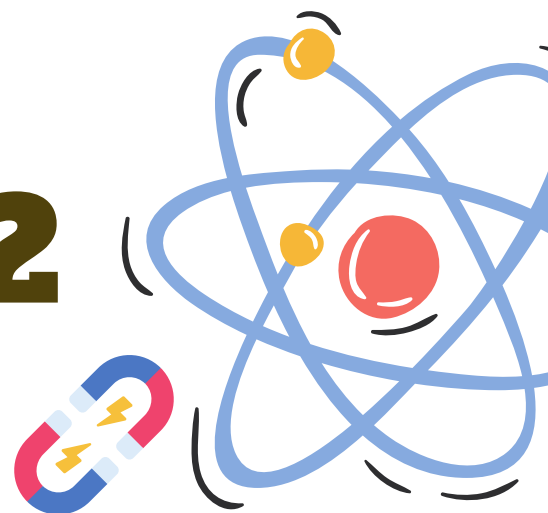




Science Education

E-MODULE 2 (PHYSICS 10)



iLab

An e-module based on Deped CARAGA
LEAST LEARNED COMPETENCIES with
Internet-Based Laboratory Activities



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$$d = v_0 t + \frac{1}{2} a t^2$$

$$v = r/a$$

$$KE = \frac{1}{2} m v^2$$

$$F = m \cdot a$$

$$\rho = \frac{m}{V}$$

$$W = m g$$

$$E = m \cdot c^2$$

Welcome to the Future of Learning Physics! Explore, Experiment, and Discover the Wonders of the Physical World!

To the Facilitator

Welcome to this e-module with an Internet-Based Laboratory Activities in Physics 10, an interactive and comprehensive learning resource designed to enhance your understanding of the fundamental concepts in physics.

- As a facilitator, you are expected to orient the learners on how to use this e-module. You also need to keep track of the learners' progress while allowing them to manage their own learning at home. Furthermore, you are expected to encourage and assist the learners as they do the tasks included in the e-module.

Thank you for choosing this iLab as your learning resource. We hope your journey through this e-module is both delightful and richly rewarding.

To the Learner

Welcome to the exciting world of digital learning! As a learner, you must learn to become responsible of your own learning. We hope that this e-module will serve as a valuable tool in your learning journey, providing you with the knowledge and skills you need to excel in your studies. We encourage you to take full advantage of this resource, explore all its features, and actively participate in the interactive activities.



iLab Policies

As you go through the different activities of this e-module be reminded of the following:

Remember, the goal is not just to complete the module, but to truly understand and absorb the information it provides. Always bear in mind that you are not alone. We hope that through this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. Happy learning!

Rule 1:

Active Participation: Engage actively with all the materials and activities. The more you interact, the more you learn.

Rule 2:

Pace Yourself: Don't rush through the content. Take your time to understand each concept before moving on to the next.

Rule 3:

Note-Taking: Keep a notebook handy for jotting down important points or questions that arise during your learning.

Rule 4:

Utilize Resources: Make full use of additional resources provided in this module. It is there to enhance your understanding.

Rule 5:

Reflect: After completing each section, take a moment to reflect on what you've learned and how you can apply it.



How to use these e-modules?

The e-module is composed of the following parts.

01

OVERVIEW

This provides you with the general information about the e-module.

02

PRE-TEST

This determines your background knowledge of the lesson.

03

MOTIVATIONAL ACTIVITY

This is an activity before proceeding to the lesson proper.

04

LESSON PROPER

This is the part where you can find the basic concepts about the lessons discussed

05

ILAB

These are the internet-based laboratory activities to be performed by you which will enrich your understanding of the lessons or concepts.

06

POST-TEST

This is the part that intends to determine how much you have learned from the lesson.

07

ANSWER KEY

This is the part that presents the answers to the activities included in the module.



Overview

Understanding the Effects of Electromagnetic Radiation on Living Things and the Environment

Learning Competency:

Explain the effects of electromagnetic radiation on living things and the environment. **(S10FE-Ile-f-49)**



Electromagnetic radiation plays a significant role in modern society, from medical imaging to communication. However, understanding its potential risks is essential to safeguard human health and the environment. By actively engaging with this e-module, you will gain a deeper insight into how different types of electromagnetic radiation affect both living organisms and ecosystems, along with measures to reduce potential harm.

Expected Outcomes:

After reading this e-module and performing the activities you should be able to:

- Classify electromagnetic waves as ionizing and non-ionizing radiation using energy levels.
- Explain the effects of electromagnetic radiation on living things and the environment
- Explore preventive measures to minimize the harmful effects of electromagnetic radiation.



Pre-Test

Before we delve into our upcoming lesson, it's crucial to establish a foundational understanding of the topic at hand. This not only primes your mind for new information but also allows you to connect new knowledge with what you already know.

To facilitate this, we have prepared a set of questions designed to gauge your existing knowledge on the subject matter. These questions are not a test, but a tool to help you and us understand your current familiarity with the topic.

We encourage you to answer these questions thoughtfully and honestly. There's no need to rush - take your time to reflect on each question. Remember, the goal here is not to get all the answers right, but to provide an accurate snapshot of your current understanding.

So, let's embark on this journey of discovery together. Your responses will guide us in tailoring the upcoming lessons to your learning needs, ensuring a more effective and enjoyable learning experience.

Ready? Let's begin!

Directions: Read and understand each question carefully and encircle the letter of the best answer.

1. Which of the following is a type of electromagnetic radiation?

- a) Sound waves
- b) Radio waves
- c) Wind energy
- d) Water waves

2. What effect does ultraviolet (UV) radiation have on humans?

- a) It helps with vitamin D production
- b) It can cause skin cancer with overexposure
- c) It has no effect on humans
- d) It helps plants grow

3. Which type of electromagnetic radiation is used in medical imaging?

- a) Microwaves
- b) Gamma rays
- c) X-rays
- d) Radio waves

4. How does excessive exposure to microwaves affect animals?

- a) It has no effect
- b) It can disrupt the nervous system
- c) It increases reproductive rates
- d) It helps animals communicate

5. What is a possible environmental impact of high-energy radiation, like gamma rays, on plant life?

- a) It speeds up plant growth
- b) It may cause mutations or kill plants
- c) It makes plants healthier
- d) It has no impact on plants

6. Which of the following is a preventive measure to reduce exposure to harmful electromagnetic radiation?

- a) Increasing the intensity of radiation
- b) Using radiation shields or protective devices
- c) Spending more time near radiation sources
- d) Ignoring safety guidelines

7. Which of these electromagnetic radiation types is most commonly associated with the warming of the Earth's atmosphere?

- a) Radio waves
- b) Microwaves
- c) Infrared radiation
- d) Gamma rays

8. What can be done to protect plants from the harmful effects of radiation?

- a) Use more chemical fertilizers
- b) Reduce exposure to harmful radiation by planting in shaded areas
- c) Increase the exposure to high-energy radiation
- d) Ignore the radiation impact

9. What is one of the harmful effects of electromagnetic radiation on wildlife?

- a) It improves communication between animals
- b) It causes confusion or disruption in migration patterns
- c) It enhances their ability to find food
- d) It helps animals grow faster

10. Which of the following is a recommended action to reduce human exposure to radiation from devices like mobile phones?

- a) Use the phone for longer periods
- b) Keep the phone close to the body
- c) Use speaker mode or hands-free devices
- d) Avoid turning off the phone



Motivational Activity

"The Case of the Mysterious Radiation"

Directions: Read and investigate on the case as shown below. Identify the potential cause of these incidents whether electromagnetic radiation is to blame and answer the activity questions.

Case Background

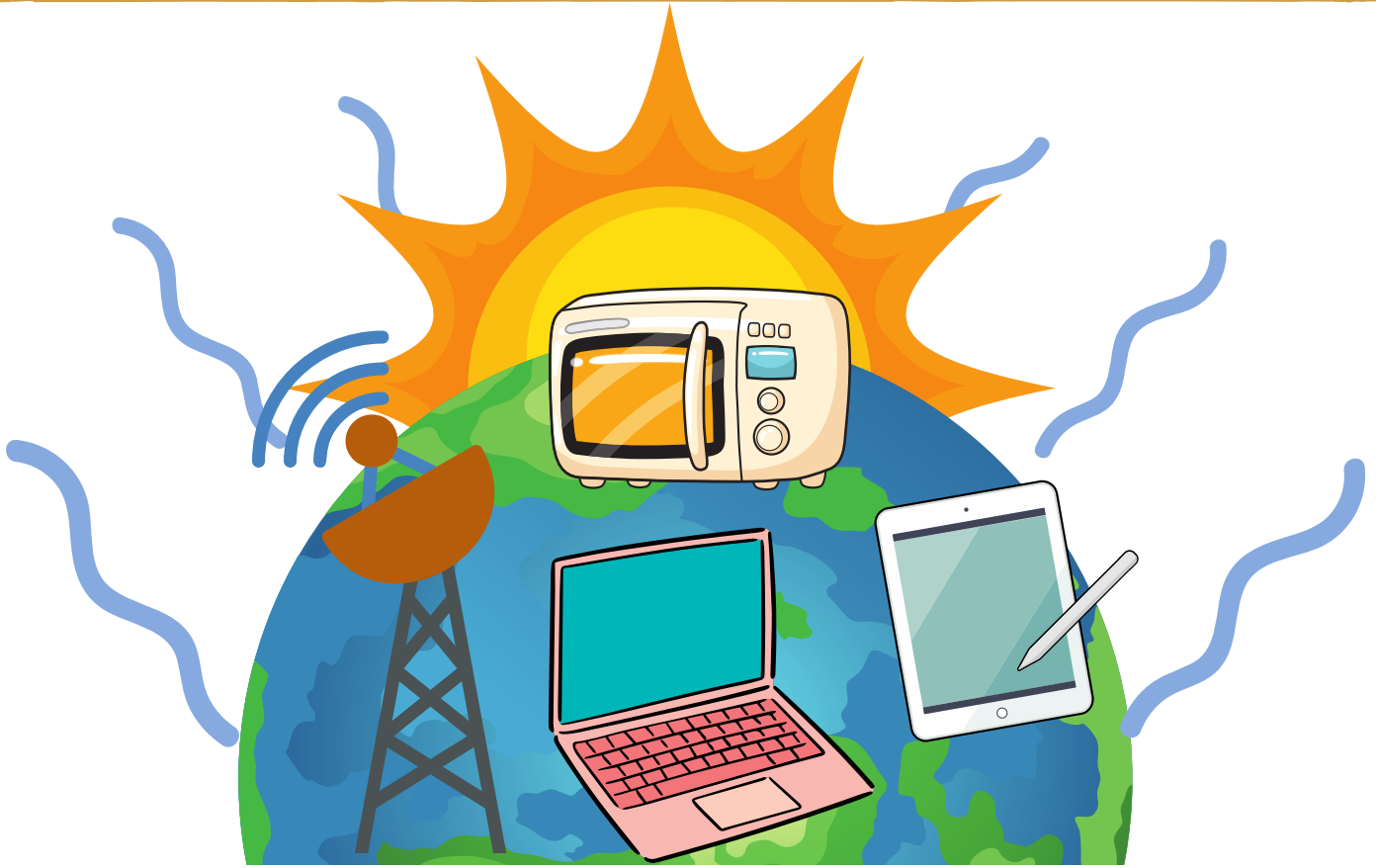
Over the past year, Greenfield Hospital has experienced a rise in health complaints from both staff and patients. Nurses have reported increased fatigue, headaches, and dizziness. Patients who have undergone frequent X-ray exams have developed unexplained skin burns. The hospital is located near several mobile phone towers, which might be contributing to the problem. Local wildlife in the area has also shown strange behavior, including birds deviating from their migratory routes and bee colonies disappearing.



1. What type of radiation does the hospital's X-ray machine use?
2. What kind of radiation do the mobile phone towers emit?
3. Could the health problems (fatigue, headaches, skin burns) be caused by radiation? Why or why not?
4. How might the mobile phone towers affect the local wildlife, like birds and bees?
5. What can the hospital do to reduce radiation exposure to staff and patients?



Understanding the Effects of Electromagnetic Radiation on Living Things and the Environment



In this module, we will dive deep into the effects of electromagnetic radiation on human health, wildlife, and ecosystems, focusing on the different types of radiation (radio waves, microwaves, UV rays, X-rays, and gamma rays), their impact, and how we can manage and mitigate their risks. Radiation can either cause damage or be harnessed for beneficial use, depending on how we interact with it.

By the end of this module, you'll better understand how electromagnetic radiation influences the world and how we can take steps to minimize its harmful effects while maximizing its positive impact.

THE ELECTROMAGNETIC RADIATION



RADIATION is the energy released from a source as either waves or particles (photons) and creates the electromagnetic spectrum.

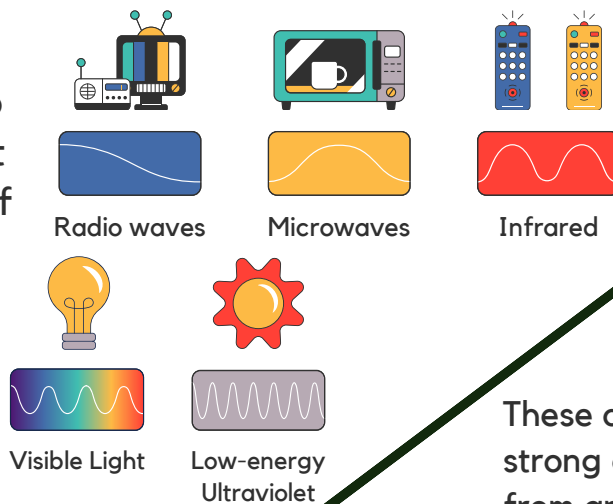
Electromagnetic radiation is pure energy that can travel as waves through matter or space while particle radiation is a high energy particle removed from the nuclei of atoms. Radiation within the electromagnetic spectrum is divided into two main types: non-ionizing radiation and ionizing radiation.

TYPES OF RADIATION

Non-ionizing Radiation

These are low energy radiation, it can heat up atoms and molecules. It includes the spectrum of radio waves, microwaves, infrared, visible light, and low energy ultraviolet light (UV-A & UV-B).

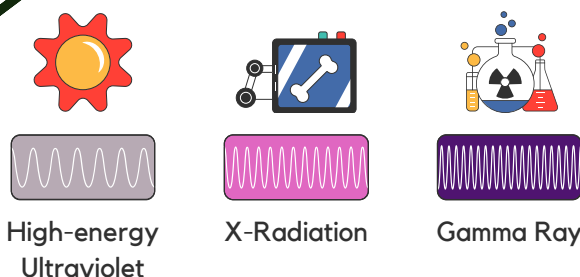
Unprotected exposure to UV-A and UV-B can damage the skin cells causing sunburn, premature aging, and skin cancer.



Ionizing Radiation

These are high energy radiation that is strong enough to remove an electron from an atom or molecules. It contains the spectrum of high energy ultraviolet light (UV-C), X-rays, and gamma rays.

High doses of ionizing radiation absorbed by living cells can damage their genetic material (DNA). The body cells are effective at repairing this damage. But, if the damage does not repair properly, the cell may die or become cancerous.

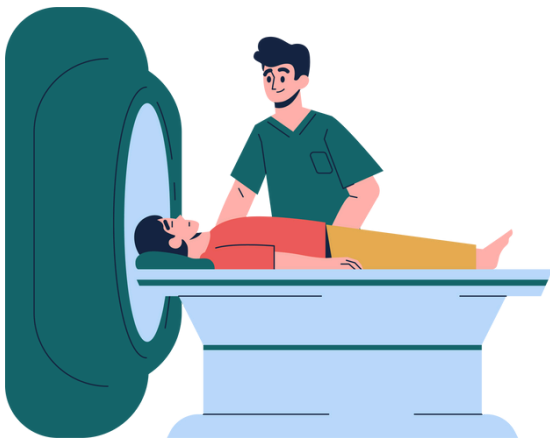


EFFECTS OF ELECTROMAGNETIC RADIATION ON LIVING THINGS AND THE ENVIRONMENT:



Humans:

- Prolonged exposure to UV rays can cause severe health effects, including skin cancer, premature aging of the skin, and eye damage (such as cataracts). UV radiation can also suppress the immune system.
- While essential for medical imaging, X-rays are a form of ionizing radiation that can cause DNA damage and increase the risk of cancer if exposure is frequent or high.
- Due to their high energy, gamma rays can penetrate deep into the body, potentially causing cellular damage, genetic mutations, and increased cancer risk.
- Long-term exposure to lower levels of radiation, like from mobile phones, might contribute to headaches, fatigue, and disrupted sleep.

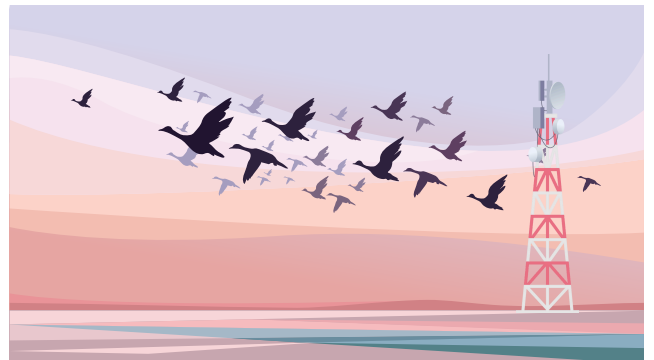


Animals:

Electromagnetic radiation from mobile towers can disrupt animal navigation systems and migratory patterns (e.g., birds losing their way, bees disappearing).

Birds: Many bird species rely on the Earth's magnetic field for navigation during migration. Strong electromagnetic fields from mobile towers and power lines can disrupt these natural processes, leading birds off course.

Bees: Bees also use electromagnetic fields for navigation and communication. Radiation, particularly from mobile phone towers, may interfere with their ability to forage and pollinate plants, which has a direct impact on food production.



Plants:

Excessive exposure to radiation can lead to mutations, reduced photosynthesis, and stunted growth.

Disruption of Ecosystems:

High levels of electromagnetic radiation in the environment can disrupt the natural balance, leading to the loss of biodiversity, habitat destruction, and disorientation of species.



MITIGATION AND SAFETY MEASURES



Human health and the environment must be protected against the harmful effects of radiation. The **International Atomic Energy Agency (IAEA)** formulated the standard radiation safety principles including the time of exposure, shielding, and distance.

- **Time of Exposure.** The amount of radiation dosage is directly proportional to the time exposure. Therefore, if the amount of radiation dosage increases, the time of exposure is also increasing. For example, if you spend a lot of time on the street, you will be exposed to the sun, and get a sunburn. Spend less time under the sun and more time in the shade, your sunburn will be less severe.
- **Shielding.** In handling radioactive materials, additional armor/protective materials are placed between the person and the source of radiation to absorb most of its radiation. For instance, wrinkle-causing UV-A rays and burn-inducing UV-B's can pose a serious risk to your health. Sunscreen protection with SPF (sun protection factor) of at least 30 is used to shield skin from the sun's harmful ultraviolet radiation.
- **Distance.** It refers to how near you are to a radiation source. Increasing the distance from the radiation source can reduce radiation exposure. Therefore, maintaining a greater distance from the X-ray generator is very effective to lessen radiation exposure.



Exploring the Effects of Electromagnetic Radiation

Objective:

- Identify the properties and characteristics of light waves.
- Understand how light waves behave and interact with different materials.
- Analyze the impact of light waves on living things and the environment through simulation.

Materials Needed:

- Computer or tablet with internet access.
- Notebook or digital device for recording observations and answers.
- Access to the simulation Link:
<https://dynamicinfographic.wgbhdigital.org/en/instances/the-electromagnetic-spectrum/>

Activity Instructions:

1. Explore each segment of the electromagnetic spectrum.
2. Click through the infographic to understand the characteristics of each type of radiation, such as wavelength, frequency, and energy.
3. Observe real-world applications and examples for each type of radiation, and how they are used in various fields such as medicine, communication, and scientific research.

Key Questions:

1. What are the key differences between ionizing radiation and non-ionizing radiation in terms of their wavelength and energy?
2. How does ultraviolet radiation affect human health, and what precautions should be taken to avoid overexposure?
3. What role does X-ray radiation play in medical diagnostics and what are the risks associated with its use?



Post-Test

As we conclude our lesson, it's important to assess your understanding of the topic we've just explored. This step not only helps reinforce your new knowledge but also enables you to connect the concepts you've learned with your existing understanding.

To assist in this, we've prepared a set of questions designed to gauge how well you've grasped the key points of the lesson. These questions are not a test, but a valuable tool to help both you and us assess your progress.

Take your time to reflect on each question and answer thoughtfully. There's no rush – the goal here is not to get every answer right, but to give an honest and accurate snapshot of your current understanding.

This process will guide us in refining future lessons to better meet your learning needs, ensuring a more effective and enjoyable experience moving forward.

So, let's continue on this journey of discovery! Ready? Let's begin!

Directions: Read and understand each question carefully and encircle the letter of the best answer.

1. Which type of electromagnetic radiation has the longest wavelength?
 - a) Gamma rays
 - b) Radio waves
 - c) Microwaves
 - d) X-rays

2. What potential harm can ultraviolet (UV) radiation cause to human health?
 - a) It can cause skin burns with short exposure
 - b) It helps the body absorb calcium
 - c) It can lead to skin aging and increase the risk of skin cancer
 - d) It has no impact on human health

3. Which of the following types of electromagnetic radiation is commonly used for cancer treatment?
 - a) Radio waves
 - b) Microwaves
 - c) X-rays
 - d) Gamma rays

4. How might high levels of electromagnetic radiation from mobile phones affect animals?
 - a) It improves their vision
 - b) It disrupts their biological rhythms and behaviors
 - c) It boosts their energy levels
 - d) It strengthens their immune systems

5. What effect can high levels of radiation, such as gamma rays, have on ecosystems?
 - a) It encourages biodiversity
 - b) It can disrupt ecosystems and harm living organisms
 - c) It increases plant and animal populations
 - d) It helps preserve ecosystems

6. What is one method to reduce exposure to electromagnetic radiation in daily life?

- a) Increase time spent near radiation sources
- b) Use protective devices and shielding
- c) Ignore government safety regulations
- d) Use high-powered radiation devices in open areas

7. Which type of radiation is mainly responsible for the greenhouse effect and global warming?

- a) Ultraviolet radiation
- b) Radio waves
- c) Infrared radiation
- d) X-rays

8. What can be done to reduce the impact of radiation on plant life?

- a) Expose plants to more artificial light
- b) Increase exposure to harmful radiation
- c) Use shading or protective materials to limit UV radiation exposure
- d) Increase the use of chemical treatments for plants

9. What impact does electromagnetic radiation from mobile towers have on wildlife migration?

- a) It enhances migration accuracy
- b) It can interfere with navigation, leading to disorientation
- c) It strengthens animal communication
- d) It has no effect on wildlife migration

10. Which is the best way to reduce exposure to radiation from mobile devices?

- a) Use mobile phones in close proximity to the body
- b) Keep the mobile phone turned off during sleep
- c) Use mobile phones continuously without breaks
- d) Place the phone on the highest radiation setting

Compare your answers with the pre-test to see how much you've learned and retained.



Answer Key

Pre-test

1. Which of the following is a type of electromagnetic radiation?

Explanation: Radio waves are part of the electromagnetic spectrum, alongside other types such as microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays.

- a) Sound waves
- b) **Radio waves**
- c) Wind energy
- d) Water waves

2. What effect does ultraviolet (UV) radiation have on humans?

a) It helps with vitamin D production

b) It can cause skin cancer with overexposure

c) It has no effect on humans

d) It helps plants grow

Explanation: UV radiation from the sun can cause skin damage, leading to conditions like sunburn and increasing the risk of skin cancer when exposed for long periods without protection. While UV radiation helps in vitamin D production, excessive exposure is harmful.

3. Which type of electromagnetic radiation is used in medical imaging?

Explanation: X-rays are a form of high-energy electromagnetic radiation used in medical imaging to view the inside of the body. They are commonly used in diagnostics like X-ray scans and CT scans.

- a) Microwaves
- b) Gamma rays
- c) **X-rays**
- d) Radio waves

4. How does excessive exposure to microwaves affect animals?

a) It has no effect

b) It can disrupt the nervous system

c) It increases reproductive rates

d) It helps animals communicate

Explanation: Microwaves, if overexposed, can interfere with biological processes, particularly by affecting the nervous system. This may lead to symptoms like dizziness, headaches, and other issues in both humans and animals.

5. What is a possible environmental impact of high-energy radiation, like gamma rays, on plant life?

a) It speeds up plant growth

b) It may cause mutations or kill plants

c) It makes plants healthier

d) It has no impact on plants

Explanation: High-energy radiation such as gamma rays can damage the DNA of plants, leading to mutations or even killing them. Plants, like all living organisms, are sensitive to radiation, which can disrupt their growth and reproduction.

6. Which of the following is a preventive measure to reduce exposure to

harmful electromagnetic radiation?

- a) Increasing the intensity of radiation
- b) Using radiation shields or protective devices
- c) Spending more time near radiation sources
- d) Ignoring safety guidelines

Explanation: Using radiation shields, such as protective clothing or barriers, is a proven method of reducing exposure to harmful electromagnetic radiation, especially in environments like medical settings or places with high-frequency radiation.

7. Which of these electromagnetic radiation types is most commonly

associated with the warming of the Earth's atmosphere?

- a) Radio waves
- b) Microwaves
- c) Infrared radiation
- d) Gamma rays

Explanation: Infrared radiation is responsible for heating the Earth's surface and plays a key role in the greenhouse effect. While other radiation types (like UV and X-rays) have specific impacts, infrared radiation is primarily associated with heat energy.

8. What can be done to protect plants from the harmful effects of

radiation?

- a) Use more chemical fertilizers
- b) Reduce exposure to harmful radiation by planting in shaded areas
- c) Increase the exposure to high-energy radiation
- d) Ignore the radiation impact

Explanation: Shading plants from harmful radiation, especially UV rays, can help reduce potential damage. This protection can be provided by other plants, structures, or other means to shield them from direct exposure to high levels of radiation

9. What is one of the harmful effects of electromagnetic radiation on

wildlife?

- a) It improves communication between animals
- b) It causes confusion or disruption in migration patterns
- c) It enhances their ability to find food
- d) It helps animals grow faster

Explanation: Certain types of electromagnetic radiation, such as those emitted by communication satellites or power lines, can interfere with the natural navigation systems of migratory animals, like birds and sea turtles, causing them to become disoriented.

10. Which of the following is a recommended action to reduce human exposure to radiation from devices like mobile phones?

- a) Use the phone for longer periods
- b) Keep the phone close to the body
- c) Use speaker mode or hands-free devices
- d) Avoid turning off the phone

Explanation: Using speaker mode or hands-free devices helps reduce the amount of radiation absorbed by the head and body during phone calls. Keeping the phone away from the body when not in use also reduces exposure to radiation.

"The Case of the Mysterious Radiation"

Key Answers:

1. What type of radiation does the hospital's X-ray machine use?
Answer: The X-ray machine uses ionizing radiation, which has enough energy to remove electrons from atoms and potentially cause damage to cells and tissues.

2. What kind of radiation do the mobile phone towers emit?
Answer: The mobile phone towers emit non-ionizing radiation, specifically radiofrequency (RF) radiation, which is generally considered safe in low levels but can cause health effects with long-term exposure at high levels.

3. Could the health problems (fatigue, headaches, skin burns) be caused by radiation? Why or why not?
Answer: The fatigue and headaches could possibly be linked to non-ionizing radiation from the mobile phone towers if exposed to high levels over time, though there is limited evidence for this. Skin burns are more likely caused by overexposure to ionizing radiation from the X-ray machine, as excessive radiation can lead to skin damage.

4. How might the mobile phone towers affect the local wildlife, like birds and bees?
Answer: Non-ionizing radiation from the mobile phone towers might interfere with animals' navigation systems or biological functions. For example, birds might lose their way during migration, and bees might experience disorientation or lose their ability to navigate, possibly leading to colony collapse.

5. What can the hospital do to reduce radiation exposure to staff and patients?
Answer: The hospital can:

Use shielding around X-ray machines to reduce radiation exposure.

Limit unnecessary X-ray exams and follow strict safety guidelines.

Implement regular maintenance and calibration of equipment.

Distance staff from radiation sources during procedures.

Use protective gear like lead aprons for staff and patients.

Post-test

1. Which type of electromagnetic radiation has the longest wavelength?
a) Gamma rays
b) Radio waves
c) Microwaves
d) X-rays

2. What potential harm can ultraviolet (UV) radiation cause to human health?
a) It can cause skin burns with short exposure
b) It helps the body absorb calcium
c) It can lead to skin aging and increase the risk of skin cancer
d) It has no impact on human health

3. Which of the following types of electromagnetic radiation is commonly used for cancer treatment?
a) Radio waves
b) Microwaves
c) X-rays
d) Gamma rays

4. How might high levels of electromagnetic radiation from mobile phones affect animals?
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b) It disrupts their biological rhythms and behaviors
c) It boosts their energy levels
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b) Increase exposure to harmful radiation

c) Use shading or protective materials to limit UV radiation

exposure

d) Increase the use of chemical treatments for plants

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10. Which is the best way to reduce exposure to radiation from mobile devices?

a) Use mobile phones in close proximity to the body

b) Keep the mobile phone turned off during sleep

c) Use mobile phones continuously without breaks

d) Place the phone on the highest radiation setting

Compare your answers with the pre-test to see how much you've learned and retained.

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