

## Unit 9: Waves

### Content Outline: Electromagnetic Waves: Light Waves (9.6)

#### I. Light waves

- A. These are *mid-wavelength* electromagnetic waves are commonly called light.
- B. This range of electromagnetic waves has shorter wavelengths and higher frequencies than radio waves, but not as short and high as X rays and gamma rays.
- C. Light includes visible light, infrared light, and ultraviolet light.

#### II. Visible Light (A.K.A. White Light)

- A. The only light that people can see is called **visible light**.
  1. **Absorption** – these are the colors of white light we cannot see when look at a substance.  
You see this text as blue, because the ink absorbs the other colors of white light, but the paper appears white because no colors are being absorbed...so you seem them all combined...white.
  2. **Reflection** – these are the colors (lightwaves) being bounced of the object and collected by your eyes.  
This appears blue because the blue light was bounced off the pigments and collected by your eye.  
This appears black because nothing is bouncing back to your eyes. All the colors were absorbed by the pigment.  
If light is energy, what color of clothing should you were in the spring and summer. How about fall and winter?
- B. It refers to a *very narrow range* of wavelengths in the electromagnetic spectrum that falls between infrared light and ultraviolet light.
  1. Within the visible range, we see light of different wavelengths as different colors of light.
    - a. From red light, which has the *longest wavelength* and therefore *least energy*, to violet light, which has the *shortest wavelength* and *most energy*.
    - b. The colors composing white light are: red, orange, yellow, green, blue, indigo, and violet. An easy way to remember is ROY G. BIV, like a name.
    - c. When all of the wavelengths are combined, as they are in sunlight, visible light appears white.

#### III. Infrared Light

- A. The spectrum part of visible light with the *longest wavelengths and least energy* is called **infrared light**.
- B. The term *infrared* means "below red." Infrared light is the range of light waves that have longer wavelengths than red light in the visible spectrum. You can't see infrared light waves, but you can feel them as heat on your skin. The sun gives off infrared light as do fires and living things.
- C. Night vision goggles, which are used by law enforcement and the military, also detect infrared light waves. The goggles convert the invisible waves to visible images.

#### IV. Ultraviolet Light

- A. Light with wavelengths *shorter and having more energy* than visible light is called **ultraviolet light**.
- B. The term *ultraviolet* means "above violet."
  1. Ultraviolet light is the range of light waves that have shorter wavelengths than violet light in the visible spectrum. Humans can't see ultraviolet light, but it is very useful nonetheless. It has higher-frequency waves than visible light, so it has more energy.
- C. It can be used to kill bacteria in food (often called **Pastuerization**) and to sterilize laboratory equipment.
  1. Louis Pastuer developed the process used for cow milk sterilization.
- D. The human skin also makes vitamin D when it is *exposed* to ultraviolet light.
  1. Vitamin D is needed for strong bones and teeth.
  2. Too much exposure to ultraviolet light can cause sunburn and skin cancer.
    - a. You can protect your skin from ultraviolet light by wearing clothing that covers your skin and by applying sunscreen to any exposed areas.
    - b. The **SPF**, or **sun-protection factor**, of sunscreen gives a rough idea of how long it protects the skin from sunburn. A sunscreen with a higher SPF protects the skin *longer*. You should use sunscreen with

an SPF of at least 15 even on cloudy days, because ultraviolet light can travel through clouds. Sunscreen should be applied liberally and often.

If your skin normally burns in 10 minutes of sun exposure, what would using a sunscreen with an SPF of 30 mean? Ideally, your skin would begin to burn only after 30 times 10 minutes, or 300 minutes, of sun exposure - and not going in the water, as the water washes the SPF off your skin. How long does sunscreen with an SPF of 50 protect skin from sunburn?