A Century of Astronomy

1920's	Edwin Hubble determines that Andromeda Nedula is a galaxy.
	Cecilia Payne-Gaposhkin determines that hydrogen is the most common element in the universe.
	Hubble discovers expanding universe.
1930's	Clyde Tombaugh discovers Pluto (planet).
	Karl Jansky detects first radio waves from space.
	Walter Baade & Fritz Zwicky describe neutron stars that would form in a supernova collapse.
	Hans Bethe describes nuclear fusion that powers stars.
1940's	Palomar 200 inch telescope built.
1950's	Sputnik 1 launched - 1st man made object in space.
	Luna 2 & 3 explore the moon (crash into and photographing the dark side).
1960's	1st Human to orbit Earth.
	Mariner 2 became first man made object to visit another planet (Venus).
	Maarten Schmidt discovers quasars (active galaxies) and therefor the most distance objects know at that time.
	Arno Penzias & Robert Wilson discovers the Cosmic Microwave Backround.
	Luna 9 made the 1st soft landing on the moon.
	Jocelyn Bell discovers the 1st pulsar.
	First manned flight to the moon (Apollo 8).
	First manned landing on the moon (Apollo 11).
	Charles Thomas Bolton identified Cygnus X-1 as a black hole
1970's	Uhuru is the 1st satellite launched.
	1st Space station launched.
	Verena 9 sends back 1st images from the surface of Venus.
	Viking landers arrive at Mars to search for life.
	Voyager 1 & 2 launched to explore outer solar system.
	Rings of Uranus discovered.
	Vera Rubin confirmed the existence of dark matter.

A Century of Astronomy (cont)

1980's	IRAS launched and become 1st satellite to work in infrared.
	Voyager 2 visits Uranus.
	Voyager 2 visits Neptune.
1990's	Magellan spacecraft maps the surface of Venus with radar.
	Hubble Space Telescope launched.
	Cosmic Background Explorer detects ripples in the background radiation.
	!st confirmed detection of an exoplanet.
	Construction of ISS (International Space Station) begins.
	Discovery of dark energy.
2000's	Mike Brown discovers Eris in the outer solar system.
	The International Astronomical Union formally defined a planet and dwarf planet.
2010's	Suvi Gezari discovers 1st visual proof of a black hole.
	First Extrasolar asteroid discovered.
	New Horizons explores Pluto
	1st detection of gravitational waves.
	Source of gravitational waves (neutron star collision) identified.

The Celestial Sphere

Zenith	The point straight overhead of an observer.
Horizon	The circle where the celestial sphere meets the Earth.
Celestial pole	The projection of the Earth's poles to the celestial sphere.
Celestial equator	The projection of the Earth's equator to the celestial sphere.
Ecliptic	The apparent path of the Sun on the celestial sphere.
Vernal equinox	The intersection of the ecliptic and the celestial equator, where the Sun is moving northward.
Circum-polar stars	Stars close to the pole that never sets (e.g. Polaris).
Retrograde Motion	Only planets, the loop back wards when following the path of a planet.

Coordinate Systems

Locations on Earth	Latitude (north/ south) and Longitude (east/ west).
Location in the Sky	Declination (north/ south of celestial equator) and Right Ascension (east of vernal equinox in hours).

Ancient Astronomy

Eudoxus (Geocentric)	An early mode of the universe.
Aristotle (Geocentric)	The Earth is round, circular orbits and uniform speed.
Eratosthenes	Measure circumference of Earth using shadows.
Aristarchus (Heliocentric)	Suggested that Sun is the center of the universe.
Hipparchus	Magnitudes (apparent brightness - 1 being the brightest and 6 the faintest) of stars and discovered precession (how the Earth spins and how the axis' direction changes).
Ptolemy (Geocentric)	A mathematical model putting everything together called The Almagest.

The Origin of Modern Astronomy

The Copernican Revolution - 1st suggested by Aristarchus.

Nicolaus Copernicus (1473 to 1543) suggested that Earth is a planet and completed heliocentric model.

Heliocentric model: sun at the center with Earth and other planets revolving around the Sun. It predicted parallax of stars (not detected until 1838) and simply explained retrograde motion.

Retrograde motion: apparent backwards motion of planets explained by epicycles in the geocentric model and relative motion in the heliocentric model. Continued use of circular orbits caused the need of epicycles in a heliocentric model as well to explain motion.

Galileo Galilee (1564 to 1642) 1st scientist to perform experiments and 1st to use telescope to observe the space and make predictions.

Observations and Predictions: Sun rotation, Sun and moon spots, Venus orbits the Sun (shown by the phases of Venus), Jupiter has 4 satellites and the Milky Way.

Time and The Calendar

Day	Rotation of Earth.
Week	Seven objects that move among the stars (Sun, moon and 5 known planets).
Month (29.5 days)	Phases of the moon.
Year (365.24 days)	Revolution of Earth around the Sun.
Stonehenge	Alignments with rising/ setting of sun/ moon.
Mayans	Complex calendar based on Venus.
Chinese	12-year cycle of Jupiter leads to 12-year cycle of Chinese zodiac.
Julian	Differs actual year by 11 min. Added up to 10 days over a thousand years.
Gregorian	Dropped 10 days to fix from Julian calendar and added extra rules for leap years.
Leap year	Add and extra day every 4 years, except century years (ending in 00) had to be divisible by 400 to be a leap year.

Phases of the Moon and Tides

Waxing lunar phase (overhead before midnight)	More illuminated (right side) each day, moving towards a full moon.
Waning lunar phase (overhead after midnight)	Less illuminated (left side) each day, moving towards a new moon.
Synodic month	Cycle of lunar phases (29.5 days).
Sidereal month	Revolution of moon around the Earth (27.3 days).
New moon	Always in same direction as the Sun, rises and sets with the sun.
Crescent	Always close to the Sun in the sky, visible right before (after) sunrise (sunset)..
Quarter	Halfway around the sky from the Sun.
Gibbous	More than halfway around the sky from the Sun

Phases of the Moon and Tides (cont)

Full	Opposite side from the Sun, rises and sets opposite the Sun
Tides	Caused by the Moon and Sun (differential gravitation force), a stronger force is acting on the side closest.
Spring Tides (New & full)	When the Sun and Moon are lined up and their forces are working constructively to cause higher/ bigger tides.
Neap Tides (Quarters)	The forces caused by the Sun and Moon are working perpendicular destructively) to each other.

Synchronous Rotation: The rotation and revolution of the moon are the exact same, causing the same side to always face Earth.

Eclipses

Solar eclipse	Moon pasees in front of the Sun with the same apparent size.
Lunar eclipse	Moon passes into the Earth's shadow (new moon).
Umbra	Darkest part, where the sunlight is completely blocked out.
Penumbra	Region of partial shadow, where the sunlight is partially blocked.
Total solar eclipse	The entire face of the sun is blocked out.
Partial solar eclipse	Part of the Sun's face is blocked.
Annular solar eclipse	A ring of sunlight is visible around the moon, when the moon is at a further point from Earth.
Total lunar eclipse	Entire moon in the umbra.
Partial lunar eclipse	Part of the moon in the umbra.
Penumbral lunar eclipse	Moon passes through the penumbra only.
Eclipse season	When the moon is near a node.
Saros Cycle	The time between very similar eclipses (18 years 11 days and 8 hours). .

Light and Electromagnetic Spectrum

Electromagnetic (EM) radiation	Created by moving photons (charged particle).
Wave nature	Wavelength, frequency, interference, reflection, refraction, diffraction and doppler effect.
Speed of light	300 000 km/s
Particle nature	Photoelectric effect and gravitational deflection.
Temperature	Mausre of average kinetic energy of particles.
Absolute Zero	If there was absolutely no energy or movement.
Kelvin	Based on absolute zero = 0K = -273 degrees. Outer space is 3K.
Blackbody radiation	An ideal radiator that absorbs all radiation and only reflects light based on temperature.
Stefan-Bo-ltzmann Law	Higher temperature means higher intensity.
Wien's Law	Higher temperature means shorter peak wavele-ngth.