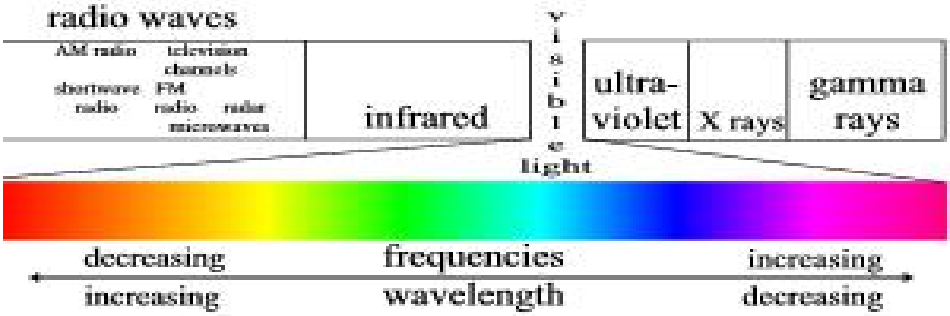
# Topic 8 – Beyond Light (pgs. 249-256)

The sun is the most abundant source of direct natural light on the Earth. There are other forms of energy, invisible, that are also supplied by this source. The tiny band of visible light that we see is only part of the entire spectrum of light energy we receive. Called the electromagnetic spectrum, because the light waves, electrical and magnetic fields vibrate as they radiate to earth.




Different colors on the electromagnetic spectrum have different wavelengths (nanometers) and different frequencies (hertz).

**Radiation in the Environment**

Radiation is a natural part of our environment. Humans have always lived on earth in the presence of radiation. Natural radiation reaches earth from outer space and continuously radiates from the rocks, soil, and water on the earth. Background radiation is that which is naturally and inevitably present in our environment. Levels of this can vary greatly. People living in granite areas or on mineralized sands receive more terrestrial radiation than others, while people living or working at high altitudes receive more cosmic radiation. A lot of our natural exposure is due to radon, a gas which seeps from the earth's crust and is present in the air we breathe.

**Radiation and Life**

Radiation is energy traveling through space. Sunshine is one of the most familiar forms of radiation. It delivers light, heat and suntans. We control its effect on us with sunglasses, shade, air conditioners, hats, clothes and sunscreen. There would be no life on earth without lots of sunlight, but we have increasingly recognized that too much of it on our persons is not a good thing. In fact it may be dangerous. so we control our exposure to it. Sunshine consists of radiation in a range of wavelengths from long-wave infra-red to shorter wavelength ultraviolet. Beyond ultraviolet are higher energy kinds of radiation which arc used in medicine and which we all get in low doses from space, from the air, and from the earth. Collectively we can refer to these kinds of radiation as lonising radiation. It can cause damage to matter, particularly living tissue. At high levels it is therefore dangerous, so it is necessary to control our exposure.

**Infrared Radiation**

Red light has a wavelength of about 700 nanometers, but it could be stretched out to 100 nm, it would become heat radiation, or infrared radiation. It would become invisible to the eyes, but you could sense it with your skin. Anything that is warmer than its surroundings emit infrared rays.

Practical applications include:

- motion sensors
- burglar alarms
- heat lamps

**Radio Waves**

If you could stretch the infrared wave out even further, so it became a few millimeters long, you could get radio waves. Radio waves have a longer wavelength and a lower frequency than visible light. Different types of radio waves have different uses.

Microwaves have the shortest wavelength and the highest frequency of the all the radio waves.

Microwaves have three characteristics that allow them to be used in cooking:

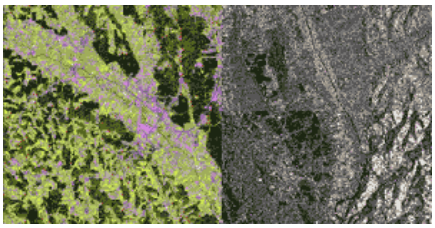
- they are reflected by metal;
- they pass through glass, paper, plastic, and similar materials;
- and they are absorbed by foods.

Microwaves are used to detect speeding cars, to send telephone, satellite and television communications, and to treat muscle soreness. Industry uses microwaves to dry and cure plywood, to cure rubber and resins, to raise bread and doughnuts, and to cook potato chips. But the most common consumer use of microwave energy is in microwave ovens. Microwave ovens have been regulated since 1971.

**Remote Imaging Technologies**

Radio waves are around us all the time. The signals from radio stations, television stations, cell phones and even distant stars pass through your body every day.

**LANDSAT** is another Canadian satellite that records how different parts of the light from the Sun reflect back to the satellite. It's most important use is for agriculture, monitoring crops for damage by disease, pests and drought.



**RADARSAT** is a Canadian telecommunications satellite, which, from time to time, sweeps the ground below it with radio waves, penetrating fog, haze, clouds and rain. Their reflection back to the satellite give scientists information they can use in their studies of the Earth.

- Monitoring ice floes, which can endanger ships
- Search possible sites for minerals, oil and natural gas.
- Monitoring a flood, so that sandbagging efforts can be maximized where it is needed most.

**Ultraviolet Radiation**

Just beyond the violet part of the visible spectrum are wavelengths of about 200 nm. , known as ultraviolet (UV) radiation. This radiation is very energetic. It causes tanning, but it can also do irrepairable damage to us.

**UV rays** can ... damage the cornea of the eye (fogging which can lead to a slow loss of vision)
In more recent years, more UV radiation is reaching us because the ozone layer in the atmosphere (which protects us from the damaging radiation by absorbing the UV rays) is being thinned. This thinning of the ozone layer is speeded-up by the use of aeorsol sprays and Freon gas, which break up the ozone particles. (see Figure 3.70 p. 254)

**X-Rays**

Even shorter wavelengths with higher frequencies are the **X-rays**. These waves pass through tissue (skin and muscle) and are absorbed by the bones. This radiation always stays in the bone and builds up over time. Therefore people who work as technicians taking the x-rays must protect themselves, by leaving the room where the xray is taken and also protect the patient's other areas of the body with lead vests to prevent over-exposure.

**Gamma Rays**

Gamma rays have the **shortest wavelength** and the **highest frequency** of all the waves in the electromagnetic spectrum. Gamma rays result from nuclear reactions and can kill cells. This can be useful if the cells being destroyed are harmful - like cancerous cells. The cancerous growth of cells and tissue can be radiated, using gamma rays, and is known as **radiation therapy**.

**Topic 8 Review p. 256**

**Wrap-up ( Topics 6 - 8 ) p. 257** **UNIT REVIEW pgs. 262 – 265**