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Waves and Rays, Part II

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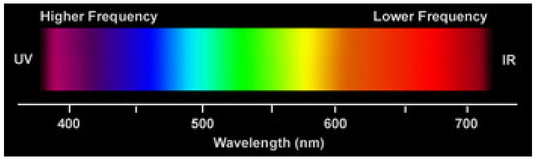

In *Waves and Rays, Part I*, you learned about radio, microwave, and infrared waves in the electromagnetic (EM) spectrum.

Just above the infrared band of the EM spectrum is the spectrum of visible light. This part of the EM spectrum we CAN see. The waves are between 30 millionths of an inch and 14 millionths of an inch. These have very high frequencies, ranging from a hundred trillion to a thousand trillion cycles per second. Your eyes and the eyes of every creature on Earth have evolved to be able to see these particular light waves.

Light appears to be white to us. But by using a prism, we can separate light into its different colors. The colors are red, orange, yellow, green, blue, indigo, and violet. Each color has its own wavelength and its own frequency. You can remember the order of the colors by remembering Roy G. Biv. Each letter stands for a color in the spectrum. We see these colors in a rainbow in the sky. Sunlight passing through raindrops in the sky is refracted, or bent. When this happens, the light waves slow down. Starting with red, each color that follows has a shorter wavelength and a higher frequency than the one before it. A rainbow can only be seen in the early morning or later afternoon, when the sun is no higher than 42 degrees above the horizon.

All the colors of the visible light spectrum combine in white light to let you see. If there's no light, you can't see color. To see, you must have light from the sun or from an electric light bulb, a fire, or another source. Everything you see has its own color. When light shines on an object, the molecules of the object absorb most of the wavelengths of the visible spectrum. When they don't absorb them, the wavelengths are reflected. If an object reflects only the red wavelengths, the object looks red to you. If the object reflects green, you see the object as green. If an object reflects all colors, you see the object as white. If an object absorbs all colors, you see it as black.

Higher up on the EM spectrum are ultraviolet (UV) waves. These waves have higher frequency, more than one thousand trillion cycles per second, and shorter wavelength. When UV waves hit some materials that "fluoresce," or glow, they produce visible light. Special "black light" fluorescent tubes send out energy in UV wavelengths only a billionth of an inch long. Under black light, certain types of material have an eerie glow. These UV rays are what cause your skin to sunburn. A small amount of UV radiation isn't harmful to you; in fact, it allows your body to produce vitamin D that you need for strong bones. Too much UV will damage your skin. It can cause cancers, wrinkles, and early aging of the skin.

The next band above UV waves is X rays. Notice that the name has changed from "waves" to "rays." From here on up the spectrum, wavelengths grow smaller and frequencies become extremely high. The radiation carries large amounts of energy so they are called rays. X rays have wavelengths around one ten-billionth of an inch or more. Their frequencies are about one million trillion cycles per second. Their energy is so great that just a brief burst of them can kill diseased cells all the way inside your body. Ultraviolet waves damage the skin on the outside of your body, but X rays go much deeper.

Doctors use X rays to take pictures inside your body. You may have had an X ray taken of your teeth or of a broken bone. Having an X ray taken of a part of your body every now and then is generally safe. X ray technicians must protect themselves from X rays so that they are not exposed to too much radiation. A lead shield or an apron made of lead will not let X rays penetrate.

The last part of the EM spectrum is the gamma-ray band. Gamma rays are extremely high energy. They have a frequency of around one hundred million trillion cycles per second. Gamma rays are as much as ten billion times more energetic than visible light. These powerful rays are released into Earth's atmosphere when a nuclear bomb explodes and are given off by the radioactive fallout. If a gamma ray passes through a healthy human cell, it can knock electrons from some of the cell's atoms. After enough of this damage, the cell may die. That's why nuclear accidents cause radiation sickness.

Doctors use gamma rays to destroy diseased cells and make patients healthy again. Gamma rays and X rays used in radiation

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therapy can target the diseased cells of tumors. The tumor cells are destroyed and healthy cells can continue to grow.

Scientists in the last hundred years have found ways to create and use electromagnetic energy. Your everyday life is filled with EM rays that light your sight, cook your food, change channels on your TV, and entertain you. What would we do without them?

Earth's atmosphere blocks many infrared waves, most ultraviolet waves, all X rays, and all gamma rays. There would be no life on Earth if all these high-energy waves and rays were able to get through the atmosphere.

Waves and Rays, Part II

Questions

_____ 1. What is the part of the EM spectrum that we can see?

A. gamma rays
B. visible light
C. infrared
D. X rays

_____ 2. At what times of the day can rainbows be seen?

A. sunrise and sunset
B. early morning and late afternoon
C. any time of day
D. early afternoon and late morning

_____ 3. In what order do the colors of the spectrum appear?

A. in any order
B. yellow, green, blue, indigo, violet, orange, and red
C. blue, violet, indigo, green, red, yellow, and orange
D. red, orange, yellow, green, blue, indigo, and violet

_____ 4. Ultraviolet (UV) waves can:

A. enable your body to produce Vitamin D
B. cause cancers
C. cause skin damage
D. all of the above

_____ 5. X rays can:

A. only pass through your skin
B. help your body make Vitamin D
C. be used to take "pictures" of broken bones
D. both b and c are correct

_____ 6. Nuclear bombs release:

A. X rays
B. UV waves
C. infrared waves
D. gamma rays