Chapter 28 Section 1 Student Notes

**Tools of Astronomy**

* The light that comes to Earth from distant objects is the best tool that astronomers can use to learn about the universe.
* In most cases, there is no other way to study the cosmos except to analyze the light that we receive from it.

**Radiation**

* Electromagnetic radiation consists of waves of electrical and magnetic disturbances.
* It includes visible light, infrared and ultraviolet radiation, radio waves, microwaves, X rays, and gamma rays.
  + Wavelengths—the distance between peaks on a wave.
  + Frequency—the number of waves or oscillations occurring per second.

**Telescopes**

* When exploring space, telescopes have many benefits:
  + Detectors can be attached to a telescope to observe all wavelengths, not just visible light.
  + A telescope brings much more light to a focus than the human eye can, allowing the observation of faint objects.
  + Specialized equipment, such as a photometer which measures the intensity of visible light, can be used with a telescope.
  + With the aid of imaging devices, telescopes can be used to make time exposures to detect objects that are too faint for the human eye to see.
* **Refracting and Reflecting Telescopes**
  + Two different types of telescopes are used to focus visible light.
  + **Refracting telescopes**, or refractors, are telescopes that use lenses to bring visible light to a focus.
  + **Reflecting telescopes**, or reflectors, are telescopes that bring visible light to a focus with mirrors.
* **Reflectors make up the majority of telescopes that are in use today.**
* **Most major observatories are located in remote, high elevation locations in order to minimize light and atmospheric interference.**

**Telescopes at Other Wavelengths**

* **For all telescopes, the goal is to bring as much radiation as possible to a focus.**
* **Interferometry is the process of linking separate telescopes together so that they act as one telescope.**
* **This process has been used with radio telescopes for a number of years and is now being applied to other telescopes as well.**
* **The detail in the images that they produce improves as the distance between the telescopes increases.**

**Satellites, Probes, and Space-Based Astronomy**

* **Instruments often must be sent into space to collect information because:** 
  + **Earth’s atmosphere blocks infrared radiation, ultraviolet radiation, X rays, and gamma rays.**
  + **When Earth’s atmosphere does allow certain wavelengths to pass through, the images are blurred.**
  + **It is the only way to make close-up observations   
    and even obtain samples from nearby objects in the solar system.**
* **The *Hubble Space Telescope (HST)* makes observations in visible-light, infrared, and ultraviolet wavelengths.**
* **Other space-based telescopes, such as the *Far Ultraviolet Spectroscopic Explorer*, the *Chandra X-Ray Observatory*, and the *Spitzer Space Telescope*, observe other wavelengths that are blocked by Earth’s atmosphere.**
* **Spacecraft**
  + **Space-based exploration can be achieved by sending spacecraft directly to the bodies being observed.**
  + **Robotic probes make close-up observations and sometimes land to collect information directly.**
  + **More recently, the twin robots *Spirit* and *Opportunity* conducted scientific experiments on Mars in 2004.**
* **Human Spaceflight**
  + **Exploring the short term effects of space has been accomplished with the space shuttle program, which began in 1981.**
  + **Since habitation and research began in 2000, a multi-country space station called the   
    *International Space Station* has been used to study the long-term effects of life   
    in space.**
* **Spinoffs**
  + **Spinoffs are technologies that were originally developed for use in space programs that have been passed on to commercial industries for common use.**
  + **More than 1400 different NASA technologies have been incorporated into products ranging from artificial hearts to cordless tools.**