Chapter Nineteen: Exploring Space
Lesson 1: Observing the Universe

Most people thought the Earth was the center of the universe.

Earth is part of an 8 planet Solar System that revolves around the Sun → The Sun is part of a larger Milky Way Galaxy → The Milky Way Galaxy is part of billions of other stars and galaxies.

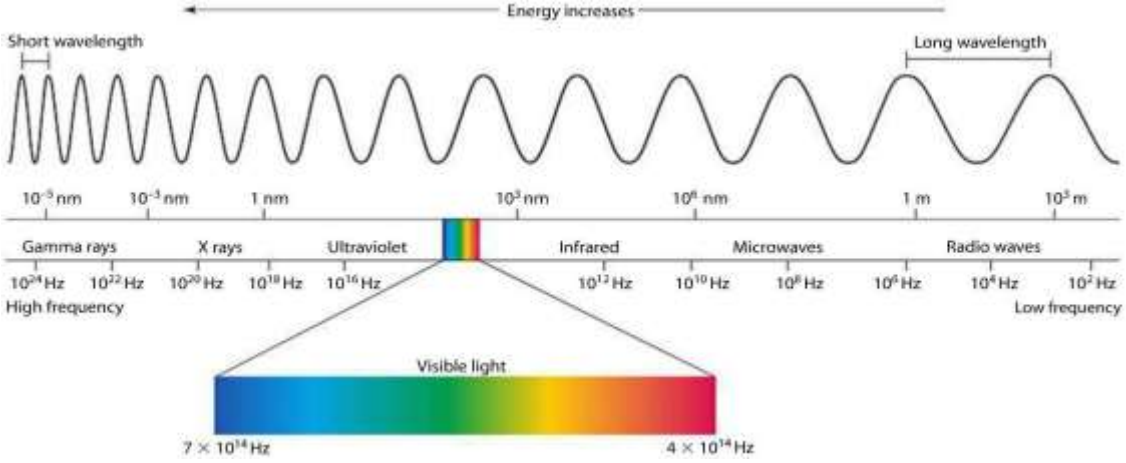
Scientists have not found life anywhere else.

Telescope: gathers and focuses light from objects in space

- Enables astronomers to observe many more stars than they could with their eyes alone

2 types of waves:

1. **Sound waves:** called compression waves
    a. Travel along the wave
    b. Travel through solids, liquids, and gases
2. **Light waves:** called transverse waves
    a. Travel in an up and down pattern
    b. Travel through matter or through a vacuum (space)
    c. Electromagnetic Spectrum: the entire range of radiant energy carried by electromagnetic waves



    d. Humans can only see the Visible Light in the middle

Hot stars emit mostly shorter waves with higher energy (X-rays, gamma) = this is why blue stars are hotter

Cool stars emit mostly longer waves with lower energy (infrared or radio waves) = this is why red stars are cooler

Our Sun is a medium temperature range = we see visible light

We see the Moon and other planets because they reflect light from the Sun.

All electromagnetic waves travel at the speed of light = 3.0×10^8 m/s.

- Light reflected from the Moon reaches Earth in about 1 second.
- Light from the Sun reaches Earth in about 8 minutes.
- Light reaches Jupiter in about 40 minutes.

2 types of optical telescopes:

1. **Refracting telescopes:** a telescope that uses a convex lens to concentrate light from a distant object
    - **a.** Convex lens: lens that is curved and thick in the middle
    - **b.** There is an eyepiece in this telescope and it magnifies the image at the end
2. **Reflecting telescopes:** a telescope that uses a curved mirror to concentrate light from a distant object
    - **a.** Light is reflected from a primary mirror to a secondary mirror.
        - **i.** The secondary mirror is titled to allow the viewer to see the image.

Radio telescope: collects radio waves and some microwaves using an antenna that looks like a TV satellite dish

Moisture in Earth's atmosphere can absorb and distort radio waves and visible light.

- This is why most telescopes are located in dry environments or built on top of mountains.

<u>Optical Space Telescopes:</u> better because there is no atmospheric gases, the sky is darker, and there is no weather.

Hubble Space Telescope: the first optical space telescope is a reflecting telescope that orbits Earth

- Routinely sends Earth spectacular images of far-distant objects
- Collects visible light

Spitzer Space Telescope: orbits the Sun and collects infrared waves

James Webb Space Telescope: launched in 2014 will collect infrared radiation as it too orbits the Sun

- Too far to be serviced by astronauts
- Used to detect galaxies formed very early in the history of the universe