

Article Review

- *New Frontiers & New Dangers*
- *Electromagnetic Radiation: Taming the Wild Energies*
- *Do You Want the Recipe?*
- *In the Kitchen with Poly*
- *Measuring Exposure to Radiation*

Time

10 minutes
prep time.
5 minutes
presentation
time per
question

Questions

- (EASY review question.) (*New Frontiers-New Dangers*) Summarize briefly and succinctly what happens during a coronal mass ejection and the dangers this form of solar weather poses to the space station and astronauts.
 - CME's eject radioactive particles (protons, beta particles, and alpha particles) and dangerous radiation (X-rays and gamma rays) towards the earth. These solar emissions expose the astronauts to dangerous levels of radiation. Radiation is measured in terms of rads and rems.*
- (MEDIUM review question.) (*Radiation: Friend and Foe*) Explain the relationship between frequency, wavelength, and energy. Use specific examples of different frequencies on the electromagnetic spectrum. Sketch a picture to illustrate your answer.
 - Wavelength is the length of a wave from peak to peak or trough to trough. Frequency is the number of wavelengths that move past a given point at the speed of light in a given period of time. The higher the frequency, the shorter the wavelength, the higher the energy of the radiation. An example of high-energy radiation would be a gamma ray. An example of low energy radiation would be a radio wave.*
- (DIFFICULT review question.) (*Radiation: Friend and Foe*) Explain the difference between ionizing radiation and non-ionizing radiation and give examples of each type of radiation. Explain the ionization process and give an example of matter that is ionized. Can non-ionizing radiation still be harmful? Give examples. (Suggestion: divide the topics between members of your group.)
 - Ionizing radiation (gamma rays and X-rays) has a short wavelength, high frequency, and high energy level. Non-ionizing radiation has a longer wavelength and lower energy level. Energy packets, or photons, of ionizing radiation are powerful enough to penetrate an atom and energize and detach an electron. This leaves the atom with a net positive electrical charge. One example of matter composed of ionized atoms is plasma. Some forms of non- ionizing radiation that can be dangerous to humans are microwaves, ultraviolet, and intense infrared waves and visual light (lasers). Radio, and TV waves are not normally harmful to humans. Intense forms of non-ionizing radiation can cause changes in molecular structure and are, in this way, dangerous to humans. Lasers are intense visual light and can cause significant damage to humans.*
- (Teacher Question) Explain the difference between radiation and radioactivity. Illustrate the popular use of the term "radiation" to imply dangerous radiation as used in medicine or nuclear power generation, etc.
 - As I have pointed out before, the word "radiation" can be used in two ways. First, it can be used to describe all types of electromagnetic radiation. Secondly, as used in this unit, it can be used to represent just the most harmful forms, or ionizing forms, of radiation. Radioactivity, on the other hand, consists of actual atomic particles that are the byproduct of thermonuclear reactions such as fusion and fission. Some forms of radioactive particles are also emitted during the natural deterioration (half-life) of the nucleus of some atoms, y uranium and plutonium, for instance. The radioactivity emitted by radioactive elements is in forms, alpha and beta particles. An alpha particle is a helium nucleus consisting of 2 protons and 2 neutrons with no electrons). Its two protons give it a double negative charge.). A beta particle is a free electron or positron. Like ionizing radiation, radioactive particles can penetrate the atomic and molecular structure in human cells and cause ionization of atoms and the mutation of human cells. Radiation is not all dangerous, as we now know. Some forms of radiation, like light and TV and radio waves are completely harmless at most levels of intensity. Even ionizing radiation if used under controlled medical circumstances is not dangerous. When we hear the term "radiation," however, it usually connotes a dangerous form of radiation. You students, however, will now be aware of the great varieties of radiation and the common use of the term.*
- (MEDIUM review question.) (*The Human Recipe*) Briefly describe human DNA, where it resides, what it is made of, and what role it plays in reproducing human cells. (Suggestion: divide the topics between members of your group. Use sketches if possible.)
 - DNA resides in the chromosomes of each human cell's nucleus. It is made of four different nucleotides (A,C,T,and G) and two groups of chemicals, namely sugars and phosphates. Each cell's DNA contains the recipes for the entire human body. This recipe is divided into sections. Each section is called a gene. The different genes within DNA contain the instructions, or information, needed to produce all 200 different human cell structures.*

(Cont)

Time Questions

10 minutes
prep time.
5 minutes to
resent each
question

6. (EASY review question.) (*The Human Recipe*) Briefly explain what cell mutation is, the three types of mutation, and what systems of the body are most susceptible to damage by ionizing radiation. (Suggestion: divide the topics between members of your group. Use sketches if possible.)
 - A. *Cell mutation occurs when the DNA within a cell is changed such that newly reproduced cells are different from their parent cells. The three types of mutation are neutral mutation, harmful mutation, and helpful mutation. Lymphoid cells, reproductive cells, bone marrow, epithelial cells, epidermal cells, hepatic cells, and kidney cells are particularly susceptible to damage because their cells reproduce at a high rate.*
7. (MEDIUM Review question.) (*In the Kitchen with Poly*) Briefly summarize the story of the Christmas Bricks by stating the important facts, then answer these questions: What does ALARA stand for? What different options do the astronauts (ALARA) have in protecting themselves from dangerous levels of radiation? (Suggestion: divide the topics between members of your group. Use sketches if possible.)
 - A: *A woman astronaut requested shielding to ensure she could have children after her mission to the space station during which she was concerned about her possible exposure to dangerous radiation. Engineers picked polyethylene material shaped as bricks to strap together for a sleep shield. "Poly" is light and full of hydrogen, a good shielding agent. For protection, astronauts can go to sleep areas, shield themselves with water tanks on board Zarya, monitor radiation using TEPC device, and realign the space station in relation to the sun.*
8. (EASY review question.) (*Measuring Exposure to Harmful Radiation*) How is radiation measured on the space station? Explain the difference between rads and rems. When are we exposed to radiation on earth and to how much are we exposed while participating in normal activities? What is a dose of radiation? (Suggestion: divide the topics between members of your group. Use sketches if possible.)
 - A: *A TEPC measures radiation in terms of rems. Rads are a measure of absorbed radiation. We are constantly exposed to ionizing radiation while watching TV, walking, driving, and during medical procedures. A radiation dose is measured in millirems (remember millimeters) or thousandths of a rem.*