has been alarmed with rapid growth of skin cancer. Data of Philippine Skin Cancer have shown that people living in the remote barangay are more vulnerable of the disease due to lack of knowledge. As a dermatologist, you are invited by PSCF to reach out and give information drive on skin cancer prevention.

As a dermatologist, you are requested to conduct a symposium about skin cancer prevention. Which of the following statements about skin cancer or damage can be used in the symposium?

A. People of color do not get skin cancer
B. Ultraviolet (UV) radiation from the sun is the number one cause of skin cancer.
C. You cannot get sun damage on a cloudy day.
D. Some ingredients in sunscreen can cause cancer.

18. A rumor is spreading fast across the country that microwave oven use is linked to the development of intestinal cancer. As a renowned Physicist of the country, you are invited by media men to clarify the matter. The public expects your point to be presented in any medium they are commonly exposed to.

As a physicist, you are requested to write a column in a newspaper explaining in details whether the public needs to be scared or not. You are tasked to give possible recommendations that you can include in your news article. Which of the following statements is NOT true?

A. Microwave ovens meeting the standards are not hazardous to health.
B. If you use a microwave oven in the correct way there is no known harmful effect on humans.
C. Direct microwave exposure is not generally possible, as microwaves emitted by the source in a microwave oven are confined in the oven by the material out of which the oven is constructed.
D. Microwave ovens make foods radioactive because nutrients are lost when heating foods

19. You are tasked by your teacher to make an information dissemination campaign so that everybody will be aware on the risks and hazards of the different forms of electromagnetic radiation around us. Which of the following statements will you consider in this information dissemination campaign?

A. The effects of electromagnetic radiations exposure are negligible because we cannot feel the electromagnetic radiations around us.
B. The effects of electromagnetic radiations exposure are dependent on the level, type and duration of exposure to the source.
C. The effects of electromagnetic radiations exposure are the same to all forms of electromagnetic waves because they travel at the same speed.
D. The effects of electromagnetic radiations exposure are only applicable to visible light because this is the only form of electromagnetic radiation that we can see.

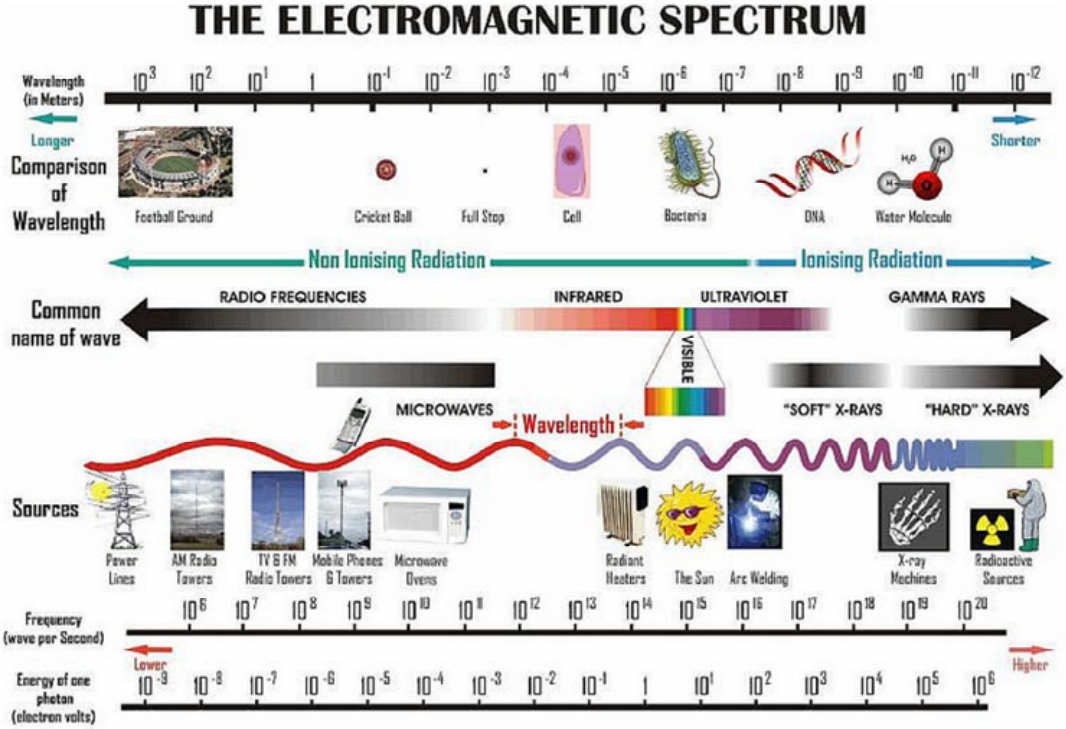
20. Gamma-rays have the smallest wavelengths and the most energy of any other waves in the electromagnetic spectrum. These rays travel to us across vast distances of the universe, only to be absorbed by the Earth's atmosphere. It is considered the primary hazard to the general population during most radiological emergencies. In fact, when the term "radiation sickness" is used to describe the effects of large exposures in short time periods, the most severe damage almost certainly results from gamma radiation. Gamma Rays are also used in medicine for killing cancer cells.

Knowing the characteristics, properties and uses of gamma rays, what will you remember when dealing with gamma radiation?

A. Gamma rays have high penetrating power and it has the ability to travel great distances.
B. Gamma rays are the same with any other forms of electromagnetic waves because they all travel at the speed of light.

C. Gamma rays do not exist around us because it is not visible in our naked eye.
D. The effects of gamma radiation can only be applied in hospitals to treat cancer cells.

Consider the electromagnetic radiation spectrum below:



21. If you are going to make an information dissemination campaign on the varying effects of electromagnetic radiations around us, which of the following statements CANNOT be used in that campaign?

A. The ionizing electromagnetic radiations can be more harmful than non-ionizing radiation because they have more penetrating power.
B. Visible light has the shortest range of wavelength in the spectrum and yet we can see this type of electromagnetic wave.
C. The different forms of electromagnetic waves have different wavelengths, frequencies and speed.
D. Radio wave has the least level of energy and the gamma has the greatest level of energy.

EXPLORE

In the previous grades, you recognized that different forms of energy travel in different ways—light and sound travel. Also you investigated some properties and characteristics of visible light. Doing the different activities on light, gave you a clear picture on the nature and characteristics of light. You learned that light is an electromagnetic wave. Still, an important question remains. *How safe are electromagnetic waves?* This is the question that you are going to seek answers as you try to perform the different activities in this module.

Let's start the module by gathering your thoughts about the different exposure to the different forms of electromagnetic waves.

ACTIVITY NO. 1: INTEGUMENTARY SENSATIONS

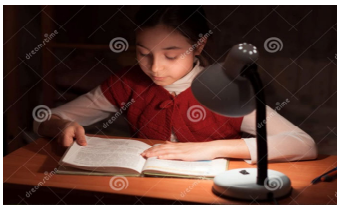
The skin as the largest organ of the body protects the internal organs from the environmental elements. It is a host to a lot of sensory receptors to help the body react to different situations.

Below are illustrations of exposures of the skin to some stimulus. Write on the Activity Sheet below the skin sensation/s you can associate with every situation. Try to figure out also if the exposure to the different samples can cause harm to living things and environment.

Answer the process questions afterwards.

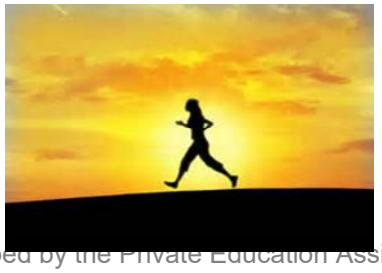
X-RAY ESPOSURE

LAMP SHADE



BONFIRE ESPOSURE

SUN ESPOSURE



SOUND ESPOSURE

CRT MONITOR ESPOSURE

Activity Sheet: Integumentary Sensations	
EXPOSURE	**SENSATION**
Lamp Shade Exposure	
X-ray Exposure	
Bonfire Exposure	
Sun Exposure	
Sound Exposure	
CRT Monitor Exposure	

Process Questions:

1. Are there similarities/differences with the sensations felt in the different situations? How may your answer help describe the characteristics of the stimulus?
2. Are there stimuli in the given situations that can be considered as harmful? If so, in what way?
3. Can we guarantee our safety with the constant exposures to these phenomena/situations? Explain and justify.

What do you feel in doing the activity? Are you having a hard time identifying the different sensations in the different exposures mentioned above? What question in the process questions you find difficult to answer? What do you think is the reason of this difficulty? Think about these questions as you do the next activity.

ACTIVITY NO.2: THINKING OUT OF THE BOX- ELICITING PRIOR KNOWLEDGE

In the previous activity, you were asked to think about on the exposure on the different forms of electromagnetic waves keeping in mind the question:
How safe are electromagnetic waves? Gather your thoughts to express your answer using the thinking outside the box strategy below:

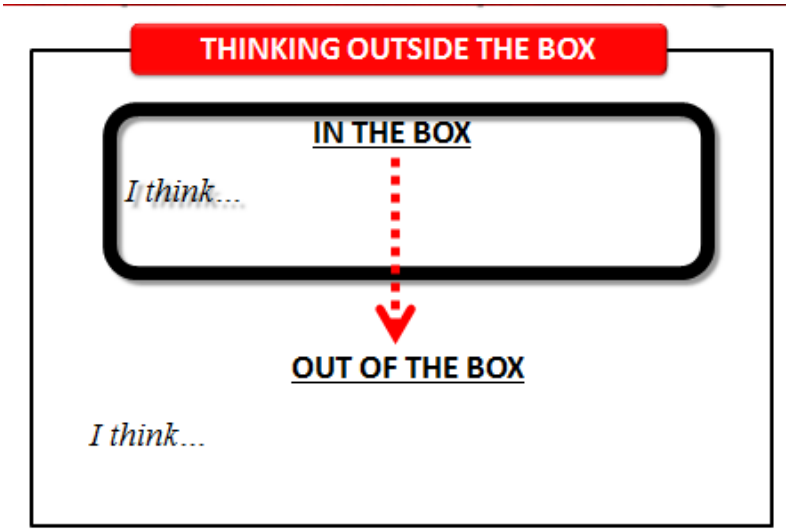
Instruction: You are going to fill up the thinking outside the box template by answering the guide question below:

How safe are electromagnetic waves?

Inside the box: Write your thoughts and ideas of the guide question in the box using the different pictures and your answers to the process questions in Activity No. 1.

Outside the box: Write your thoughts and ideas using different real life samples to defend your answer to the guide question. Be specific in your answers and examples.

How safe are electromagnetic waves?



Write your answers to the guide question in the template provided. When you are finished, submit your answers to the discussion board and try to find out the similarities and differences of your answers to the others learners online. Write your findings by writing the similarities and differences in the activity sheet below:

How safe are electromagnetic waves?	
SIMILARITIES	DIFFERENCES
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

Process Questions:

a. Why do you agree or disagree on the answers of the learners online to the guide question?
b. What basis or bases did you use in agreeing or disagreeing on the answers to the guide question?
c. What experiences do you have that cause you to disagree or agree on the other learners online?

What can you say about your ideas about electromagnetic waves? Do you think you have the correct concepts on the exposure to the different forms of electromagnetic waves? Which of your ideas are acceptable? How are you going to verify the correct concept? How are you going to reconcile the differences? How safe really are electromagnetic waves?

End of EXPLORE:
You gave your initial ideas on how safe are the electromagnetic waves by doing the *integumentary sensations activity* and by answering the *thinking outside the box activity.*

You found out that your answers have similarities and differences to the other learners online. You are going to continue to find answers to the guide question. As you perform the different activities on this module, you will find out that your ideas are in line with the standard. You will also learn other concepts which will help you complete the required project found at the end. This project is an information dissemination drive about the effects of electromagnetic wave exposure

We will start by doing the next activity.

FIRM-UP

Your goal in this section is to learn and understand key concepts about electromagnetic waves (EM waves), electromagnetic spectrum, examples of practical applications of the different regions of EM waves and explain the effects of EM radiation on living things and the environment;

Monitor your accomplishment in these competencies.

CHECKLIST OF COMPETENCIES	
	Explain how electromagnetic waves are produced
	Compare the relative wavelengths of different forms of electromagnetic waves
	Cite examples of practical applications of the different regions of EM waves, such as the use of radio waves in telecommunications
	Describe the regions of the electromagnetic spectrum, their properties and uses

	Explain the effects of EM radiation on living things and the environment

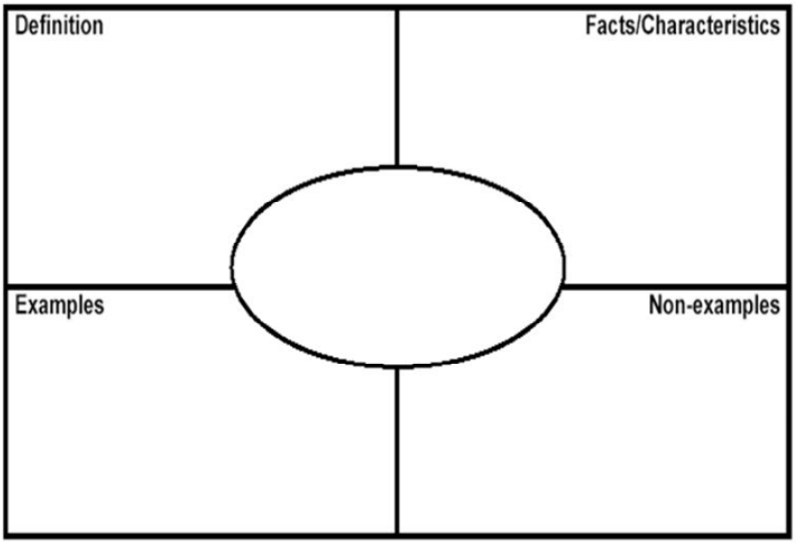
We will be focusing on some important questions as we go along with our discussions to meet the requirements of the different competencies in this module:

How are the electromagnetic waves produced?
What are the components, properties and uses of the different regions of the electromagnetic spectrum?
How safe are electromagnetic waves?

ACTIVITY NO. 3: LET'S DO THE WAVE!- FRAYER'S MODEL MAP

In grade 7, you learned that waves are carrier of energy. You also investigated the types of waves, characteristics of waves and wave velocity. It was in your grade 7 when you have a clear concept on the nature and characteristics of electromagnetic wave. This module is build up in the basic concept of electromagnetic wave. Let us review if you still have the correct concepts on electromagnetic waves by doing the Frayer's model activity below:

FRAYER'S MODEL MAP



Follow the given procedure below:

1. In the center oval of the Frayer Model map, write the word ELECTROMAGNETIC WAVE.
2. What is an electromagnetic wave? Write your answer to the guide question to the definition box of the Frayer's Model Map.
3. What facts/characteristics can you think of if you heard about the word "electromagnetic wave"? If you already thought of these characteristics, list them on its given box.
4. Then, write examples of electromagnetic waves in the box labeled examples. Give three answers
5. Do the same for the non-examples of electromagnetic waves. Give also three answers

After completing the Frayer's Model Map, answer the guide questions below:

PROCESS QUESTIONS:

1. Based on your answers in the model, what can you say about electromagnetic wave?
2. What are the characteristics of electromagnetic wave?
3. What are some concrete examples of electromagnetic waves?
4. What are examples and non-examples of electromagnetic waves? Explain your answer.

After doing the activity, do you still have the correct concepts on electromagnetic waves? How certain are you on your ideas on electromagnetic waves? Let us find out by doing the next activity.

ACTIVITY NO. 4: VIDEO ANALYSIS: WHAT'S WITH THE ELECTROMAGNETIC WAVES?

Open the link: https://www.youtube.com/watch?v=xZ6XUk7QLbU and watch the video about the electromagnetic waves and how these waves behave. Take note of the important points that are shared in the video. Write your notes in the table below:

My notes:
_____
_____
_____
_____
_____
_____

PROCESS QUESTIONS:

1. What is an electromagnetic wave? How does it behave?
2. What indicates that electromagnetic waves travel or move?
3. Describe the relationship of wavelength and frequency.
4. *According to the video, you cannot make observations around us or see the world at all without light, would this mean that electromagnetic waves are safe? Explain.*

After doing the activity, do you have already the correct concepts on how electromagnetic waves are produced? Double check your ideas by doing the next activity.

ACTIVITY NO. 5: WEBPAGE READING- INTRODUCTION TO ELECTROMAGNETIC WAVE

Read the webpage on the physics classroom that discusses the electromagnetic waves and visible spectra. This will give you an idea on how the electromagnetic waves are produced. Open the link below:

http://www.physicsclassroom.com/class/light/Lesson-2/The-Electromagnetic-and-Visible-Spectra

Be sure to make an outline of the important facts you get from reading the given article.

Process Questions:

1. How are electromagnetic waves produced?
2. How fast does an electromagnetic wave travel? How does it travel?
3. What are the different kinds of electromagnetic waves?
4. *Discuss the importance of frequency, wavelength and energy in the study of electromagnetic wave? Would this determine how safe are the electromagnetic waves? Explain.*

In this activity, you learned how electromagnetic waves are produced. You are going to perform the next activity so that you can visualize on how electromagnetic waves propagate through space.

ACTIVITY NO.6: WEB SIMULATION ON ELECTROMAGNETIC WAVE

You are going to do web simulation on electromagnetic wave so that you will have visual representation on how electromagnetic waves are produced. Open the given link:

http://www.phy.ntnu.edu.tw/ntnujava/index.php?topic=35.msg215#msg215

See to it that you have the *java applet application* installed in your computer. Observe the simulation of an electromagnetic wave. Try to take note how this wave produced and how this wave propagates through space.

Process Questions:

1. What are your observations in the simulation of an electromagnetic wave?
2. What happen to the electromagnetic wave as you try to manipulate the given variables in the simulation set-up?
3. What are the things that you want to remember as you manipulate the electromagnetic wave simulation?

You have learned how the electromagnetic waves are produced and how this type of wave propagated through space. Express your ideas by completing the statements below:

COMPLETING THE STATEMENTS WORKSHEET
1. Electromagnetic Waves are produced _____ _____ _____ _____ _____
2. Electromagnetic Waves are propagated through space by _____ _____ _____ _____ _____
3. Electromagnetic Waves are important because_____ _____ _____

_____ _____

Post your answers in the discussion board. Try to check the answers of the other learners online. Give your opinion and ideas in the discussion board so that your ideas will also be clarified as well as the ideas of the other learners on line.

What did you observe to the answers of the other learners on line? Can you say that you have the same concepts on how the electromagnetic waves are produced? This is important because you need to know the nature and characteristics of electromagnetic waves because you will use this in the study of electromagnetic spectrum which contains an extremely broad spectrum of wavelength and frequency. You will investigate more the electromagnetic waves as you try to discover the world of electromagnetic spectrum. Let us try to explore the electromagnetic spectrum by doing the next activity.

ACTIVITY NO. 7: SONG ANALYSIS

Click on this link and listen to the electromagnetic spectrum song: *https://www.youtube.com/watch?v=A0un-_jBPPU*

Use the lyrics of the song to complete the sequenced of information in the table below:

TYPES OF ELECTROMAGNETIC WAVES	SOURCES/EXAMPLES

Process Questions:

1) Cite another example/source for each type of electromagnetic wave and add it in the table above. Highlight your new example with a yellow color.

2) Which of the sources/examples are commonly encountered or are frequently used?
3) Which of the sources/examples are beneficial to the living things and the environment? Why?
4) Which of the sources/examples are harmful to the living things and the environment? Why?
5) *How do you protect yourself from the harmful effects of electromagnetic radiation?*

After having completed the table and answered the process questions, are you now confident of your ideas about electromagnetic spectrum? Let's continue to verify your ideas in the next set of activities.

ACTIVITY NO. 8: DRAG AND DROP

After listening to the song on the *Electromagnetic Spectrum*, take a look at the pictures below. Draw and label a line representing the electromagnetic spectrum and drag the pictures to the appropriate type of electromagnetic wave that it emits.

MY ELECTROMAGNETIC SPECTRUM

Process Questions:

1) Which pictures were mentioned in the song?
2) Which picture was hard to classify? Why?
3) *Of the pictures that you arranged, which posed a risk to human beings? Why?*

Congratulations! You've made your own representation of the EM spectrum".

How many pictures were correctly placed? Proceed to the next activity and try to verify which of the pictures were in its proper place.

ACTIVITY NO. 9: WEBPAGE READING ON ELECTROMAGNETIC SPECTRUM

Read the article below by following the link provided. Use the article in filling up the table below.

http://www.cyberphysics.co.uk/topics/light/emspect.htm

After reading the article, use the important concepts in the article to complete the table below:

NAME	CHARACTERISTICS	SOURCES	USES	DANGER
Gamma Rays				

Process Questions:

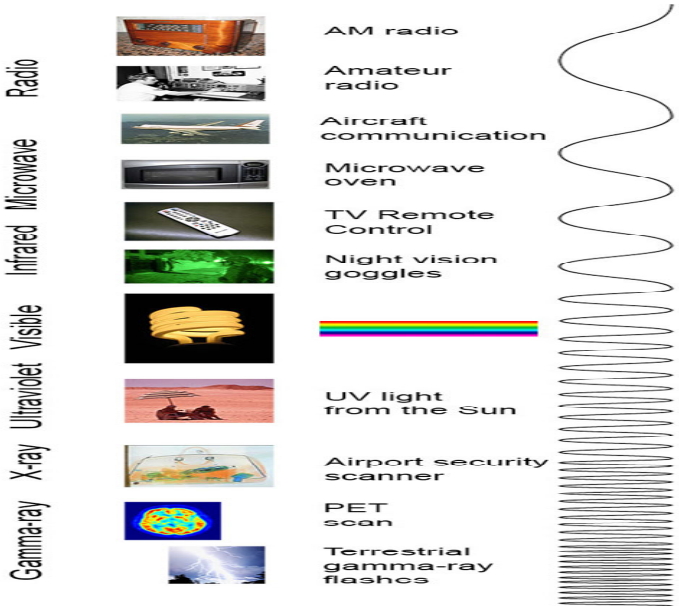
1) What are the similarities and differences of different waves of electromagnetic spectrum?
2) Compare the relative wavelengths of different forms of electromagnetic waves.
3) What relationship do they have in terms of frequency and wavelength?
4) Discuss the frequency and energy of the different regions of the electromagnetic spectrum
5) How does the energy of the different waves of the electromagnetic spectrum vary with frequency and wavelength?
6) How do you perceive things without electromagnetic spectrum?
7) How does understanding the behavior of electromagnetic spectrum help in making informed decisions?

After completing the webpage reading, are you confident of your ideas about electromagnetic spectrum? The next activity will strengthen more your ideas and concepts on electromagnetic spectrum

ACTIVITY NO.10: RECIPROCAL TEACHING

1. Suppose you are given this illustration from a certain article for a particular topic:

Electromagnetic Spectrum



- Write a prediction about what the article will cover and support your answer. Write your answers in the Prediction and Support Portion

Name:_____

Chapter or Book title: _____

Reciprocal Teaching Worksheet

- (first row) of the template below:

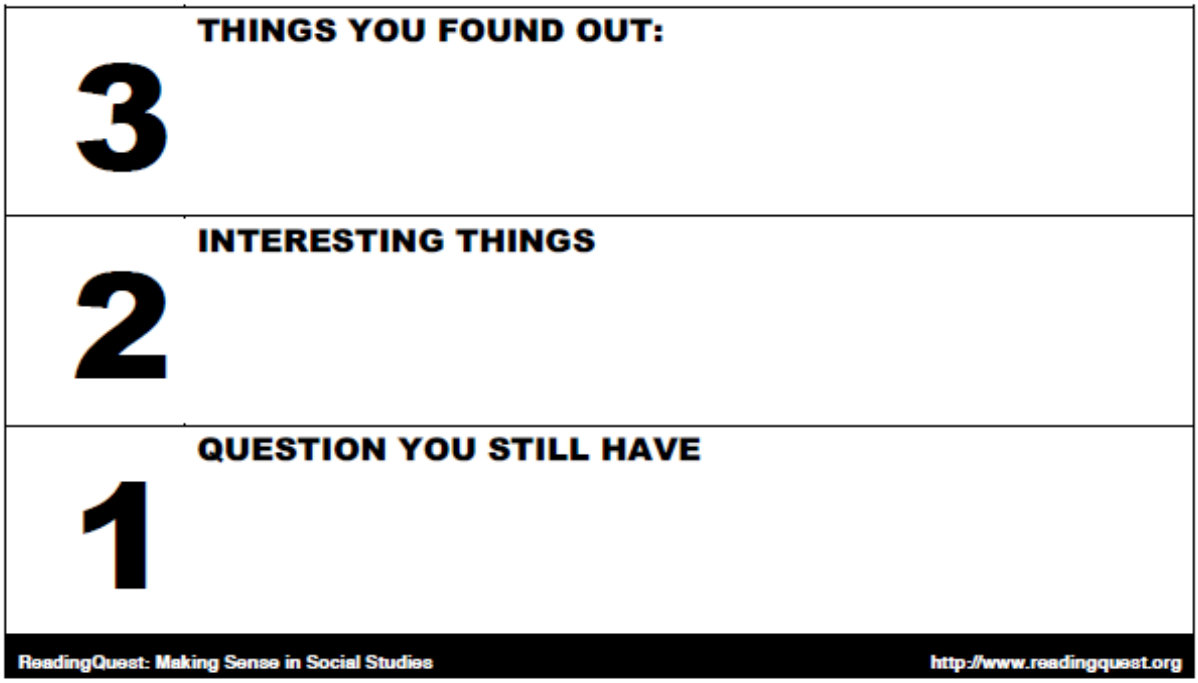
Prediction: Before you begin to read the selection, look at the title or cover, scan the pages to read the major headings, and look at any illustrations. Write down your prediction (s)	
Prediction:	**Support:**
Main Ideas: As you finish reading each paragraph or key section of text, identify the main idea of that paragraph or section.	**Questions:** For each main idea listed, write down at least one question.
Main Idea 1: _____ _____ _____ Main Idea 2: _____ _____ _____ Main Idea 3: _____ _____ _____ Main Idea 4: _____ _____ _____	**Question 1**: _____ _____ _____ **Question 2**: _____ _____ _____ **Question 3**: _____ _____ _____ **Question 4**: _____ _____ _____

Main Idea 5: _____ _____ _____	**Question 5**: _____ _____ _____
Summarize: Write a brief summary of what you read.	
Clarify: Copy down words, phrases, or sentences in the passage that are unclear. Then explain how you clarified your understanding.	
Word or Phrase:	**Clarify:**

2. Click the webpage below and read the text about the Electromagnetic Spectrum: http://imagine.gsfc.nasa.gov/science/toolbox/emspectrum1.html

   As you read the selection, check to see whether it turns out as you predicted. Stop at several points during your reading and ask yourself how closely the content of the article fits your initial prediction. How do the facts or information that you have read change your prediction about what you will find in the rest of the article?
3. Stop after each paragraph or major section of the passage. Construct two or more complete sentences that sum up only the most important idea (s) that appear in the section. Write these summary (main idea) sentences in the *Reciprocal Teaching Worksheet* and continue reading.
4. Look at the ideas that you have summarized as you read the article. For each main idea listed write down at least one question that the main idea will answer.

5. Sometimes in your reading, you will run into words, phrases or whole sentences that really don't make sense. If you come across a word whose meaning you do not know, read the sentences before and after it to see if they give you clues to the word's meaning. If the word is still unclear, look it up in a dictionary. If a phrase or sentence is unclear, reread the phrase or sentence carefully and try to understand it. Write your answers in the last row of the *Reciprocal Teaching Worksheet.*
6. After completing the *Reciprocal Teaching Worksheet*, answer the questions below:
   a. Were your predictions the same as the article you read? What similarities did your prediction and the article have? Were there any differences? What are these?
   b. After reading the article, complete the 321 Chart below:



The last question that you have about the Electromagnetic Spectrum will be answered as you complete the rest of the activities in this module. Let us continue to investigate more your ideas and concepts on electromagnetic spectrum by dong the different simulation activities:

ACTIVITY NO.11: A TOUR ON THE ELECTROMAGNETIC SPECTRUM

Visit the interactive activity from the *NOVA* Web site. The activity provides a self-guided tour of the electromagnetic spectrum, including examples of some of the most common uses of different types of waves:

http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfw.spectrum/tour-the-electromagnetic-spectrum/

After watching the lecture part, you are to proceed to the simulation of electromagnetic spectrum interactive to investigate the relationship among frequency, wavelength and energy of the different regions of the electromagnetic spectrum.

http://earthguide.ucsd.edu/eoc/special_topics/teach/sp_climate_change/p_emspectrum_interactive.html

Process Questions:

1. Describe the different regions of the electromagnetic spectrum? Cite the properties and uses of the different regions of the electromagnetic spectrum
2. What are the advantages and disadvantages of the presence of the different forms of electromagnetic waves around us?
3. How does the energy of the different waves of the electromagnetic spectrum vary with frequency and wavelength?
4. Based from the simulation activity, describe the relationship among wavelength, frequency and energy?
5. Why do we have to know the relationship among wavelength, frequency and energy?
6. *Do we have to be threatened to the different forms of electromagnetic waves?*

The videos supported the ideas you have about the electromagnetic spectrum. You can use the ideas you have from the article and videos to proceed to our next simulation activities.

ACTIVITY NO. 12: ELECTROMAGNETIC SPECRTRUM ACTIVITY

Check this website below for you to have hands-on experience about electromagnetic radiation
http://www.bbc.co.uk/schools/gcsebitesize/science/21c_pre_2011/radiation/electromagneticradiationact.shtml

Process Questions:

1. Compare the relative wavelengths of different forms of electromagnetic waves.
2. What relationship do they have in terms of frequency and wavelength?
3. Discuss the frequency and energy of the different regions of the electromagnetic spectrum
4. How does the energy of the different waves of the electromagnetic spectrum vary with frequency and wavelength?
5. How are gamma rays different from infrared radiation?
6. Why is x-ray important in medical aspect?
7. What is the purpose of radio waves?
8. *Why do the different parts of the spectrum have different effects to living things and environment?*

With the given hands-on activities, you were able to discover more about the different regions of the electromagnetic spectrum. You have known more about their wavelength, frequency and energy.

In the next part of this module, you are going to do the enrichment activities on electromagnetic spectrum. In this manner, your misconceptions and queries on electromagnetic spectrum will be answered.

ACTIVITY NO. 13: ENRICHMENT ACTIVITIES ON ELECTROMAGNETIC SPECTRUM

A. VIDEO ON ELECTROMAGNETIC SPECTRUM

Watch the video on NASA-tour of the electromagnetic spectrum on you tube about what electromagnetic spectrum is all about. Open the site: http://www.youtube.com/watch?v=HPcAWNlVl-8

As you watch the video, be sure to take note of some key concepts that will help you answer the given questions below.

Process Questions:

1. What are the components of the electromagnetic spectrum?
2. How do these parts differ from one another?
3. Why are some parts of the spectrum dangerous to living things?

B. QUIZ ON ELECTROMAGNETIC SPECTRUM

You are going to take the quizzes on electromagnetic waves to check if you have clear concepts on electromagnetic waves and electromagnetic spectrum:

1. Electromagnetic Spectrum Quiz
http://www.proprofs.com/quiz-school/story.php?title=electromagnetic-spectrum-quiz

2. Glencoe Online Quiz on Electromagnetic Spectrum
http://glencoe.mheducation.com/sites/0078617766/student_view0/chapter3/section2/self-check_quiz-eng_.html

Process Questions:
1. How do you find the quiz on electromagnetic spectrum?
2. Are you certain of your ideas on electromagnetic spectrum?
3. What will you do to correct your misconceptions on electromagnetic waves and electromagnetic spectrum?

After doing the enrichment activities, do you still have clarifications on electromagnetic spectrum? Are you certain now of your ideas on electromagnetic spectrum? Now that you have clear concepts on electromagnetic spectrum, you are going to investigate some practical applications of electromagnetic waves and its effect on living things and environment. You will get to explore more about radiation and its different effects. Let us continue by doing the virtual lab below.

ACTIVITY NO.14: VIRTUAL LAB.- VISIBLE LIGHT: HERE, THERE AND EVERYWHERE

Visible light is one common type of electromagnetic waves that we are all familiar with. Light is everywhere in our world. We need it to see: it carries information from the world to our eyes and brains. Seeing colors and shapes is second nature to us, yet light is a perplexing phenomenon when we study it more closely. You are going to investigate the complex and yet wonderful world of visible light. As you try to do the different activities on visible light, ask yourself the following questions: Do we have to be alarmed in the presence of visible light around us? Why do we have to?

Click the link below:
http://www.learner.org/teacherslab/science/light/

You may click on your desired activity to get to know more about light and its properties together with the many applications it has.

Process Questions:

1. What are the properties of light as part of the spectrum?
2. *Why do the different parts of the spectrum have different effects?*

You were able to realize many important things about visible light. Let us proceed with another fun way of learning other applications of the EM waves. The next sets of activities will give you more insights to the practical application of the different forms of electromagnetic waves and its effects on living things and the environment. Enjoy learning!

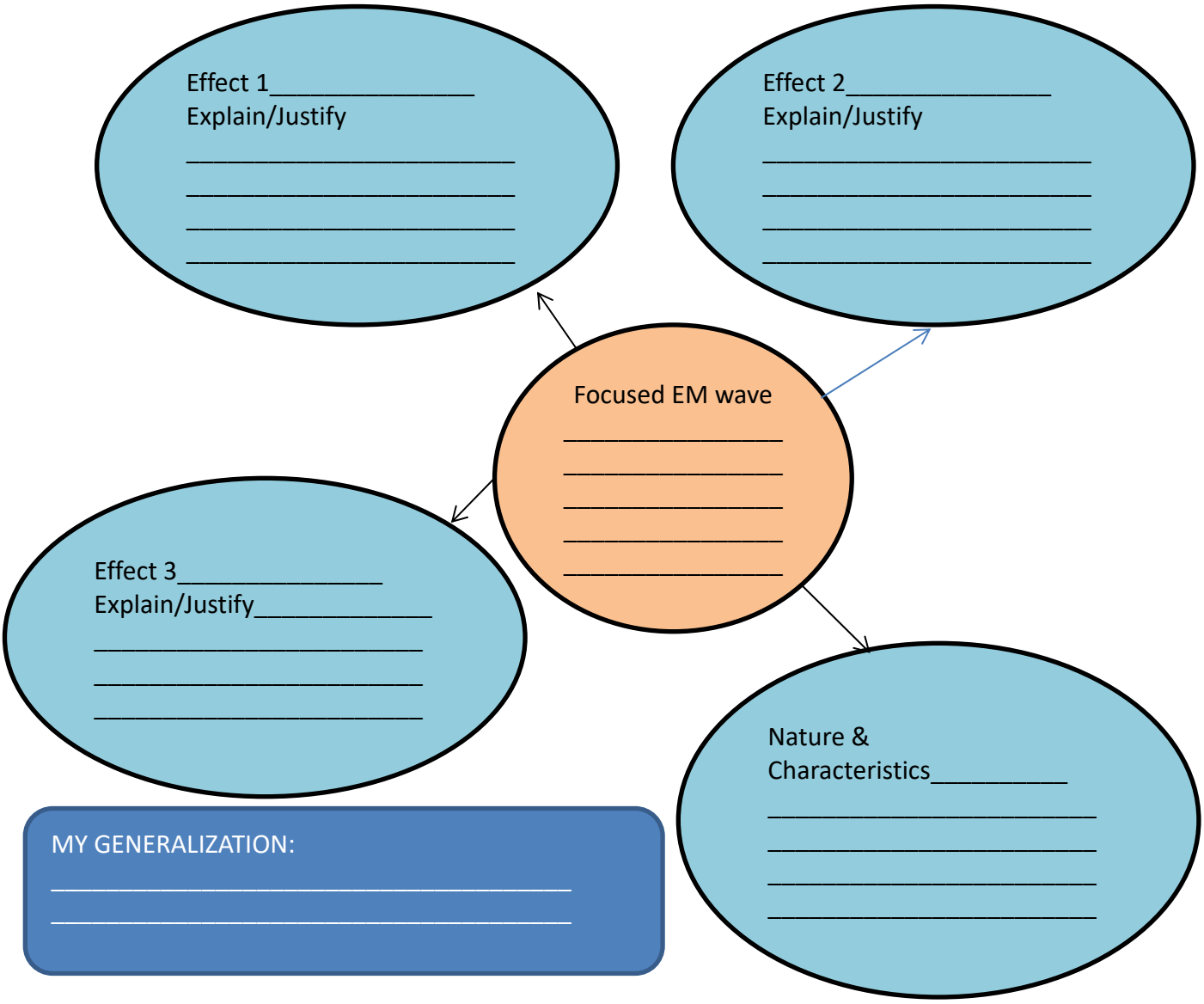
ACTIVITY NO. 15: ENJOY THE SUN----SAFELY! *(***SCAFFOLD 1:** *Directed Writing-Tree Strategy)*

Read the two articles on some effects of ultraviolet rays from the sun to living things by following the links provided.

1. Cosmetic Procedures: Sun Exposure and Skin Cancer
   http://www.webmd.com/beauty/sun/sun-exposure-skin-cancer

2. Ultraviolet radiation and the INTERSUN Programme
   http://www.who.int/uv/sun_protection/en/

Organize your notes and ideas on the article by completing the graphic organizer below. Refer to the process questions as you complete the organizer.



Now write your paragraph based on the graphic organizer that you have completed.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

_____
_____

Process Questions:

1. What specific dangers to the skin may be brought about by the exposure to the sun?
2. What type of radiation is responsible for this skin damage?
3. *How do you protect yourself from such damages?*

What did you observe in doing the activity? Are all electromagnetic waves harmful? Continue you exploration on practical application of the different forms of electromagnetic waves and its effects on living things and the environment by doing the next activity.

ACTIVITY NO.16: RAINBOW EXPERIMENT

Go over the activity found on the link: http://www.curriculumbits.com/prodimages/details/physics/rainbow.html

After finding out the characteristics and properties of light, create a one page drawing of a rainbow showing its effects and importance on living things and environment. You can use other resources to come up with a good output in this activity. Use the Web 2.0 application- http://blabberize.com/ to express your ideas of the given task. Submit your work to your online teacher. Your online teacher will give feedback on your work.

Process Questions:

1. How are the colors of the rainbow arranged?
2. How do these different colors undergo dispersion or other processes?
3. Why can we not see all the colors of the rainbow all the time?
4. What are the effects of rainbow dispersion on living things and environment?
5. In the absence of visible light, are we capable of appreciating and enjoying the things around us through the presence of colors?
6. *Are all electromagnetic waves harmful?*

Try to do the next activity to discover more your understanding on the different effects of electromagnetic waves.

ACTIVITY NO. 17: NOTE-TAKING FROM YOUTUBE.

Open the link: https://www.youtube.com/watch?v=cfXzwh3KadE.
The video talks about the uses or application of the different electromagnetic spectrum. It will help you more appreciate the different radiations through their application.

After watching the video, write the things you have learned, organize your thoughts and fill in the **POW + tree activity** below.

Strategy		Activity
 ick an idea or opinion. *(Formulate an opinion and state that opinion clearly)*		
 rganize and generate notes and ideas for each part of the TREE. *(Organize notes by completing a graphic organizer)*		
	**Topic Sentence** *(Formulate a topic sentence expressing an opinion)*	
	Reason *(Give at least three reasons to support the topic sentence)*	
	Explanation *(Explain your reasons)*	

	Ending *(Formulate a statement to summarize the topic sentence)*	
 rite and say more. *(Write a complete paragraph. Follow the plan developed using the TREE strategy)*		

Process Questions:

1. Why do electromagnetic waves have varying effects on living organisms and the environment?
2. What are the things to consider when somebody will be exposed to the different forms of electromagnetic radiation?
3. *Are all electromagnetic waves harmful? When do electromagnetic waves become harmful? Support your answer by citing important evidences.*

Based on the activity, can you say that we have to be threatened to all forms of electromagnetic waves? What are the things to consider in the exposure to the different forms of electromagnetic waves? Are the exposures to the different forms of electromagnetic waves harmful? You will perform the next activity to see some important applications of electromagnetic radiation around us.

ACTIVITY NO.18: GPS: A TRACKING DEVICE

Read the article in the link: http://www.ocregister.com/articles/school-288730-students-program.html to find out more about GPRS and how this was used by a school as part of their school system.

Process Questions:

1. What does GPS stand for?
2. How does a GPS function?
3. Why does the school use this for their students? How does this device help the teachers and school heads?
4. *Are all forms of electromagnetic waves harmful?*

After answering the given questions, you are to fill in the given *Sum It Up worksheet*

Sum It Up

NAME DATE

TITLE of READING SELECTION

1. Read the selection and underline the key words and main ideas. Write these in the blank area below where it says "Main Idea Words."

2. At the bottom of this sheet, write a one-sentence summary of the article, using as many main idea words as you can. Imagine you only have $2.00, and each word you use will cost you 10 cents. See if you can "sum it up" in twenty words!

Main Idea Words:

"Sum It Up" for $2.00 _____ _____ _____
_____ _____ _____ _____ _____
_____ _____ _____ _____ _____
_____ _____ _____ _____ _____
_____ _____ Adapted from Pat Widdowson Surry County (NC) Schools

Good job! You have completed the Sum It Up activity. At this point, go over the given articles. Find out what are common things among them and be able to answer the given questions after.

You have completed the different activities that exposed you to some practical applications of the different forms of electromagnetic waves and its effects on living things and the environment. It is time for you to write your thoughts on this matter to determine if you have indeed learned the varying effects of the different forms of electromagnetic radiation.

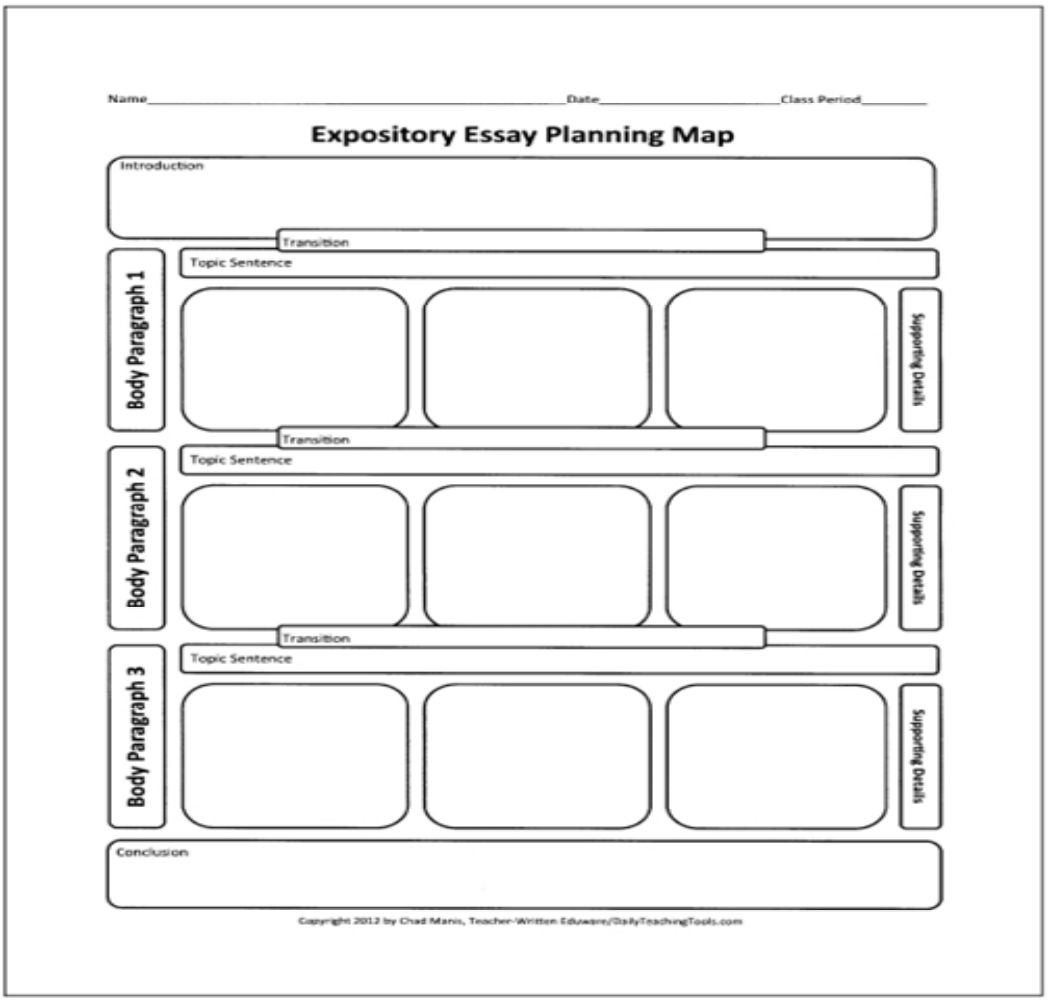
ACTIVITY NO.19: ESSAY WRITING: OH MY EM RADIATION!

You are going to make an essay that will contain your understanding on the following important questions:

- What are some practical applications of the different regions of the Electromagnetic Waves?
- What are the effects of electromagnetic radiation on living things and the environment?
- How safe are electromagnetic waves?

Use the Expository Essay Planning Map to organize your thoughts. You are going to make an essay not less than 300 words that contain the answers to the guide questions above. Your work will be evaluated using the essay rubric below:

OH MY EM RADIATION!



Name_____ Date_____ Class Period_____

Expository Essay Planning Map

Introduction

Transition

Topic Sentence

Body Paragraph 1

Supporting Details

Transition

Topic Sentence

Body Paragraph 2

Supporting Details

Transition

Topic Sentence

Body Paragraph 3

Supporting Details

Conclusion

Now write your essay (not more than 300 words) on the activity sheet below:

ESSAY WRITING RUBRIC:

CRITERIA	Outstanding 4	Satisfactory 3	Developing 2	Beginning 1	RATING
Content	Presents comprehensive scientific reasoning with detailed elaboration of the pros and cons.	Presents a good number of scientific reasons with sufficient elaboration of pros and cons.	Presents insufficient and inconsistent scientific evidences in some parts with little elaboration of pros and cons	No scientific reasoning was presented.	
Organization	Order of ideas is apparent and has an interesting progression.	Order of ideas is apparent. Sufficient details are geared to the central idea.	Order of ideas is confusing in some parts Some details are not specific to one central idea.	Order of ideas is not present. No supporting details were given	
Justification	Evidences gathered from the data and relevant and updated information are presented clearly and concisely making the work reasonable and compelling. highly convincing	Evidences gathered from the data and relevant information are presented clearly and concisely making the work reasonable	Few evidences are presented and with very few references to the data; some information is not presented clearly making the work unconvincing in certain parts	Almost no evidences are presented and made no references to the data; many important information is presented in a confusing way. is not presented clearly making the work unconvincing	

Submit your output to your online teacher.

You are done with the four activities on the different effects of electromagnetic spectrum around us. Your essay serves as the learnings you got from the varied activities given to you for better understanding of the topic.

End of FIRM UP:
In this section, the discussion was about the electromagnetic waves (EM waves), electromagnetic spectrum, examples of practical applications of the different regions of EM waves and explains the effects of EM radiation on living things and the environment.

Also, go back to the previous section and compare your initial ideas with the discussion. How much of your initial ideas are found in the discussion? Which ideas are different and need revision? What new learning goal should you now try to achieve? Go back to your learning competencies and do self-monitoring of your accomplishment of the listed goals.

Now that you know the important ideas about this topic, let's go deeper by moving on to the next section.

DEEPEN

Your goal in this section is to take a closer look at some aspects of the electromagnetic spectrum. You will this time get to make a generalization on how safe are the electromagnetic waves. Your knowledge in the previous section will let you more develop appreciation on the importance of these electromagnetic waves around us

This will further help you answer our essential question: ***How safe are electromagnetic waves?***

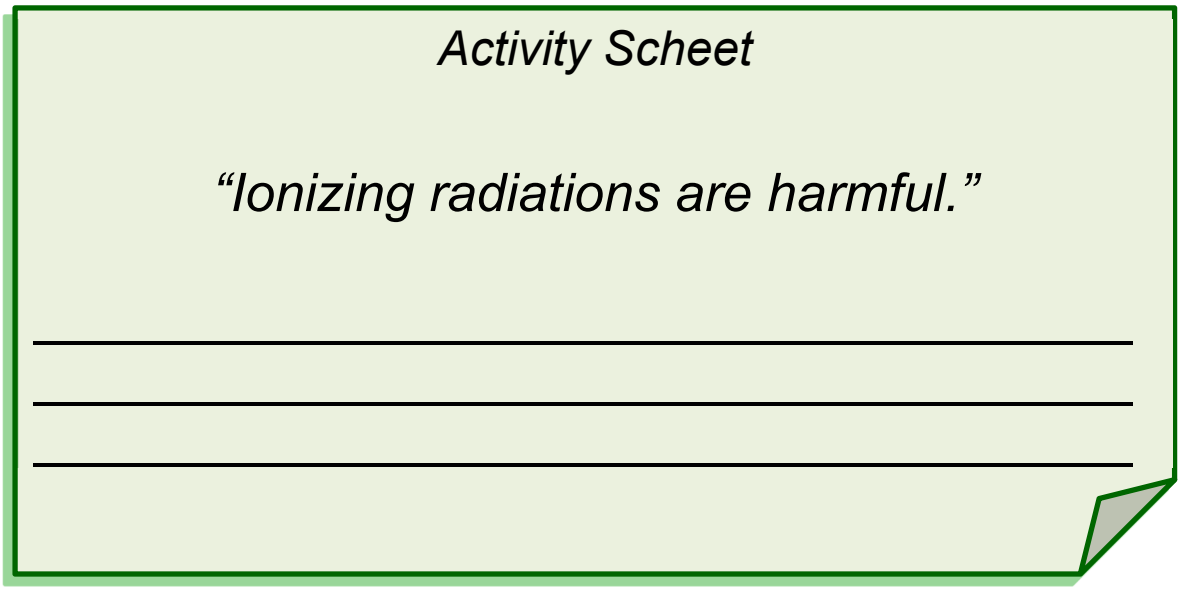
Let's start by doing our next activity

ACTIVITY NO. 20. MISCONCEPTION CHECK: RADIATION ALERT! (SCAFFOLD 2)

Comment on the statement,

"Ionizing radiations are harmful."

Express your view using the activity sheet below. Support your claims by reading the article found in the link below. Recall how you elaborated your point in the Tree Strategy to help you out in this task. http://agni.phys.iit.edu/~vpa/medical%20applications.htm



Process Questions:
1. What radiation is used in medical treatments?
2. Can all electromagnetic waves be used in treating illnesses?
3. How did you make your point in the activity reliable?
4. What are your considerations when you talk on the varying effects of electromagnetic waves?
5. When do electromagnetic waves become harmful?
6. *How safe are radiations?*

After doing the activity, are you certain of your answer to the question: How safe are the electromagnetic waves? Let us continue doing the next activity. The next activity will help you make your generalization on the essential question.

ACTIVITY NO. 21: RADIO WAVES IN TELECOMMUNICATION

The application of radio waves in telecommunication is one of the breakthroughs of the important use of electromagnetic waves around us. Try to click the different websites below in order for you to have a good grasps on the role of radio waves in telecommunication.

1. Webpage Reading on radio waves and safety: http://www.ideacellular.com/wps/wcm/connect/709ff7e8-0c41-43ec-8182-42aa43ebbc91/mobile+communication-radio+waves+and+safety+10th+sept+12+final.pdf?mod=ajperes

2. Video on radio waves on telecommunications: https://www.youtube.com/watch?v=al7sFP4C2TY

3. Simulation Activity on radio waves and electromagnetic fields:

   https://phet.colorado.edu/en/simulation/radio-waves

After doing the different activities on radio waves in telecommunications, you are going to prepare a 1-minute oral presentation through the use of Web 2.0 application- http://voki.com/ on how safe are radio waves? Submit your work to you online teacher. You are going to choose an avatar from http://voki.com/ to deliver your message. You will be evaluated using the scoring rubric below:

CRITERIA: JUSTIFICATION

4 points-Evidences gathered from the data and relevant and updated information are presented clearly and concisely making the work reasonable and compelling. highly convincing

3 points- Evidences gathered from the data and relevant information are presented clearly and concisely making the work reasonable

2 points- Few evidences are presented and with very few references to the data; some information is not presented clearly making the work unconvincing in certain parts

1 point- Almost no evidences are presented and made no references to the data; many important information is presented in a confusing way. is not presented clearly making the work unconvincing

Process Questions:

1. How safe are radio waves?
2. When does radio wave become harmful?
3. *Are all electromagnetic waves harmful? Explain.*

Based on the activity, can you say that we have to be threatened by the presence of radio waves around us? What are the things to be considered in dealing with electromagnetic radiations? The next activity

will also give you an idea on the use of electromagnetic waves around us.

ACTIVITY NO. 23: OUTLINING THE EFFECTS OF RADIATION

Instruction: Use the outline tool below to summarize the effects of radiation. Develop your answers based on the provided articles. Use the process questions for each article as your guide in elaborating your point.

Article 1: How Radiation Threatens Health
http://www.scientificamerican.com/article/how-radiation-threatens-health/

1) What type of electromagnetic wave is cited in the article?
2) What harm does this type of EM wave bring?
3) Will exposure to this type of EM wave certainly make you ill? Why?

Article 2: Cellphones and Cancer Risk
http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones

1) Describe the level of harmfulness of the type of radiation cited in the article based on its location in the electromagnetic spectrum.
2) In the context of radiation risk, what can you recommend to make the use of cellphones safer?

Article 3: Effects of Sun Exposure to Skin
http://www.webmd.com/beauty/sun/sun-exposure-skin-cancer

1) What specific dangers to the skin may be brought about by the exposure to the sun?
2) What type of radiation is responsible for this skin damage?
3) How do you protect yourself from such damages?

You are going to put together your answers to the essential questions that we asked for each article.

	Article #1:	Article #2:	Article #3
ESSENTIAL QUESTIONS:	How Radiation Threatens Health	Effects of Sun Exposure to Skin	Article #3: Electromagnetic Fields and Public Health: Microwave ovens

How safe are electromagnetic waves?	The effects of the electromagnetic waves are…..	The effects of the electromagnetic waves are…..	The effects of the electromagnetic waves are…..

The varying effects of the electromagnetic waves are…..

_____
_____
_____
_____

Supporting reasons and examples from the above articles:

_____
_____
_____
_____

How safe are electromagnetic waves?

_____
_____
_____
_____

PROCESS QUESTIONS:

1. Look at your answers to the essential questions in the above table. What do all the answers have in common?
2. Are all the strategies the same? How do the answers differ? What are the different effects of the electromagnetic waves to humans and the environment?
3. How safe are the electromagnetic waves?

What did you notice to your answers to the question: How safe are the electromagnetic waves? Try to recall your answers to these questions in the entire duration of this module and assess if you have changes to your answers. Were you able to have concrete, specific and certain answers in this activity? Let us check these understandings by making

your own generalization on how safe are the electromagnetic waves in the next activity.

ACTIVITY NO. 24: MY OWN GENERALIZATION ON ELECTROMAGNETIC RADIATIONS

Let us verify if you have a good grasp of your answers to the essential question: *How safe are electromagnetic waves?* You are going to find three situations in any form or resources that will show the varying effects of electromagnetic radiations to living things and the environment. The situation can be an article, a discussion in the net, drawing, cartoons, comic strip and the likes. You are going to put you answers in the activity sheet below:

MY OWN GENERALIZATION ON ELECTROMAGNETIC RADIATIONS			
	Situation #1:	**Situation #2:**	**Situation #3**
ESSENTIAL QUESTIONS: How safe are electromagnetic waves?	*Write the situation here* The effects of the electromagnetic waves are…..	*Write the situation here* The effects of the electromagnetic waves are…..	*Write the situation here* The effects of the electromagnetic waves are…..

Answer the guide questions below:

The varying effects of the electromagnetic waves are…..

_____
_____
_____
_____

Supporting reasons and examples from the above articles:

_____
_____
_____
_____

How safe are electromagnetic waves?

_____
_____
_____
_____

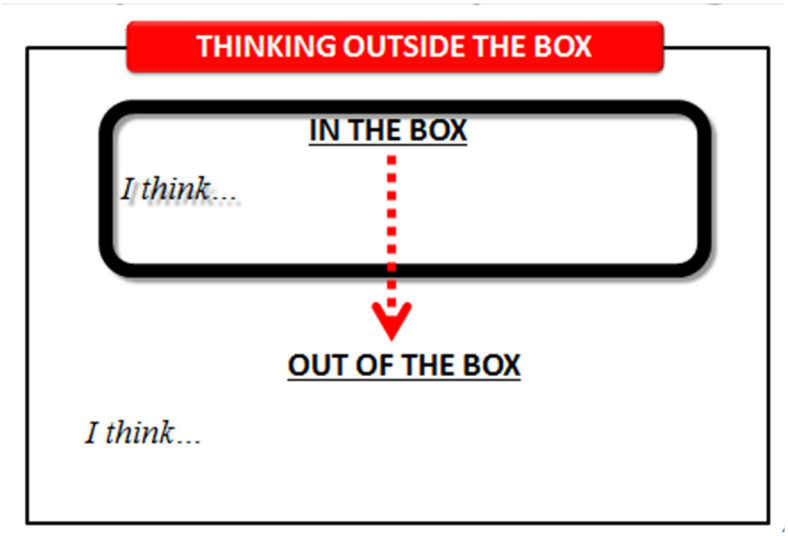
Submit your answers to your online teacher. Your teacher will give feedback on this work.

Are you certain of your ideas on how safe are the electromagnetic waves? What factors help you to come up with a good generalization on the essential question? Let us go back to your answers on the beginning of this module so that you will see the changes in your answers and give the correct explanation to your answers.

ACTIVITY NO 25. REVIEW-THINKING OUT OF THE BOX ACTIVITY

Go back to your answers at the start of this module on the activity-Thinking out of the box:

How safe are electromagnetic waves?



You also have answers in this activity sheet where you wrote the similarities and differences of your answers to other learners on line:

How safe are electromagnetic waves?	
SIMILARITIES	DIFFERENCES
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

If you are going to make changes to the answers on this activity what will it be and why? Complete the table below:

ACCEPTABLE ANSWERS	
Statements	*Explanation*
1.	1.
2.	2.
3.	3.
MISCONCEPTIONS	
4.	4.
5.	5.
6.	6.

What did you notice to your answers to this activity? Do you have changes on your initial ideas on how safe are electromagnetic waves? Were you able to correct your misconceptions? Share your generalization by making a blog so that other members in the online community will be enlightened on this matter.

ACTIVITY NO 26: WRITE YOUR OWN BLOG!

Make a blog on what you found out on this module by answering the essential question: How safe are the electromagnetic waves? Give examples and justification in your answers. Publish, share your work and collaborate to other members on line using the web 2.0 application - https://www.blogger.com/

Process Question:

1. Are you confident to your answers to the essential question: How safe are the electromagnetic waves?
2. Were you able to collaborate with other members on line with regard to the answers to this guide question?

End of DEEPEN:
In this section, you investigated further the different scenarios and situation in order for you to find the answer to the question: How safe are electromagnetic waves?

What new realizations do you have about the topic? What new connections have you made for yourself? What helped you make these connections?

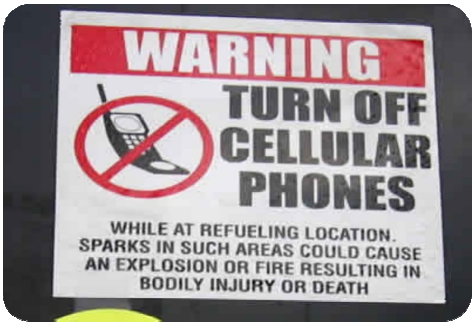
Now that you have a deeper understanding of the topic, you are ready to do the tasks in the next section.

TRANSFER

Your goal in this section is apply your learning to real life situations. You will be given a practical task which will demonstrate your understanding.

ACTIVITY NO.27: DILEMMA: TO SWITCH OR NOT TO SWITCH? (SCAFFOLD 3)

In all gas stations, you will see this signage:



Your task in this activity is to visit the website www.edjudo.com and select what you think is the best Web 2.0 application that will allow you to show the effects of radio waves in order for you to decide whether the signage has basis or not. You will submit your output to your teacher. Your work will be evaluated according to content, organization, justification and impact.

Remember all the skills that you learned in the previous activities on electromagnetic waves.

Process Questions:

1. What have you found out about radio waves?
2. What do you think is the basis for the signage?
3. If you are given the chance to correct or enhance it, what would you suggest?
4. Are radio waves safe? Justify your answer.
5. Which web 2.0 application did you choose? Why?
6. Will using a web 2.0 application to convey information be effective?

Were you able to make an informed decision in the situation given above? Are you certain on the reasons of your answers? You are about to do the performance task of this module but before doing that let us check if you were able to have a good grasps of the competencies on this lesson in which you will use in the Performance Task.

ACTIVITY NO. 28: AM I READY?

Instruction: Complete the Competency Check table below to assess your readiness to do the performance task.

SELF-EVALUATION OF PERFORMING COMPETENCIES			
SKILLS	**I can do this by myself and in different ways**	**I can do this by myself**	**I still need help to do this**
Explain how electromagnetic waves are produced			
Compare the relative wavelengths of different forms of electromagnetic waves			
Cite examples of practical applications of the different regions of EM waves, such as the use of radio waves in telecommunications			
Describe the regions of the electromagnetic spectrum, their properties and uses			
Explain the effects of EM radiation on living things and the environment			

Process Questions:

1. Which competencies do you feel confident about?

2. In which competencies do you still need assistance?
3. What do you plan to do in order to better prepare yourself for the performance task?

Are your ready for your performance task on this module. Check and perform the performance task in the next activity.

ACTIVITY NO. 29: PERFORMANCE TASKS (DIFFERENTIATED GRASP)

The purpose of this performance task is for you to conduct an information drive about the effects of electromagnetic wave exposure to help people make informed decisions. You are going to do this through Differentiated GRASP so that you will have choices on the desired product that you will make for this module. Read the Differentiate GRASP below:

OPTION #1: **JOURNALIST**

You are working for a broadcasting network and the evening news program will air in 15 minutes. One of the segments of the show is a trivia on different topics that are relevant to the times. It so happens that the current news is about the rise of several high profile individuals suffering from cancer. Hence, you were asked to come-up with a presentation on the different effects of electromagnetic exposure as this has been cited by a lot of individuals as the key carcinogenic factor. As a journalist you can:

- ❑ Write a script for the news show explaining the effects of electromagnetic exposure,
- ❑ Select a Web 2.0 application that will deliver the message to as many individuals as possible, or
- ❑ Create an advertisement that will be aired in the broadcast that will show the effects of electromagnetic exposure.

OPTION #2: **DERMATOLOGIST**

The Philippine Skin Cancer Foundation has been alarmed with rapid growth of skin cancer due to too much exposure to sunlight. Data of Philippine Skin Cancer have shown that people living in the remote barangay are more vulnerable of the disease due to lack of knowledge. As a dermatologist, you are invited by PSCF to reach out and give

information drive in the form of multimedia presentation to a remote nearby barangay. (prepare materials or information kit)

- ❑ Make a multimedia presentation showing the harmful effects of sun rays.
- ❑ Create a billboard ad that relates sun rays and skin cancer.
- ❑ Conduct a symposium about skin cancer prevention.

OPTION #3: **PHYSICIST**

A rumor is spreading fast across the country that microwave oven use is linked to the development of intestinal cancer. As a renowned Physicist of the country, you are invited by media men to clarify the matter. The public expects your point to be presented in any medium they are commonly exposed to. You may:

- ❑ write a column in a newspaper explaining in details whether the public needs to be scared or not.
- ❑ appear in a live interview in a morning TV show telling the people the facts of the matter. (Web 2.0)
- ❑ write a script for a scientific cartoon showing the details of the radiation for animation.

Your output will be evaluated according to content, organization, justification and impact.

DIFFERENTIATED GRASP RUBRIC

CRITERIA	Outstanding 4	Satisfactory 3	Developing 2	Beginning 1	RATING
Content	Presents comprehensive scientific reasoning with detailed elaboration of the pros and cons.	Presents a good number of scientific reasons with sufficient elaboration of pros and cons.	Presents insufficient and inconsistent scientific evidences in some parts with little elaboration of pros and cons	No scientific reasoning was presented.	
Organization	Order of ideas is apparent and has an	Order of ideas is apparent. Sufficient	Order of ideas is confusing in some parts Some details	Order of ideas is not present. No supporting	

	interesting progression.	details are geared to the central idea.	are not specific to one central idea.	details were given	
Justification	Evidences gathered from the data and relevant and updated information are presented clearly and concisely making the work reasonable and compelling. highly convincing	Evidences gathered from the data and relevant information are presented clearly and concisely making the work reasonable	Few evidences are presented and with very few references to the data; some information is not presented clearly making the work unconvincing in certain parts	Almost no evidences are presented and made no references to the data; many important information is presented in a confusing way. is not presented clearly making the work unconvincing	
Impact	Establishes and communicates in an engaging and practical way the importance and relevance of the issue on personal and community levels	Establishes and communicates the importance and relevance of the issue on personal and community levels. The importance and relevance are clear.	The importance and relevance to the personal and community level are not clearly established and communicated.	Does not relate the selected issue at all to the youth or their community	
				OVERALL RATING	

Before you submit your output, evaluate your output using the checklist in the next activity.

ACTIVITY NO. 32: IT IS GOOD!

Instruction: Evaluate your project's readiness by answering the checklist.

Project Evaluation

Revision Checklist	Yes	No
1. Does your material have a clear and concise idea?		
2. Does your material convey a specific purpose? Have you to the made this purpose clear to the target audience?		
3. Is there a clear plan and sense of organization to your information material? Does each information develop logically from the previous one?		
4. Are there clear transitions from one information to the next?		
5. Are the given pieces of information based on scientific evidences? Are there sufficient information to make the material compelling and highly convincing?		
6. Do the pieces of information create interest in the topic and make your audience realize the relevance of the given information?		
7. Is your material practical and relevant to the community?		

Are you confident of your output to the performance task? If you are ready, submit your output to your online teacher.

CLOSURE: Self-Assessment

Write a reflection in your synthesis journal about your experiences in the entire lesson. You may choose to answer one, some, or all of these guide questions:

- ✓ *What have you learned about the entire lesson? Is it challenging to see the world you live in?*
- ✓ *What would our life be if there are no electromagnetic waves?*
- ✓ *Do you have to be afraid of the different forms of electromagnetic radiations?*
- ✓ *What other task would you like to work on in the future that could be beneficial to living things and the environment with*

regard to the different regions of the electromagnetic spectrum?

End of TRANSFER:

In this section, your task was to make a presentation on the different effects of electromagnetic exposure. You had been given three situations and nine options as your output.

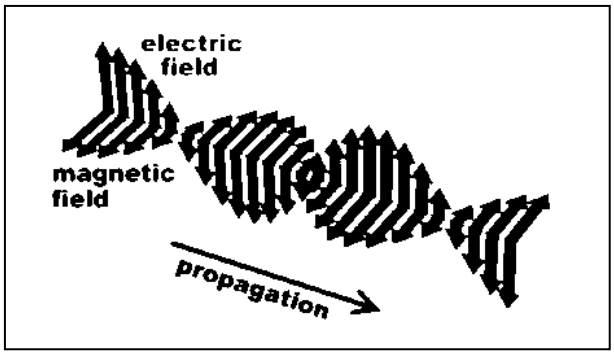
How did you find the performance task? How did the task help you see the real world use of the topic?

You have completed this lesson. Before you go to the next lesson, you have to answer the following post-assessment

POST-ASSESSMENT

It's now time to evaluate your learning. Click on the letter of the answer that you think best answers the question. Your score will only appear after you answer all items. If you do well, you may move on to the next module. If your score is not at the expected level, you have to go back and take the module again.

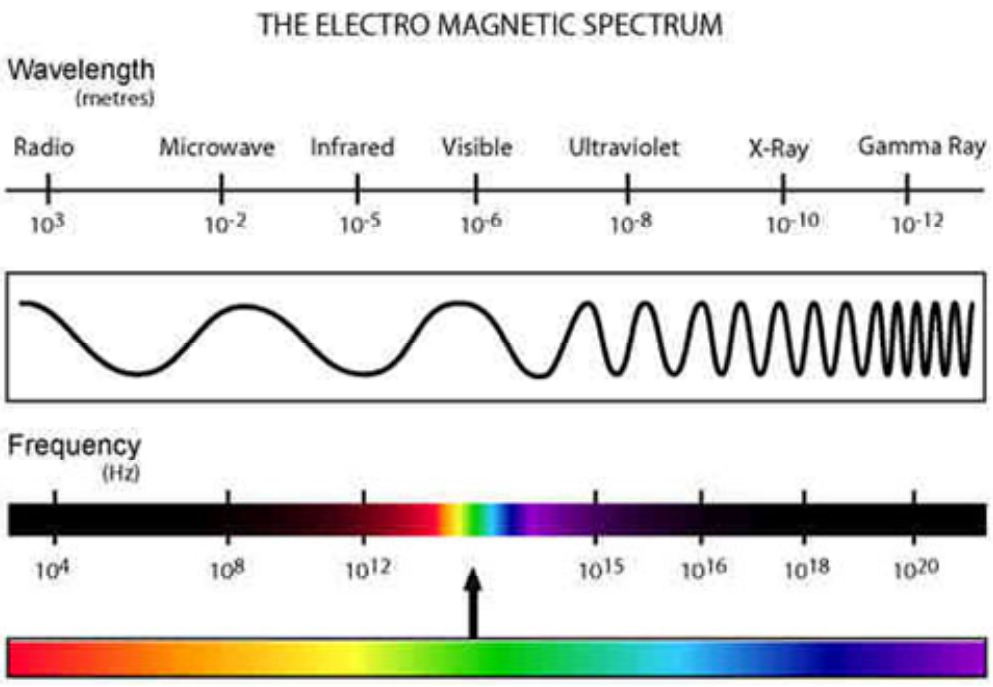
1. The diagram below shows position of the antenna with respect to the direction of the electric field of a radio carrier wave.



Radio waves are part of the electromagnetic waves. Electromagnetic waves are created by accelerating charges; moving charges back and forth will produce oscillating electric and magnetic fields, and this travel at the speed of light. Based from the diagram above, which of the following statements describe radio waves?

A. Radio waves are longitudinal waves in which the displacement of the medium is in the same direction as, or the opposite direction to, the direction of travel of the wave.
B. Radio waves are mechanical waves in which propagate through a material medium (solid, liquid, or gas) at a wave speed which depends on the elastic and inertial properties of that medium.
C. Radio waves are transverse waves that are moving waves that consist of oscillations occurring perpendicular (or right angled) to the direction of energy transfer.
D. Radio waves are standing waves that are produced whenever two waves of identical frequency interfere with one another while traveling opposite directions along the same medium.

2. The diagram below shows an electromagnetic spectrum:



Which of the relationships will describe the wavelength, frequency and energy in the electromagnetic spectrum?

A. Frequency is directly proportional to wavelength and inversely proportional to energy.
B. Frequency is directly proportional to energy and inversely proportional to wavelength.
C. Wavelength is directly proportional to frequency and energy.
D. Wavelength is inversely proportional to frequency and energy.

3. Refer to the statement below:
*The seven (7) electromagnetic waves are arranged according to increasing wavelength and named as **ABCDEFG** respectively.*

Which description is true about electromagnetic wave A?

A. It has the longest wavelength like radio wave.
B. It has the shortest wavelength like radio wave.
C. It has the longest wavelength like gamma wave.
D. It has the shortest wavelength like gamma wave.

4. Refer to the table below.

Category	Uses
gamma rays	used to kill the bacteria in marsh-mallows
X-rays	used to image bone structures
ultraviolet light	bees can see into the ultraviolet because flowers stand out more clearly at this frequency
visible light	used by humans to observe the world
infrared	night vision, heat sensors, laser metal cutting
microwave	microwave ovens, radar
radio waves	radio, television broadcasts

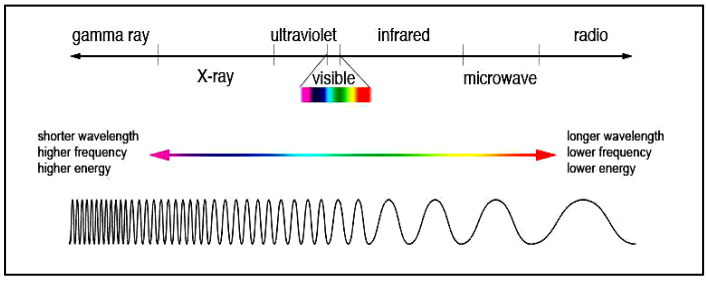
Which of the following descriptions is true about the use of radio wave?

A. Radio wave is important in TV broadcasting.
B. Radio wave is important in sanitation.
C. Radio wave is important in metal works.
D. Radio wave is important in cooking.

5. Ultraviolet radiation is a part of the components of the electromagnetic spectrum. It has its good and bad effects to living things. Which one is a good effect?

A. High doses can cause temporary clouding of the cornea
B. UV light treatment helps repigmentation
C. UV light can have deleterious effects on melanin
D. A positive effect of too much UV exposure is the induced production of vitamin E in the skin

6. Refer to the illustration below.



Which of the following description/s is/are NOT TRUE about the Infrared radiation as shown in the illustration?

I. Its energy is lower than the visible light you see.
II. Its energy is greater than the radio wave.
III. Its energy is the same with the gamma ray.
IV. Its energy is almost close to the energy of the X-ray.

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

7. One of the favorite places people love to go is the beach. Either the reason is for family event, special occasions or simply for relaxation. Often times, we see a lot of beach lovers put on their sunblock creams before going on swimming. Which below BEST explains this?
A. To prevent their skin from being irritated from the seawater
B. To make their skin look glowing and more healthy.
C. To prevent the ultraviolet radiation to reach the skin.
D. To have a cooling effect on the skin after swimming in the beach.

8. What does the picture below tell you about the application of microwave radiation?

A. The microwave is used in wireless communication.
B. The microwave is used in broadcasting.
C. The microwave is used in medical treatments.
D. The microwave is used in sanitation process.

9. Refer to the given table below:

Uses and Effects of EM Waves

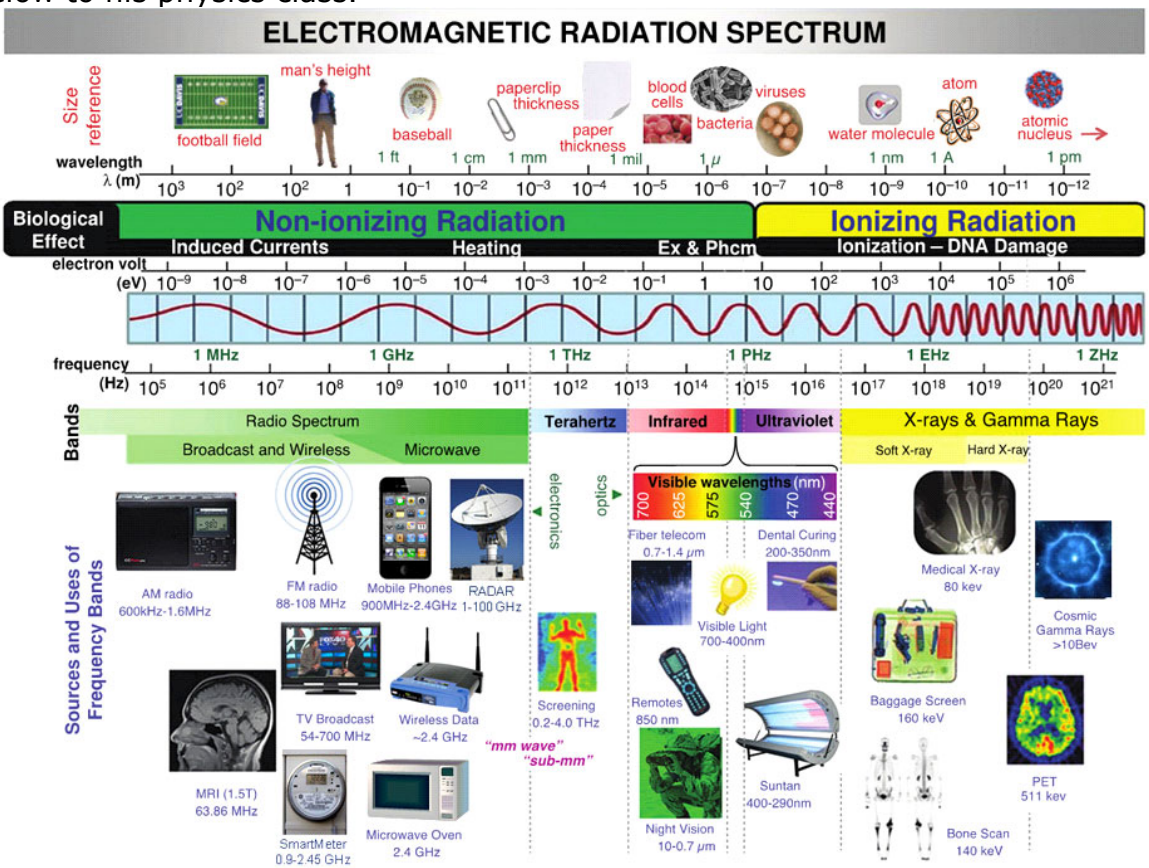
Region of the spectrum	Method of generation	Uses and Effects
Low frequency waves	Oscillation in electric circuits	This group carries weather and some aviation broadcasting.
Broadcast radio band	Oscillation in electric circuits	These bands of radio frequencies have been set aside for the regular AM broadcast band.
High frequency radio waves	Oscillation in electric circuits	In this region are many kinds of broadcasting amateur radio, TV, FM radio.
Microwaves	Oscillation in electric circuits	Used for cooking Are also used for telecommunication, such as transmitting long distance telephone messages. Also useful in radar Can be harmful to humans because they have been known to damage/kill healthy cells. Can cause interference in pacemaker which could cause it to operate erratically
Infrared	Vibration of atoms within molecules	Infrared photography which is commonly employed in land use surveys. -Also known as radiant energy emitted by very hot bodies. hot bodies-heat lamps are used to warm tired, aching muscles and to heal wounds.
Visible light	Motion of electrons in atoms	The portion our eyes are sensitive to.
Ultraviolet	Motion of electrons in atoms	Is used to determine false or counterfeit documents. Are used to help keep operating rooms in hospitals sterile. Exposure to it stimulates the production of Vitamin D in the skin. Is responsible for sunburn. Overexposure can cause skin cancer

X-ray	Rapid reactions, deceleration of charged particles	Is used in medicine. Detects flaws in metals and plastics. Can kill healthy body cells.
Gamma rays	Nuclear reactions radioactive disintegration	

Based from the table below, which of the following statement is NOT true on the different regions of the electromagnetic spectrum, their properties, uses and effects?

A. Infrared radiations are also known as radiant energy and are used to warm tired, aching muscles and to heal wounds.
B. Visible Light is generated through vibration of molecules.
C. Microwaves are generated through oscillation in electric circuit and are used in cooking.
D. X-rays are low frequency waves that cause rapid reactions, deceleration of charged particles.

10. Mr. Alberto de La Cruz showed the electromagnetic radiation spectrum below to his physics class.



He asked Anna, Diana, Maida and Rowena to give a conclusion on the presence of electromagnetic radiations around us based from the given table. Which among the four students give a correct conclusion?

Anna: *"Different forms of electromagnetic radiations have different frequencies and thus, have different uses and effects to living things and environment".*

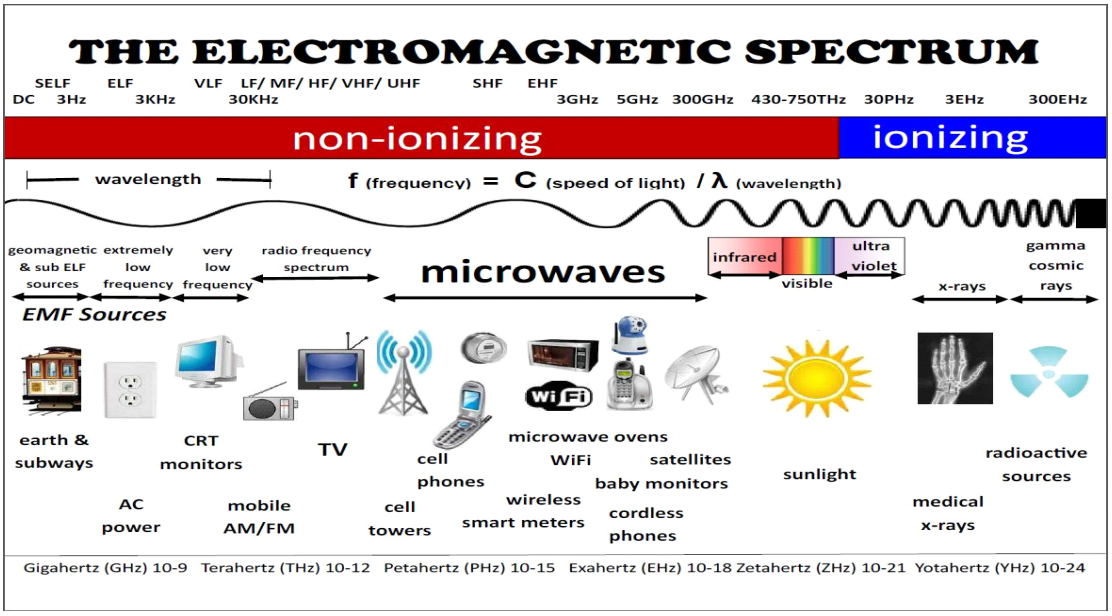
Diana: *"Electromagnetic radiations are emitted by many natural and man-made sources and play an important part in our lives like we are warmed by the electromagnetic emissions of the sun and we see using the part of the electromagnetic spectrum that our eyes detect as visible light"*

Maida: *"Diagnostic X ray machine, television sets, computers, microwave oven, radar devices, laser devices, mobile phones, etc., generates radiations of different frequencies which exist in our environment".*

Rowena:*"Different forms of electromagnetic radiations have different sources and uses of frequency bands but have the same effects on living things and environment because they all travel at the speed of light in a vacuum".*

A. Anna and Maida
B. Diana and Rowena
C. Anna, Diana and Maida
D. Anna, Diana, Maida and Rowena

11. Mr. Pedro Cruz, presented the electromagnetic spectrum diagram below:



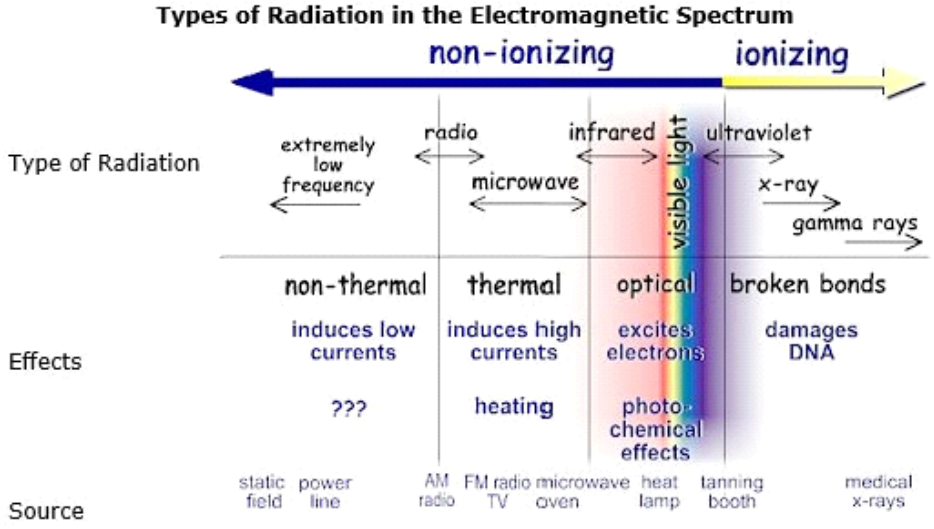
He asked his students to give an example of the sources that are arranged in a way that will pose an increasing risk to humans when exposed to the different sources of electromagnetic radiations at the same time duration and distance. Jean raises her hand and gives an answer to Sir Pedro. Observe the class conversations below:

Jean: "*mobile AM/FM* → *Wi-Fi* → *sunlight* → *radioactive source*"

Sir Pedro: *"Very Good. Can you explain to your classmates the reason for your answer?*

46. Which of the following statements could be Jean's possible answer to Sir Pedro's follow-up question?
    A. As energy decreases, frequency remains the same.
    B. As energy increases, frequency remains constant.
    C. As frequency increases so as the energy.
    D. As frequency increases, energy decreases.

12. Refer to the given picture below:



The diagram above shows the types, effects and sources of the different regions of electromagnetic spectrum. Based from the diagram above, which of the following statements will be your considerations when exposed to the different forms of electromagnetic radiations?

I. Short-term exposure to very high levels of electromagnetic fields can be harmful to health

II. Exposure to low level electromagnetic fields is harmful to human health.

III. The effects of electromagnetic radiations exposure are negligible because we cannot feel the electromagnetic radiations around us.

IV. Exposure to non-ionizing radiation can be more harmful than exposure to ionizing radiation because there are too many non-ionizing radiations around us

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

13. There are three ways that electromagnetic radiation can cause harm within to living bodies. Each effect is particular to a certain range of frequencies. Our main exposure to dangerous electromagnetic radiation is from direct sunlight.

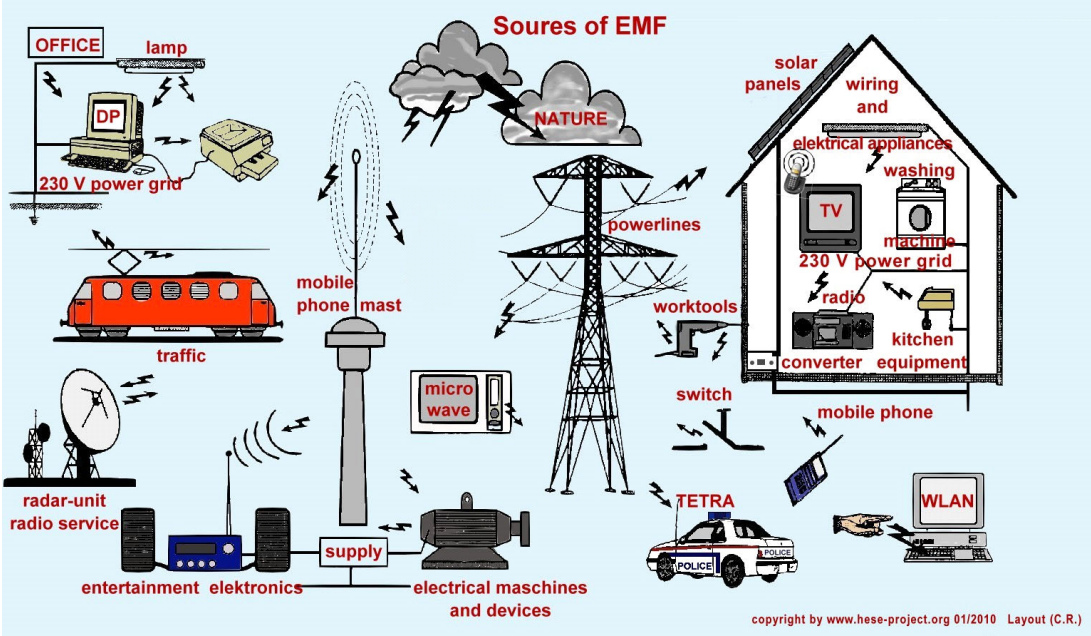
Study the table below:

Effect	Range	Effects	Disclaimer
Induced voltage gradients and/or electric currents	Low frequencies (0-3 KHz)	Magnetic fields might do weird things to our bodies.	Normal human technologies do not produce frequencies in this range, and, the Earth itself has a magnetic field.
Thermal effects Absorption causes heating	30 MHz - 300 GHz Microwaves	Absorption of energy causes heating, which if enough happens at once, can damage tissue.	Energy has to specifically and intentionally focused to have an effect.
Ionizing effects Molecules are damaged	Ultraviolet light, X-rays, gamma rays	Carcinogenic due to occasional DNA damage.	We are exposed to these from space and from the sun, but not from human technology.

Based from the table above, which of the following effects can be of greater worry when exposed to the different forms of electromagnetic radiation?

A. Magnetic fields might do weird things to our bodies.
B. Absorption of energy causes heating, which if enough happens at once, can damage tissue.
C. Carcinogenic due to occasional DNA damage.
D. Thermal Effect means that the absorption causes heating.

14. Some of the everyday human-generated sources of electromagnetic field (EMFs) to which we're exposed include the sources listed in the illustration below:



Based from the illustration, we cannot deny the fact that we are surrounded by electromagnetic radiations. Knowing that these radiations are part of our everyday undertaking, which of the following statements should NOT be a consideration when exposed to these different forms of electromagnetic radiations?

A. Shorter wavelength electromagnetic radiations like microwaves also weaken with distance, but the distances can be tremendous.
B. Electromagnetic Field exposure depends not just on strength of the field but also on proximity and duration of contact.
C. The effects of Electromagnetic Radiations are the same to the different forms of electromagnetic waves because they all travel at the same speed.
D. Ionizing radiation like gamma rays and X-rays, known with their short wavelengths for causing DNA mutations or cancer, is often thought of as the most harmful, because it can restructure molecules by knocking electrons off their nuclear orbits.

15. In your physics class, your teacher presented the diagram below so that you will be aware of the risks and hazards brought about by the presence of the different electromagnetic radiation around us.

DANGER ZONES

Here are measurements of EMF from common sources. Remember, EMF exposure depends not just on strength of the fields, but on proximity and duration of contact.

EMF in Milligauss

Source	Up to 4 Inches	At 3 Feet
Blender	50 to 220	0.3 to 3
Clothes washer	8 to 200	0.1 to 4
Coffee maker	6 to 29	0.1
Computer	4 to 20	2 to 5
Fluorescent lamp	400 to 4,000	0.1 to 5
Hair dryer	60 to 20,000	0.1 to 6
Microwave oven	100 to 500	1.0 to 25
Television	5 to 100	0.1 to 6
Vacuum cleaner	230 to 1300	3 to 40
Airplane	50 mG avg. in a 747	

If you are going to explain the diagram above to the people in the barangay, which of the following statements can be used so that the people will be aware of the risks and hazards brought about by the electromagnetic fields?

I. Distance from the source is a consideration when exposed to different forms of electromagnetic waves because electromagnetic radiation is greatest close to the source and decreases with distance from the source.
II. The strength of the electromagnetic field is a factor to consider when exposed to electromagnetic waves because the greater the strength of the electromagnetic field, the greater the energy involve.
III. Electromagnetic Field is measured in milligauss which means that the higher the value of the electromagnetic field, the higher the risks when exposed to this type of electromagnetic wave.

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

16. You are working for a broadcasting network and the evening news program will air in 15 minutes. One of the segments of the show is a trivia on different topics that are relevant to the times. It so happens that the current news is about the rise of several high profile individuals suffering from cancer. Hence, you were asked to come-up with a presentation on the different effects of

electromagnetic exposure as this has been cited by a lot of individuals as the key carcinogenic factor.

As a journalist, you are tasked to create an advertisement that will be aired in the broadcast that will show the health effects of electromagnetic exposure specifically in cancer concerns. Which of the following statements can be a possible consideration when you will make the script for the advertisement?

A. Exposure to cellphones can cause cancer because the electric and magnetic fields (EMF) present in cellphones are a form of non-ionizing radiation
B. The presence of power lines that emit electric fields and magnetic fields cause cancer.
C. Most subsequent studies have not shown that there is such an association between electromagnetic exposure and cancer, but scientists continue to investigate the possibility that one exists.
D. Exposure of different electromagnetic radiations in homes can cause cancer because there are a lot of electromagnetic radiation sources in our homes.

17. The Philippine Skin Cancer Foundation has been alarmed with rapid growth of skin cancer. Data of Philippine Skin Cancer have shown that people living in the remote barangay are more vulnerable of the disease due to lack of knowledge. As a dermatologist, you are invited by PSCF to reach out and give information drive on skin cancer prevention.

As a dermatologist, you are tasked to make a multimedia presentation showing the harmful effects of sun rays. Which of the following statements below CANNOT be used in your multimedia presentation?

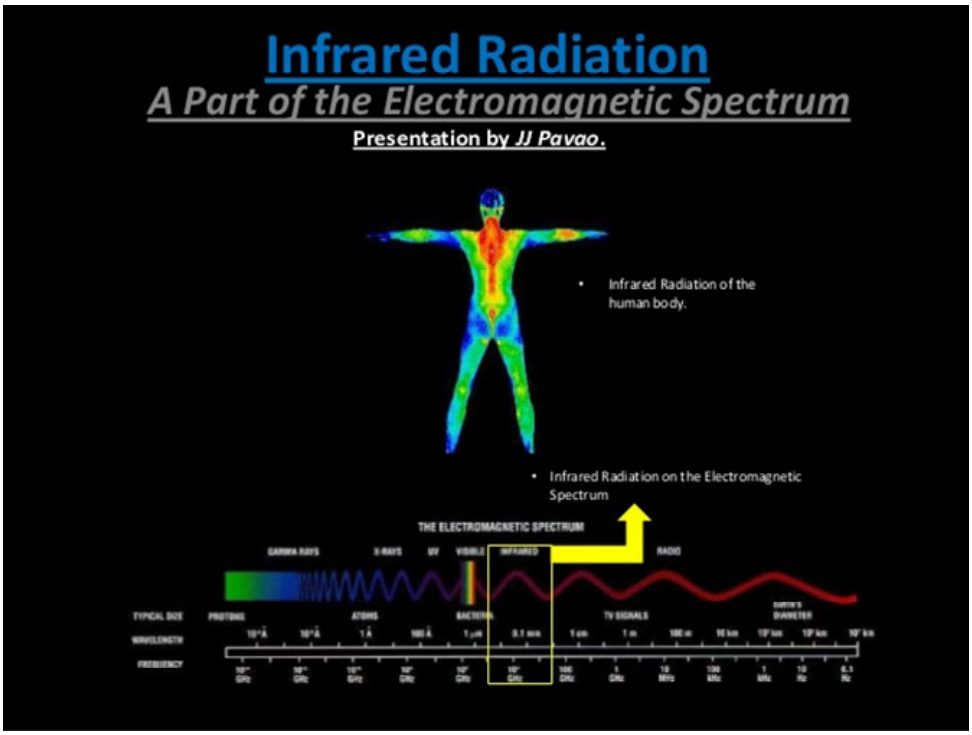
A. Ultraviolet Radiation levels are constant over the course of a day or even over the course of a year because ultraviolet rays are traveling at constant speed.
B. The amount of UV exposure a person gets depends on the strength of the rays, the length of time the skin is exposed, and whether the skin is protected with clothing or sunscreen.
C. Ultraviolet A (UVA) is the longer wave UV ray that causes lasting skin damage, skin aging, and can cause skin cancer.
D. Ultraviolet B (UVB) is the shorter wave UV ray that causes sunburns, skin damage, and can cause skin cancer.

18. A rumor is spreading fast across the country that microwave oven use is linked to the development of intestinal cancer. As a renowned Physicist of the country, you are invited by media men to clarify the matter. The public expects your point to be presented in any medium they are commonly exposed to.

    As a physicist, you are requested to write a script for a scientific cartoon showing the details of the radiation for animation. What important aspect on microwave should be part of your script?

    A. Metals get dangerously hot in microwaves.
    B. Food prepared from microwave oven can be a possible health hazard because microwave ovens make foods radioactive because nutrients are lost when heating foods
    C. Microwave ovens meeting the standards are not hazardous to health.
    D. Microwaves leak unsafe levels of electromagnetic radiation

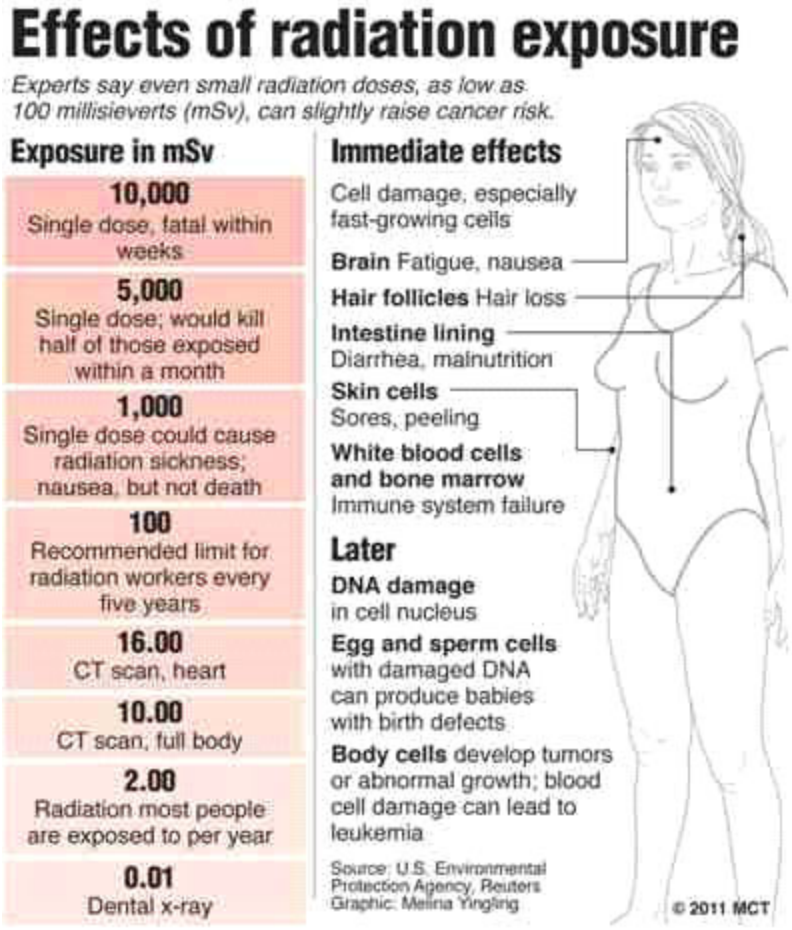
19. You want to investigate the advantages and disadvantages of the varying effects of infrared radiations around us. You believe that the presence of infrared radiations around us is important, thus, there is a need for the people to know more about infrared radiations. You make a multimedia presentation wherein you have this illustration in your first slide.



Which of the following uses and effects of infrared radiations below is NOT part of your presentation?

A. One of the environmental effects of infrared radiations is the greenhouse effect which is caused by gases such as water vapor in the atmosphere absorbing infrared radiation.
B. The dangers of infrared radiations are taken seriously because we are exposed to many infrared sources with high energy.
C. Prolonged exposure to high level of infrared radiations will result in burns and overheating.
D. Some pieces of Infrared technology are used for research and development work such as the infrared telescope.

20. You are studying the diagram on the effects of radiations below:



If you are going to conduct an information drive on the effects of radiations exposure, which of the following statements will be your consideration?

A. The effects of electromagnetic radiations exposure are dependent on the level, type and duration of exposure to the source.

B. The effects of electromagnetic radiations exposure are negligible because we cannot feel the electromagnetic radiations around us.
C. The effects of electromagnetic radiations exposure are only applicable to visible light because this is the only form of electromagnetic radiation that we can see.
D. The effects of electromagnetic radiations exposure are the same to all forms of electromagnetic waves because they travel at the same speed.

GLOSSARY OF TERMS USED IN THIS LESSON:

Electromagnetic Wave- is produced by the acceleration of an electric charge and propagated by the periodic variation of intensities of, usually, perpendicular electric and magnetic fields

Electromagnetic Spectrum -
the entire spectrum, considered as a continuum, of all kinds of electric, magnetic, and visible radiation, from gamma rays having a wavelength of 0.001 angstrom to long waves having a wavelength of more than 1 million km

Electromagnetic Radiation-
consisting of electromagnetic waves, including radio waves, infrared, visible light, ultraviolet, x-rays, and gamma rays

Frequency-the number of periods or
the number of cycles or completed alternations per unit time of a wave or oscillation

Wavelength- the distance, measured in the direction of propagation o f a
wave, between two successive points in the wave that arecharacterize d by the same phase of oscillation

Radio wave-
an electromagnetic wave having a wavelength between 1 millimeteran d 30,000 meters, or a frequency between 10 kilohertz and 300,000me gahertz

Microwave-an electromagnetic
wave of extremely high frequency, 1 GH

Infrared-
the part of the invisible spectrum that is contiguous to the red end of the visible spectrum and that comprises electromagnetic radiation of wavelengths from 800 nm to 1 mm

Visible light- electromagnetic
radiation to which the organs of sight react, ranging in wavelength from about 400 to 700 nm and propagated at a speed of 186,282mi./ sec (299,972 km/sec), considered variously as a wave,corpuscular, or quantum
phenomenon

X-ray- a form of electromagnetic radiation, similar to light but of shorter
wavelength and capable of penetrating solids and of ionizing gases

Gamma Rays-
a photon of penetrating electromagnetic radiation (gamma radiation) emitted from an atomic nucleus

REFERENCES AND WEBSITE LINKS USED IN THIS LESSON:

http://www.nytimes.com/2014/07/08/science/debate-continues-on-hazards-of-electromagnetic-waves.html
News article on The New York times that covered the topic on the Hazards of Electromagnetic Fields in Science Times 25 years that ago to see what has changed — and what has not.

https://www.youtube.com/watch?v=xZ6XUk7QLbU
Video about the electromagnetic waves and how these waves behave. This video will also give ideas about how the waves function

http://www.physicsclassroom.com/class/light/Lesson-2/The-Electromagnetic-and-Visible-Spectra
Webpage on the physics classroom that discusses the electromagnetic waves and visible spectra. This will give you an overview on how the electromagnetic waves behave in space.

http://www.phy.ntnu.edu.tw/ntnujava/index.php?topic=35.msg215#msg215
Web simulation on electromagnetic wave so that you will have visual representation on how electromagnetic waves are produced.

https://www.youtube.com/watch?v=A0un-_jBPPU
Electromagnetic spectrum song that will help you identify the different parts of the electromagnetic spectrum. The song will also give the different sources on the different forms of electromagnetic waves.

http://www.cyberphysics.co.uk/topics/light/emspect.htm
Article on the electromagnetic spectrum where you will know the characteristics, sources, uses and danger of the different forms of electromagnetic waves.

http://imagine.gsfc.nasa.gov/science/toolbox/emspectrum1.html

Webpage on NASA-Astronomer toolbox where the different components and examples of electromagnetic spectrum are discussed.

http://www.pbslearningmedia.org/resource/phy03.sci.phys.mfw.spectrum/tour-the-electromagnetic-spectrum/
Interactive activity from the NOVA Web site. The activity provides a self-guided tour of the electromagnetic spectrum, including examples of some of the most common uses of different types of waves:

http://earthguide.ucsd.edu/eoc/special_topics/teach/sp_climate_change/p_emspectrum_interactive.html
Simulation of electromagnetic spectrum interactive to investigate the relationship among frequency, wavelength and energy of the different regions of the electromagnetic spectrum.

http://www.bbc.co.uk/schools/gcsebitesize/science/21c_pre_2011/radiation/electromagneticradiationact.shtml
Websites on hands-on experience about electromagnetic radiation

http://www.youtube.com/watch?v=HPcAWNlVl-8
Video on NASA-tour of the electromagnetic spectrum on you tube about what electromagnetic spectrum is all about.

http://www.proprofs.com/quiz-school/story.php?title=electromagnetic-spectrum-quiz
Electromagnetic Spectrum Quiz to check your understanding on the different forms of electromagnetic waves

http://glencoe.mheducation.com/sites/0078617766/student_view0/chapter3/section2/self-check_quiz-eng_.html
Glencoe Online Quiz on Electromagnetic Spectrum to enrich your understanding of the different parts of electromagnetic spectrum.

http://www.learner.org/teacherslab/science/light/
Different activities to get to know more about light and its properties together with the many applications it has.

http://www.webmd.com/beauty/sun/sun-exposure-skin-cancer
Webpage Cosmetic Procedures: Sun Exposure and Skin Cancer. This will give you an idea on the causes of skin cancer.

http://www.who.int/uv/sun_protection/en/

Webpage on Ultraviolet radiation and the INTERSUN Programme. This will give you an idea on the effects of ultraviolet radiation to living things and environment.

http://www.curriculumbits.com/prodimages/details/physics/rainbow.html
These are interactive websites for the different electromagnetic radiation where students get the details of these types of radiation through the activities given

http://blabberize.com/
Web 2.0 application where you are tasked to create a one page drawing of a rainbow showing its effects and importance on living things and environment

https://www.youtube.com/watch?v=cfXzwh3KadE.
Video talks about the uses or application of the different electromagnetic spectrum. It will help you more appreciate the different radiations through their application.

http://www.ideacellular.com/wps/wcm/connect/709ff7e8-0c41-43ec-8182-42aa43ebbc91/mobile+communication-radio+waves+and+safety+10th+sept+12+final.pdf?mod=ajperes
Webpage Reading on radio waves and safety

https://www.youtube.com/watch?v=al7sFP4C2TY
Video from you tube on radio waves on telecommunications

https://phet.colorado.edu/en/simulation/radio-waves
Simulation Activity on radio waves and electromagnetic fields

http://voki.com/
Web 2.0 application where you are tasked to make a one-minute presentation using an Avatar on how safe are the radio waves.

http://www.ocregister.com/articles/school-288730-students-program.html Webpage about GPRS and how this was used by a school as part of their school system.

http://www.epa.gov/radiation/understand/ionize_nonionize.html
Webpage on the discussion between non-ionizing radiation and ionizing radiation

http://www.radiationanswers.org/radiation-introduction.html
Webpage on the answers to questions on Radiation and You. The webpage will let you have a closer look on the different forms of electromagnetic radiations around us.

http://www.who.int/peh-emf/about/WhatisEMF/en/
Webpage that contain the World Health Organization discussion on , properties, uses and effects of Electromagnetic fields

http://ec.europa.eu/health/archive/ph_determinants/environment/emf/brochure_en.pdf
Webpage on community research by European commission on Health and Electromagnetic Fields

http://www.saferemr.com/
News articles on Electromagnetic Radiation Safety

http://agni.phys.iit.edu/~vpa/medical%20applications.htm
Webpage on medical application of different forms of electromagnetic radiation

http://www.scientificamerican.com/article/how-radiation-threatens-health/
Article on How Radiation Threatens Health

http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones
Webpage on Cellphones and Cancer Risk

http://www.webmd.com/beauty/sun/sun-exposure-skin-cancer
Webpage on the Effects of Sun Exposure to Skin

https://www.blogger.com/
Web 2.0 applications where you are tasked to make a blog on how safe are the electromagnetic waves

www.edjudo.com
Website that contains some Web 2.0 applications. You are tasked to select on what you think is the best Web 2.0 applications that will allow you to show the effects of radio waves.