Applications of Light to Astronomy

Applications:
- Based on the spectrum of a celestial object (planet, star, nebula) we can learn:
    - How hot it is (surface temperature)
    - What it is made of (chemical composition)
    - How fast it is moving relative to Earth (towards or away)

- *Continuous Emission:*
    - Continuous emission from thermal Blackbody radiation allows us to estimate the *surface temperature*
        - e.g. infrared emission of a planet (asteroid, etc.)
        - For stars (like the Sun), we use the visible spectrum!

- *Emission Lines:*
    - Observing which wavelengths are emitted tells you about the chemical composition of a thin, excited gas (e.g. hot upper atmosphere of a planet, comet tail, Orion Nebula)

- *Absorption Lines:*
    - Observing which wavelengths are missing after *reflection* tells you about the composition of the reflecting surface!
    - Observing which wavelengths are missing after passing *through* material (e.g. atmosphere of a planet or star) tells you about that material
        - Most of the stuff in the universe is hydrogen (~71% by mass, ~91% by number of atoms) and helium (~27% by mass, ~9% by number of atoms)

- *Doppler Effect:*
    - Observing the shift in a spectrum (emission-line or absorption-line) tells you how fast the object is moving towards / away from the Earth
        - Binary Stars: orbits
        - Detecting planets around other stars
        - Spin of asteroids, Venus
        - Expansion of universe (motions of distant galaxies)
        - Dark matter (motions of stars inside galaxies)