



Basic Concepts & Units

Fundamental Units

Astronomical Unit (AU)	Average distance between Earth and the Sun. $1 \text{ AU} \approx 149.6 \text{ million kilometers}$
Light-Year (ly)	Distance light travels in one year. $1 \text{ ly} \approx 9.461 \times 10^{12} \text{ kilometers}$
Parsec (pc)	Distance at which 1 AU subtends an angle of 1 arcsecond. $1 \text{ pc} \approx 3.26 \text{ light-years}$

Coordinate Systems

Right Ascension (RA)	Analogous to longitude on Earth, measured in hours, minutes, and seconds.
Declination (Dec)	Analogous to latitude on Earth, measured in degrees, arcminutes, and arcseconds.
Altitude (Alt)	The angle between the object and the observer's local horizon.
Azimuth (Az)	The angle along the horizon, measured from North towards East.

Important Constants

Speed of Light (c)	$c \approx 299,792,458 \text{ m/s}$
Gravitational Constant (G)	$G \approx 6.674 \times 10^{-11} \text{ N(m/kg)^2}$
Stefan-Boltzmann Constant (σ)	$\sigma \approx 5.670 \times 10^{-8} \text{ W/(m}^2 \text{ K}^4)$

Celestial Objects

Planets

Terrestrial Planets	Mercury, Venus, Earth, Mars. Rocky surfaces, higher densities.
Gas Giants	Jupiter, Saturn. Primarily composed of hydrogen and helium.
Ice Giants	Uranus, Neptune. Contain heavier elements like oxygen, carbon, nitrogen, and sulfur.

Stars

Main Sequence Stars	Stars fusing hydrogen into helium in their cores (e.g., our Sun).
Red Giants	Stars that have exhausted hydrogen in their cores and have expanded.
White Dwarfs	Remnants of low- to medium-mass stars after they have shed their outer layers.
Neutron Stars	Extremely dense remnants of massive stars after supernova explosions.
Black Holes	Regions of spacetime with gravity so strong that nothing, not even light, can escape.

Galaxies

Spiral Galaxies	Disk-shaped galaxies with spiral arms (e.g., Milky Way, Andromeda).
Elliptical Galaxies	Smooth, oval-shaped galaxies with little or no spiral structure.
Irregular Galaxies	Galaxies with no defined shape.

Key Formulas & Laws

Kepler's Laws of Planetary Motion

1st Law: The orbit of each planet is an ellipse with the Sun at one of the two foci.
2nd Law: A line joining a planet and the Sun sweeps out equal areas during equal intervals of time.
3rd Law: The square of the orbital period of a planet is directly proportional to the cube of the semi-major axis of its orbit. $P^2 \propto a^3$

Doppler Effect

Change in frequency of a wave (light or sound) due to the relative motion between the source and the observer. $\lambda = \lambda_0 (1 + v/c)$ where:
<ul style="list-style-type: none"> λ is the observed wavelength λ_0 is the emitted wavelength v is the relative velocity c is the speed of light

Stefan-Boltzmann Law

The total energy radiated per unit surface area of a black body per unit time is directly proportional to the fourth power of the black body's thermodynamic temperature. $j^* = \epsilon \sigma T^4$ where:
<ul style="list-style-type: none"> j^* is the total energy radiated ϵ is the emissivity of the object (1 for a black body) σ is the Stefan-Boltzmann constant T is the absolute temperature in Kelvin

Newton's Law of Universal Gravitation

The gravitational force between two objects: $F = G * (m1 * m2) / r^2$ where:
<ul style="list-style-type: none"> F is the gravitational force G is the gravitational constant $m1$ and $m2$ are the masses of the objects r is the distance between the centers of the objects

Observational Astronomy

Telescopes

Refracting Telescopes	Use lenses to focus light.
Reflecting Telescopes	Use mirrors to focus light.
Aperture	The diameter of the main lens or mirror; larger aperture gathers more light.

Filters

Light Pollution Filters	Reduce the effects of artificial light.
Narrowband Filters	Isolate specific wavelengths of light (e.g., H-alpha for nebulae).
Color Filters	Enhance contrast and details of planets.

Observational Tips

- Allow your eyes to adjust to the darkness (dark adaptation) for at least 20-30 minutes.
- Use averted vision to see faint objects by looking slightly to the side of them.
- Plan your observing session ahead of time using star charts or planetarium software.
- Keep a logbook of your observations.