Overview of the Electromagnetic Spectrum

The electromagnetic spectrum represents all the energy that travels as a wave and radiates (moves away) from a point. This is sometimes referred to as radiation energy but due to the negative connotations of that phrase we will just refer to it as the energy of the EM spectrum.

Electromagnetic Waves

Before we start talking about the different categories of the EM spectrum lets take a moment to discuss Electromagnetic waves. All energy travels as a wave but not all waves are created equal. For example, sound moves as a longitudinal or compression wave (Image 1). Tap a pen on the desk. Do you notice that the sound seems to move away from that point? That is because when you tap the end of your pen against the desk it starts a vibration of the molecules. That vibration continues to move away from that point in all directions. The first vibrating molecule makes the neighboring molecules vibrate, then those molecules make their neighboring molecules vibrate. Creating a wave of sound that oscillates or moves back and forth in the direction of travel.

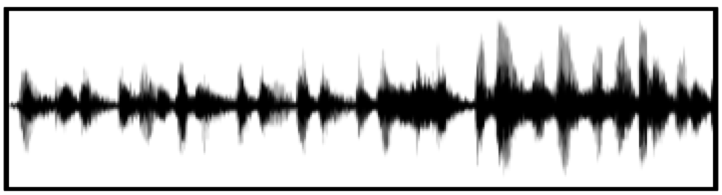

Image 1: A representation of a sound wave (Johnson, G. n.d).

Alternatively, secondary earthquake waves or S waves move as a transverse wave (Image 2). Transverse waves also start with a vibration. However, instead of causing the molecule directly beside them to vibrate the effected molecules cause the molecule at a 45 degree angle to them to vibrate. Therefore these waves move in an up and down manner at a 45 degree angle to the direction of travel.

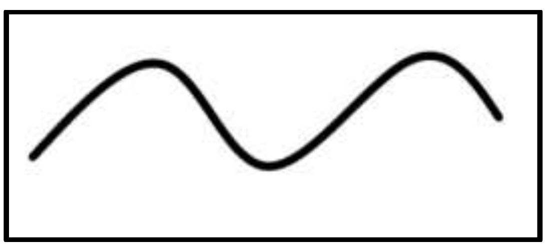

Image 2: A representation of a transverse wave (Bogan, V, 2022).

Both of the waves mentioned above require the movement of matter. After the vibration starts it moves by vibrating one particle after another. Electromagnetic waves are special because they don't require there to be particles present in order to move from one location to another. In fact, these waves are able to exist and move in a vacuum which is a place completely lacking air and matter. Another thing that makes these waves special is that they are made up of two fields; an electric field and a magnetic field. These two fields intersect at a 90-degree angle to create a wave that looks something like the image below (Image 3).

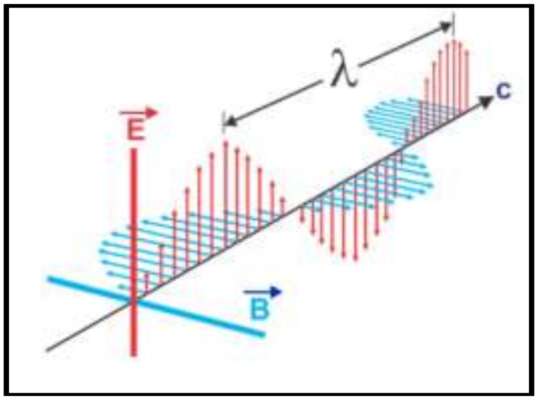

Image 3: An electromagnetic wave (Pixabay, n.d.)

These waves are created in one of two ways. An oscillating charge can cause a changing electric field. This field then causes a changing magnetic field to form. These fields continue to cause the other to form and travel away as an electromagnetic wave. Alternatively, an oscillating current can form a changing magnetic field. This field then causes an electric field to form and as before the two fields form an electromagnetic wave and move away.

Electromagnetic Spectrum

Image four represents all of the energy that is included in the electromagnetic spectrum.

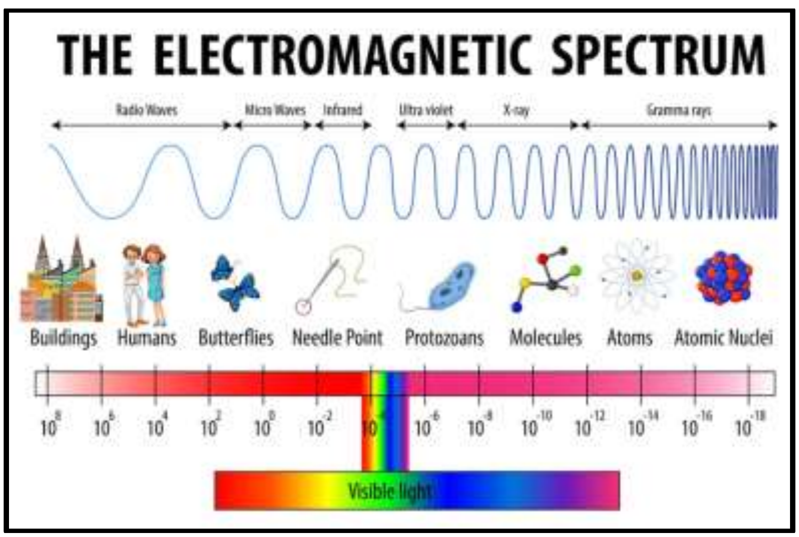

Image 4: The electromagnetic spectrum (Freepic, n.d.)

You may recognize some of the types of energy listed on this figure, for example visible light and x-rays. We use the energy of the Electromagnetic spectrum everyday for a variety of purposes. However, the portion of the spectrum we are going to use in this project may initially seem unfamiliar to you. If you look at the far-left side of image four you will find the radio waves with frequencies ranging from 10 kHz to 100 GHz. This number refers to the frequency of the wave or the number of waves that pass by a given spot in a second. Radio waves are the slowest of electromagnetic waves with the largest amount of space between waves. Even so a frequency of 10 kHz means 10,000 waves pass by a point in one second while a frequency of 100 GHz means 100 million waves pass a point in a second. So while they may be the slowest of the electromagnetic waves they are still moving pretty fast.

References

Bogan, V. (2022) Representation of a transverse wave.
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