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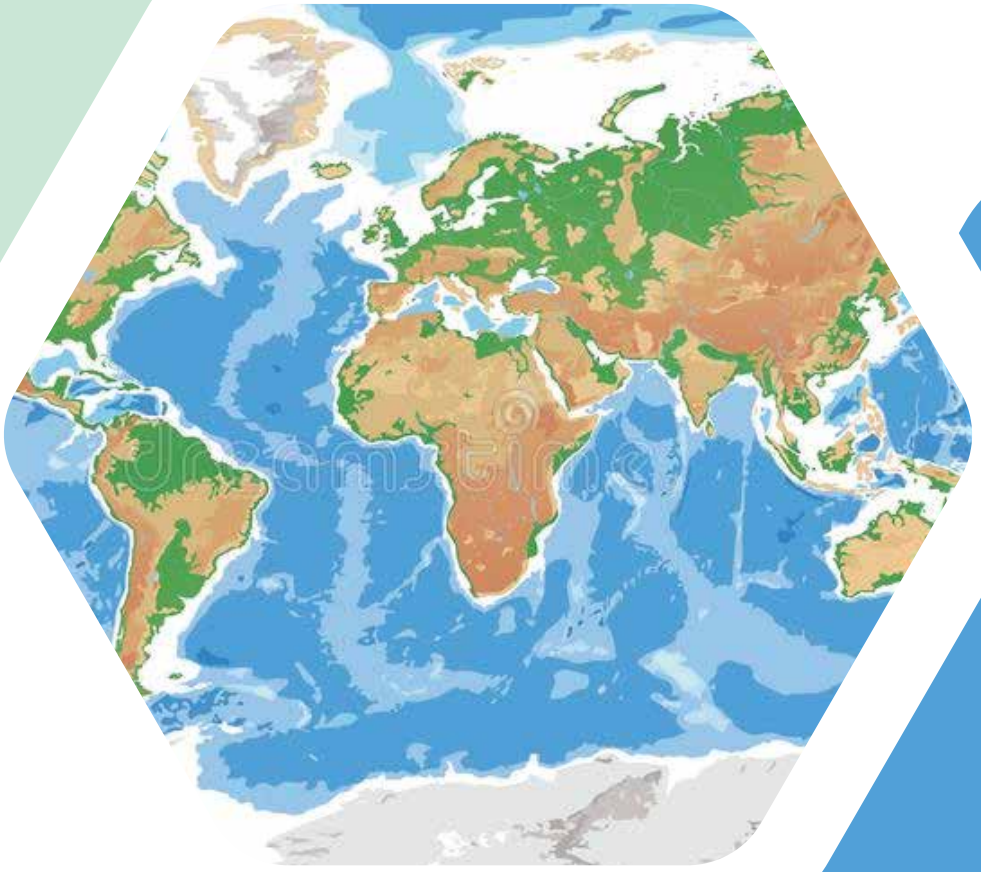


WORLD PHYSICAL GEOGRAPHY

for Civil Services Exam

CONTENTS

WORLD PHYSICAL GEOGRAPHY

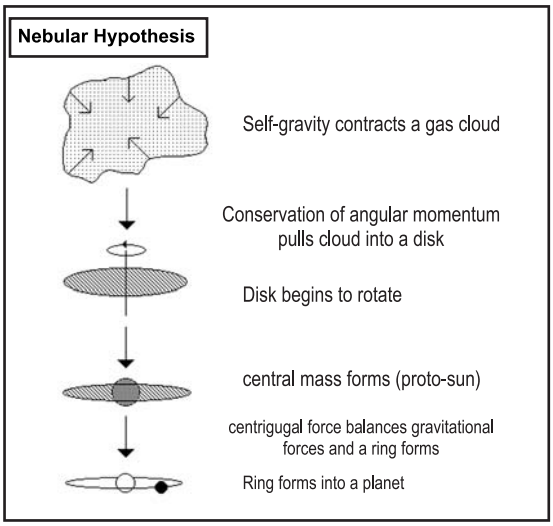
UNIT
1

UNIVERSE & EARTH

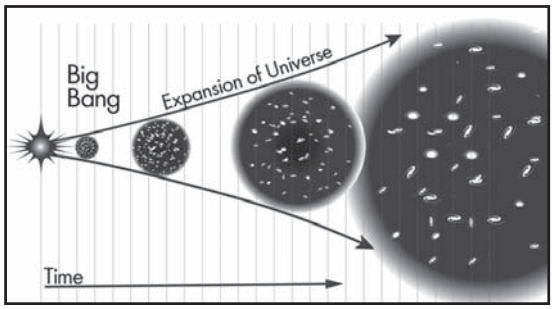
CHAPTER
1.1

UNIVERSE

■ Chronology of theories on origin of the Universe



- **Nebular Hypothesis:** (Initial arguments were given by German philosopher **Immanuel Kant** Mathematician **Laplace revised it in 1796)**. The hypothesis considered that the planets were formed out of a cloud of material associated with a youthful sun, which was slowly rotating.
- **Planetesmial Hypothesis**: In 1900, **Chamberlain and Moulton** considered that a wandering star approached the sun. Sir James Jeans and later Sir Harold Jeffrey supported the argument.
- At a later date, the arguments considered of a companion to the sun to have been coexisting. These arguments are called **binary theories.**
- In 1950, **Otto Schmidt in Russia and Carl Weizascar in Germany** somewhat revised the 'nebular hypothesis'.



- **Big Bang Theory/ Expanding Universe Hypothesis:** It was given by **Edwin Hubble.** According to "Big Bang Theory' everything in the universe emerged from a point known as **'Singularity'** 15 billion years ago. Later on, this point expanded and inside it galaxies move apart due to which empty space between them expanded. All matter in the universe was created at one instant in fixed moment of time. A single fire ball existed along with wispy clouds of matter. When it exploded, it formed cluster of galaxies which exploded to form stars and then stars exploded to form planets.

■ Big bang

- A Belgian priest named Georges Lemaître first suggested the big bang theory in the 1920s, when he theorized that the universe began from a single primordial atom. The idea received major boosts from Edwin Hubble's observations that galaxies are speeding away from us in all directions, as well as from the 1960s discovery of cosmic microwave radiation—interpreted as echoes of the big bang—by Arno Penzias and Robert Wilson.

- Here's the theory: In the first 10^-43 seconds of its existence, the universe was very compact, less than a million billion billionth the size of a single atom. It's thought that at such an incomprehensibly dense, energetic state, the four fundamental forces—gravity, electromagnetism, and the strong and weak nuclear forces—were forged into a single force.
- It's also thought that the extremely close quarters allowed the universe's very first particles to mix, mingle, and settle into roughly the same temperature. Then, in an unimaginably small fraction of a second, all that matter and energy expanded outward more or less evenly, with tiny variations provided by fluctuations on the quantum scale. That model of breakneck expansion, called inflation, may explain why the universe has such an even temperature and distribution of matter.
- By the time the universe was a billionth of a second old, the universe had cooled down enough for the four fundamental forces to separate from one another. The universe's fundamental particles also formed. Within the universe's first second, it was cool enough for the remaining matter to coalesce into protons and neutrons, the familiar particles that make up atoms' nuclei. And after the first three minutes, the protons and neutrons had assembled into hydrogen and helium nuclei. By mass, hydrogen was 75 percent of the early universe's matter, and helium was 25 percent. The abundance of helium is a key prediction of big bang theory, and it's been confirmed by scientific observations.
- As time passed and matter cooled, more diverse kinds of particles began to form, and they eventually condensed into the stars and galaxies of our present universe.
- Even now the universe is expanding, and to astronomers' surprise, the pace of expansion is accelerating. It's thought that this acceleration is driven by a force that repels gravity called dark energy. We still don't know what dark energy is, but it's thought that it makes up 68 percent of the universe's total matter and energy. Dark matter makes up another 27 percent. The rest - everything on Earth, everything ever observed with all of our instruments, all normal matter - adds up to less than 5% of the universe.

The End of the Universe

- Will the universe continue expanding? Will it just stop or even begin to contract? The answer depends on the amount of mass that the universe contains. If the universe's mass exceeds a certain crucial value, then gravity should eventually stop everything from flying away from everything else.
- With enough mass, the universe will eventually succumb to the overpowering force of gravity and collapse again into a single point—a theory often called the **Big Crunch**. But without enough mass, the universe will continue to expand.
- In 1998, astronomers found an even more remarkable puzzle: the universe seems to be accelerating while expanding, as if being pulled by some kind of **"antigravity" force**. Other astronomers have since corroborated this finding using a variety of methods, and have all but confirmed the existence of this mysterious "**dark energy**."

■ Solar System

Overview

- Our solar system consists of our star, the Sun, and everything bound to it by gravity — the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune, dwarf planets such as Pluto, dozens of moons and millions of asteroids, comets and meteoroids. The solar system also includes the Kuiper Belt that lies past Neptune's orbit. And beyond the fringes of the Kuiper belt is the Oort Cloud. This giant spherical shell surrounds our solar system.
- Solar system consists of the sun (the star), 8 planets, moons, millions of smaller bodies like asteroids and comets and huge quantity of dust-grains and gases.
- Alternatively, the first four are called **Terrestrial**, meaning earth-like as they are made up of rock and metals, and have relatively high densities. The rest four are **called Jovian or Gas Giant planets.** Jovian means Jupiter-like. Most of them are much larger than the terrestrial planets and have thick atmosphere, mostly of helium and hydrogen.

- All the planets were formed in the same period sometime about **4.6 billion years ago**.
- Till recently (August 2006), Pluto was also considered a planet. However, in a meeting of the International Astronomical Union, a decision was taken that Pluto like other celestial objects (2003 UB313) discovered in recent past may be called **'dwarf planet'.**
- The Sun—the heart of our solar system—is a yellow dwarf star, a hot ball of glowing gases. Its gravity holds the solar system together, keeping everything from the biggest planets to the smallest particles of debris in its orbit. Electric currents in the Sun generate a magnetic field that is carried out through the solar system by the solar wind—a stream of electrically charged gas blowing outward from the Sun in all directions. The connection and interactions between the Sun and Earth drive the seasons, ocean currents, weather, climate, radiation belts and aurorae. Though it is special to us, there are billions of stars like our Sun scattered across the Milky Way galaxy. The Sun rotates as it orbits the center of the Milky Way. Its spin has an axial tilt of 7.25 degrees with respect to the plane of the planets' orbits. Since the Sun is not a solid body, different parts of the Sun rotate at different rates. At the equator, the Sun spins around once about every 25 days, but at its poles the Sun rotates once on its axis every 36 Earth days. The Sun's enormous mass is held together by gravitational attraction, producing immense pressure and temperature at its core. The Sun has six regions: the core, the radiative zone, and the convective zone in the interior; the visible surface, called the photosphere; the chromosphere; and the outermost region, the corona.

Why Venus is sometimes called Earth's twin?

Venus is sometimes called Earth's twin because Venus and Earth are **almost the same size, have about the same mass** (they weigh about the same), **and have a very similar composition** (are made of the same material). They are also neighbouring planets.

However, Venus and Earth are also very different. Venus has an atmosphere that is about 100 times thicker than Earth's and has surface temperatures that are extremely hot. Venus does not have life or water oceans like Earth do. Venus also rotates backwards compared to Earth and the other planets.

Formation

- Our solar system formed about 4.5 billion years ago from a dense cloud of interstellar gas and dust. The cloud collapsed, possibly due to the shockwave of a nearby exploding star, called a supernova. When this dust cloud collapsed, it formed a **solar nebula**—a spinning, swirling disk of material. At the center, gravity pulled more and more material in. Eventually the pressure in the core was so great that hydrogen atoms began to combine and form helium, releasing a tremendous amount of energy. With that, our Sun was born, and it eventually amassed more than 99 percent of the available matter.
- Matter farther out in the disk was also clumping together. These clumps smashed into one another, forming larger and larger objects. Some of them grew big enough for their gravity to shape them into spheres, becoming planets, dwarf planets and large moons. In other cases, planets did not form: the asteroid belt is made of bits and pieces of the early solar system that could never quite come together into a planet. Other smaller leftover pieces became asteroids, comets, meteoroids, and small, irregular moons.

Structure

- The order and arrangement of the planets and other bodies in our solar system is due to the way the solar system formed. Nearest the Sun, only rocky material could withstand the heat when the solar system was young. For this reason, the first four planets—Mercury, Venus, Earth and Mars—are **terrestrial planets**. They're small with solid, rocky surfaces.
- Meanwhile, materials we are used to seeing as ice, liquid or gas settled in the outer regions of the young solar system. Gravity pulled these materials together, and that is where we find **gas giants** Jupiter and Saturn and ice giants Uranus and Neptune.

Moons

- There are more than 150 known moons in our solar system and several more awaiting confirmation of discovery. **Of the eight planets, Mercury and Venus are the only ones with no moons.** The giant planets grab the most moons. Jupiter and Saturn have long lead our solar system's moon counts. Pluto, smaller than our own moon, has five moons in its orbit, including the Charon, a moon so large it makes Pluto wobble. Even tiny asteroids can have moons. In 2017, scientists found asteroid 3122 Florence had two tiny moons.

Planets

- Interesting Planet Facts
  - Mercury – The smallest and fastest planet, it zips around the Sun in only 88 Earth days.
  - Venus – Venus' thick atmosphere makes it the hottest planet in our solar system.
  - Earth – The only planet in our solar system with liquid water on the surface.
  - Mars – Mars was a wet and warm planet billions of years ago.
  - Jupiter – The largest planet, its dark red spot is a storm larger than Earth.
  - Saturn – Saturn has the brightest, most massive and most complex ring system of any planet.
  - Uranus – Uranus is tipped on its axis by almost 90-degrees.
  - Neptune – Neptune was the first planet discovered through mathematical calculations, rather than observation.

Dwarf Planets

- There are currently five planets classified as dwarf planets: Ceres, Pluto, Makemake, Haumea and Eris. Except for Ceres, which lies in the main asteroid belt, these small planets are located in the Kuiper Belt.
- The IAU resolves that planets and other bodies, except satellites, in our Solar System be defined into three distinct categories in the following way:
- A planet is a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit.
- A "dwarf planet" is a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, (c) has not cleared the neighbourhood around its orbit, and (d) is not a satellite.
- All other objects, except satellites, orbiting the Sun shall be referred to collectively as "Small Solar System Bodies".

Exoplanets

- An exoplanet, or extrasolar planet, is a planet outside of our solar system that usually orbits another star in our galaxy.
- Most of the exoplanets discovered so far are in a relatively small region of our galaxy, the Milky Way.
- So far scientists have categorized exoplanets into the following types: Gas giant, Neptunian, super-Earth and terrestrial.
- Super-Earths – a class of planets unlike any in our solar system – are more massive than Earth yet lighter than ice giants like Neptune and Uranus, and can be made of gas, rock or a combination of both. They are between twice the size of Earth and up to 10 times its mass.
- **Barnard's Star b is the second-closest known exoplanet to Earth, after the Proxima Centauri b**. The data indicate that the planet could be a super Earth, with a mass at least 3.2 times that of the Earth, which orbits its host star in roughly 233 days. Barnard's Star, the planet's host star, is a red dwarf, a cool, low-mass star, which only dimly illuminates this newly-discovered world. Light from Barnard's Star provides its planet with only 2% of the energy the Earth receives from the Sun.

■ Facts about Solar System

- The eight bodies officially categorized as planets are often further classified in several ways:

By composition:

- ***Terrestrial or rocky planets***: Mercury, Venus, Earth, and Mars:
- The terrestrial planets are composed primarily of rock and metal and have relatively high densities, slow rotation, solid surfaces, no rings and few satellites.
- ***Jovian or gas planets***: Jupiter, Saturn, Uranus, and Neptune:
- The gas planets are composed primarily of hydrogen and helium and generally have low densities, rapid rotation, deep atmospheres and lots of satellites.

By size:

- ***Small planets***: Mercury, Venus, Earth, Mars. (The small planets have diameters less than 13000 km.)
- ***Giant planets***: Jupiter, Saturn, Uranus and Neptune. (The giant planets have diameters greater than 48000 km.The giant planets are sometimes also referred to as gas giants.)

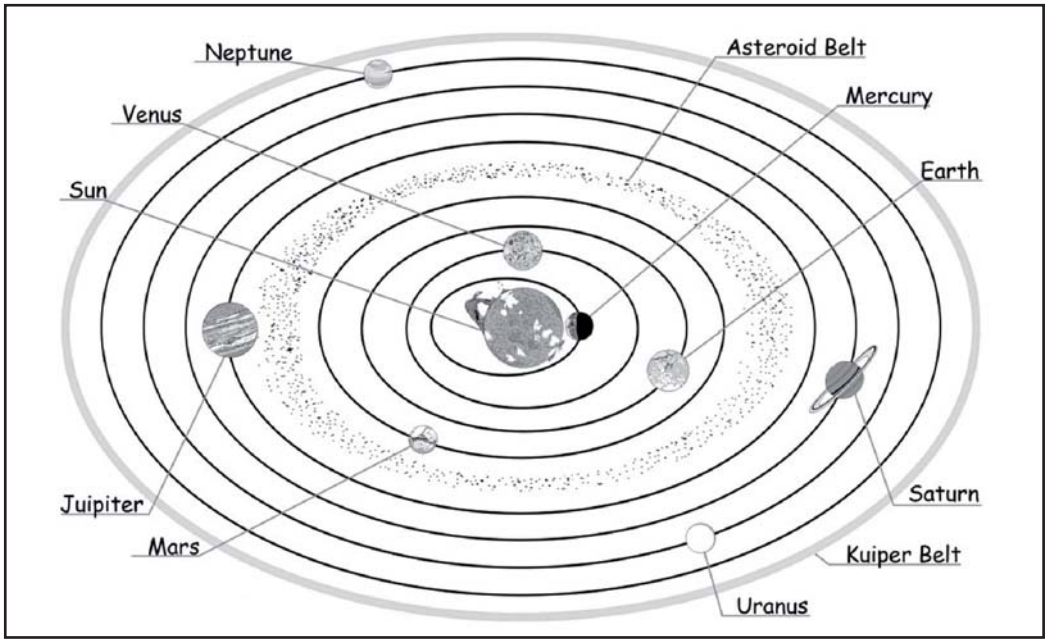
By position relative to the Sun:

- ***Inner planets***: Mercury, Venus, Earth and Mars.
- ***Outer planets***: Jupiter, Saturn, Uranus, Neptune.

  The asteroid belt between Mars and Jupiter forms the boundary between the inner solar system and the outer solar system.

By position relative to Earth:

- ***Inferior planets:*** Mercury and Venus. (Closer to the Sun than Earth. The inferior planets show phases like the Moon's when viewed from Earth.)
- ***Superior planets***: Mars to Neptune. (Farther from the Sun than Earth. The superior planets always appear full or nearly so.)

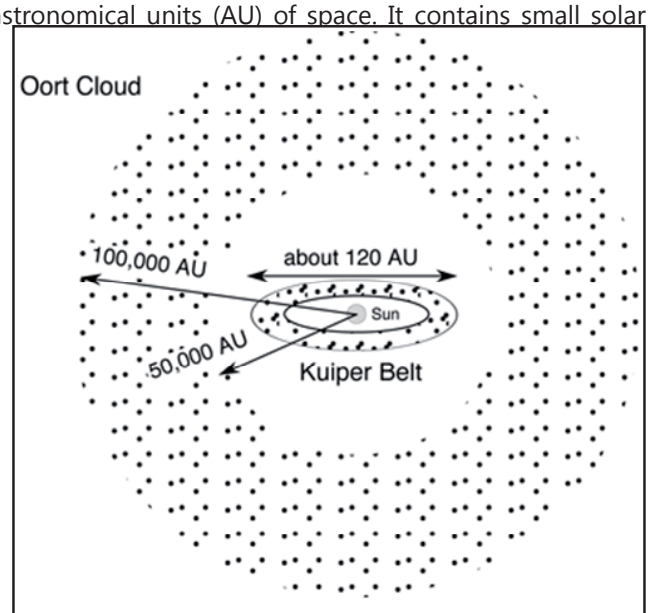


The Solar System								
	Mercury	**Venus**	**Earth**	**Mars**	**Jupiter**	**Saturn**	**Uranus**	**Neptune**
Distance	0.387	0.723	1.000	1.524	5.203	9.539	19.182	30.058
Density	5.44	5.245	5.517	3.945	1.33	0.70	1.17	1.66
Radius	0.383	0.949	1.000	0.533	11.19	9.460	4.11	3.88
Satellites	0	0	1	2	>53	About 53	about 27	13
Distance from the sun in astronomical unit i.e. average mean distance of the earth is 149,598,000 km = 1 @ Density in gm/cm^3 # Radius: Equatorial radius 6378.137 km = 1								

- Biggest Plane: Jupiter
- Blue Planet: Earth
- Green Planet: Uranus
- Coldest Planet: Neptune
- Evening Star: Venus
- Farthest Planet from Sun: Neptune
- Planet with maximum number of satellites: Jupiter
- Hottest Planet: Venus
- Densest Planet: Earth
- Fastest Rotation in Solar system: Jupiter
- Morning Star: Venus
- Red Planet: Mars
- Smallest Planet: Mercury
- Slowest Revolution in solar system: Neptune
- Slowest Rotation in solar system: Venus
- Nearest Planet to Earth: Venus
- Nearest Planet to Sun: Mercury

Kuiper Belt:

- The Kuiper Belt (sometimes referred to as the Kuiper-Edgeworth Belt) is an area of the outer solar system that is estimated to stretch across 20 astronomical units (AU) of space. It contains small solar system bodies made mostly of ices. The ices are frozen volatiles (gases) such as methane, ammonia, nitrogen and water. It also is home to the known dwarf planets Pluto, Haumea and Makemake.
- The Kuiper-Edgeworth Belt is named for the astronomers Gerard Kuiper. The Kuiper Belt extends from roughly the orbit of Neptune (at 30 AU out to about 55 astronomical units) from the Sun.



The Oort Cloud and Kuiper Belt (not to scale!). Extent of the two comet reservoirs are indicated. The nearest star is almost three times farther out than the Oort Cloud.

Oort cloud:

- The Oort cloud is an extended shell of icy objects that exist in the outermost reaches of the solar system. It is named after astronomer Jan Oort, who first theorised its existence. The Oort cloud is roughly spherical, and is thought to be the origin of most of the long-period comets that have been observed.

- Objects in the Oort cloud are also referred to as Trans-Neptunian objects. This name also applies to objects in the Kuiper Belt.

GLOSSARY

- **Celestial Bodies:** Celestial bodies or heavenly bodies are objects in space such as the sun, moon, planets and stars. They form a part of the vast universe we live in and are usually very far from us.
- **Stars:** Stars are giant balls of hot gases that can produce their own light. Stars are gigantic in size and have immense gravitational attraction.
- **Constellations:** Different groups of stars form various patterns and they are called constellations. Saptarshi is an example of constellations. In ancient times, with the help of stars directions were determined during night time. The North Star indicates the north direction (Pole Star) and it remains in the same position in the sky.
- **Planets:** They are large (almost) spherical objects that revolve around the sun. Planets move in fixed orbits around the sun. Planets may be made of rocks, metals and gases like hydrogen, nitrogen and methane. The earth is also a planet and is the only known place in the universe which supports life. Planets that revolve around other stars are called exoplanets.
- **Satellites:** Satellites are objects that revolve around planets. These may be of natural origin or sent by humans. The moon is a natural satellite of the earth and revolves around it because it is bound by the Earth's gravitational pull.
- **Comets:** These are small chunks of ice and rock that come from the outer edge of the solar system. When its orbit brings it closer to the sun, the ice on them vaporizes creating a beautiful tail behind them.
- **Asteroids:** These are small irregularly shaped rocks made up of metal or minerals that orbit the sun. Most of them are found between Mars and Jupiter in an area known as the asteroid belt.
- **Meteors and Meteorites:** These are objects from space that enter our atmosphere as they are pulled by the earth's gravity. Meteors usually are small and burn up in the atmosphere as they enter the earth. This creates streaks in the sky as though a star has fallen. They are commonly called shooting stars. If a meteor is large enough it can reach the ground and create a crater. Such objects are called meteorites.
- **Galaxies:** Galaxies are large groups of stars held together by gravity. The sun and the solar system is part of a galaxy known as the Milky Way.
- **Light Year:** A light year is measure of distance and not of time. Light travels at a speed of 300, 00 km/second. Considering this, the distance the light will travel in one year. This equals to 9.461 1012km. The mean distance between the sun and the Earth is 149,598,800 km. In terms of light years it is 8.311 minutes.
- **Astronomical Unit:** The measurement unit used for large distance is Astronomical Unit (AU). One AU represents the distance of 150 million kms (the distance between Earth and Sun).

■ Geological Time Scale

Eons	Era	Period	Epoch	Age/ Years Before Present	Life/ Major Events
	Cainozoic (From 65 million years to the present times)	Quaternary	Holocene	0 - 10,000	Modern Man
			Pleistocene	10,000 - 2 million	Homo Sapiens

		Tertiary	Pliocene Miocene Oligocene Eocene Palaeocene	2 - 5 million 5 - 24 million 24 - 37 million 37 - 58 Million 57 - 65 Million	Early Human Ancestor Ape: Flowering Plants and Trees Anthropoid Ape Rabbits and Hare Small Mammals : Rats – Mice
	Mesozoic 65 - 245 Million Mammals	Cretaceous Jurassic Triassic		65 - 144 Million 144 - 208 Million 208 - 245 Million	Extinction of Dinosaurs Age of Dinosaurs Frogs and turtles
	Palaeozoic 245 - 570 Million	Permian Carboniferous Devonian Silurian Ordovician Cambrian		245 - 286 Million 286 - 360 Million 360 - 408 Million 408 - 438 Million 438 - 505 Million 505 - 570 Million	Reptile dominate-replace amphibians First Reptiles: Vertebrates: Coal beds Amphibians First trace of life on land: Plants First Fish No terrestrial Life : Marine Invertebrate
Proterozoic Archean Hadean	Pre-Cambrian 570 Million - 4,800 Million			570 - 2,500 Million 2,500 - 3,800 Million 3,800 - 4,800 Million	Soft-bodied arthropods Blue green Algae: Unicellular bacteria Oceans and Continents form – Ocean and Atmosphere are rich in Carbon dioxide
Origin of Stars Supernova Big Bang	5,000 - 13,700 Million			5,000 Million 12,000 Million 13,700 Million	Origin of the sun Origin of the universe

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