UPSC MAINS

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PHYSICAL GEOGRAPHY

WORLD & INDIA

for Civil Servies Examination

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WORLD PHYSICAL GEOGRAPHY

UNIT - I

GEOMORPHOLOGY

1.1

ORIGIN OF THE EARTH

Physical Features of Earth

Earth is located in the Solar System, which is located in the Orion (or local) arm of Milky Way Galaxy, which is a part of Virgo Super cluster. As a part of the Milky Way Galaxy, the Earth is accelerating outward toward the outer regions of the universe. Earth is third planet from the Sun and Fifth largest planet. It is largest among the Solar System's four terrestrial planets (Mercury, Venus, Earth, and Mars). Earth is also the densest planet of the solar system.

The shape of the earth is **'Geoid'** as the earth is slightly flattened at the poles, the linear distance of a degree of latitude at the pole is a little longer than that at the equator.

Radius and Circumference of Earth

The Mean radius of Earth is 6,371.0 km. Equatorial radius is 6,378.1 km, while polar radius is 6356.8 kilometers. This means that Earth is not perfectly spherical; no single value serves as its natural radius. Even calling it Radius is factually incorrect because "radius" normally is a characteristic of perfect spheres. Earth's rotation causes it to be like an oblate spheroid with a bulge at the equator and flattening at the North and South Poles. So the equatorial radius is larger than the polar radius.

The farthest point from Earth's centre is Chimborazo, an inactive volcano in the Andes Mountains in Ecuador, in South America. Chimborazo is not the highest mountain by elevation above sea level, but its location along the equatorial bulge makes its summit the farthest point on the Earth's surface from the Earth's center. The Equatorial Circumference of Earth is 40,075.16 km, while the Meridional Circumference is 40,008.00 km.

Composition of Earth Crust

Almost half of Earth's crust is made of oxygen, while a quarter of it is made of silicon. Since silicon and Oxygen react to make silica, around 48.6% of Earth's crust is made of silica.

Major elements in Earth's crust are Oxygen (47%), Silicon (28%), Aluminum (8%), Iron (5%), Calcium (3.5%), Sodium (2.5%), Potassium (2.5%), Magnesium (2.2%) and other elements such as Hydrogen, Carbon, Phosphorus, Sulphur etc.

Major compounds in Earth's crust are shown in below table:

Compound Formula Continental Oceanic
Silica SiO2 60.2% 48.6%
Alumina Al2O3 15.2%16.5%
Lime CaO 5.5% 12.3%
Magnesia MgO 3.1% 6.8%
Iron(II) Oxide FeO 3.8% 6.2%
Sodium Oxide Na2O3.0% 2.6%
Potassium Oxide K2O2.8% 0.4%
Iron(III) Oxide Fe2O3 2.5% 2.3%
Water H2O 1.4% 1.1%
Carbon Dioxide CO21.2% 1.4%
Titanium Dioxide TiO2 0.7% 1.4%
Phosphorus Pentoxide P2O5 0.2%0.3%
Total 99.6% 99.9%

Thus, most of the rocks in Earth's crust are all oxides. The principal oxides are silica, alumina, iron oxides, lime, magnesia & potash. There are not many iron loving compounds in Earth Crust because they were depleted and relocated deeper. Further, more meteoritic content is found in Earth's Crust.

Theories on Origin of the Earth

Gaseous Hypothesis by Immanuel Kant

- According to this theory primordial matter existed which was of solid state and gas and (0C) cold. It was motionless in the beginning with no kinetic energy.
- After some time these primordial matter started to collide with each other due to their mutual gravitational attraction, with generated heat and random motion.
- Due to random motion and more heat, the rate of collision increased, increasing rotatory motion, which changed their state from solid to gaseous state.
- With heat increasing, the size of the nebula also increased. It started to spin very rapidly and an irregular ring was separated from it, which was later divided into nine-parts. It started spinning too fast that centripetal force exceeded centrifugal force.
- The matter of each ring aggregated at one point to form a core which grew as a planet in due course of time.
- By repetition of the same process rings were separated from newly formed planets and materials separated from them formed satellites.

Backdraws:

- Erroneous as he did not explain the source of primordial matter. He assumed their supernatural existence.
- He did not explain the source of external energy due to which particles started to rotate/collide as according to Newton's law, a particle remains in rest or motion until and unless an external force is applied on it. (Absence of external force)

- Collision among particles cannot cause rotatory motion among particles.
- Kant's assumption that rotatory speed of nebula increased with increase in its size was against conservation of angular momentum.

Significance:

- Kant's hypothesis was the first hypothesis which tried to explain the existence of the universe.
- It paved the way to Laplace's hypothesis.

Nebular Hypothesis of Laplace 1796

- Nebular hypothesis is totally based on Immanuel Kant theory of gaseous hypothesis, but Laplace countered the three main backdraws of Kant's theory with his hypothesis.
- He assumed that there was a huge and hot gaseous nebula in space from the very beginning.
- This nebula was rotating (spinning) on its own axis (opposite to existence of scattered solid particles& gas together).
- Nebula started to cool down from the very beginning due to radiation of heat from its outer surface. It also started contracting due to cooling (explained conservation of angular momentum).
- Due to contraction its angular speed increases and consequently one circular ring separates from the core. These rings further condensed to form planets.

Backdraws:

- He could not explain the source of the nebula, its heat and its motion.
- According to nebular hypothesis all satellites should revolve around the sun according to their father planet but satellites of Saturn and Jupiter revolve opposite to them.
- He could not explain why only 9 rings came out of the nebula, not more or less.

Planetesimal Hypothesis of Chamberlin

- It was given by T.C Chamberlin and Forest Ray Moulton
- According to Chamberlin, initially there were
  - Proto sun
  - Companion star
  - Proto Sun - It was formed of very small particles which were cold and solid.
  - Companion star or intruding star - When companion star used to come very close to proto sun, the smaller cold particles of proto sun used to get detached from it due to strong gravitational field of comparison star, these small particles were called planetesimal.

Formation of Planets:

- When these small planetesimals were detached from the proto sun, the bigger particles started to solidify and hence formed the nucleus for planets. Small planetesimals started to add to the nucleus and grew to form planets.
- External force (cause of ejection) - It was tidal force which was responsible for ejection of cold particles from proto sun.

Evolution of Earth and other Planets

- Some planetesimals vanished after disassociation from proto sun. Others remained near it and started revolving around. The companion star vanished into space Gradual disposition of small particles formed the planets and the Earth.

Evolution of Earth's atmosphere

- When Earth grew in size it became successful in capturing free atmospheric molecules.

- Occluded gases of planetesimals captured by the nucleus of the earth provided CO2, H2O, and N2.
- Volcanic eruptions provided oxygen.

Origin of heat

There were three main reasons due to which heat was produced according to Chamberlin:

- Due to mutual collision of planetesimals.
- Due to increase in pressure, due to increase in size.
- Due to molecular reaction.

Period of dominant volcanism

After the period of planetesimal accession, an increase in the heat inside the earth caused a rapid explosion and came out of molten material from inside the earth.

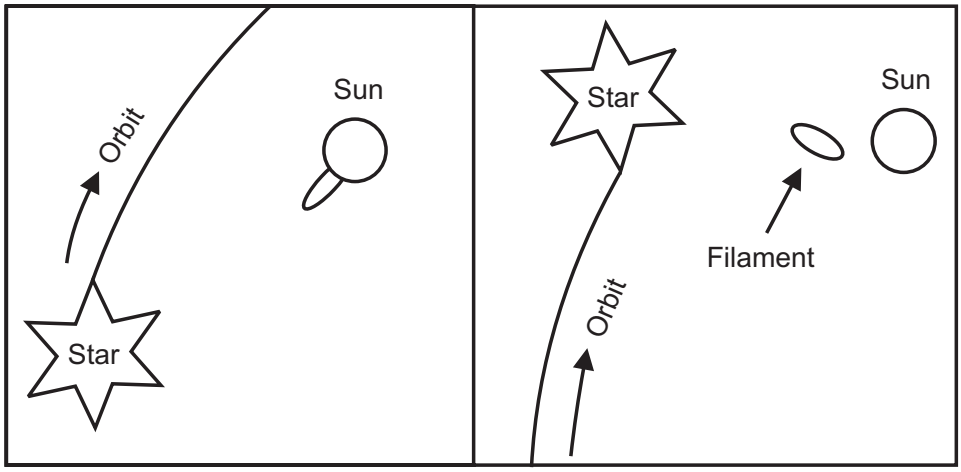
Evolution of continents and ocean basins

Water accumulated after condensation into uneven services and formed oceans. The weight of continents started to decrease due to increase in acidic material on land and washing away of basic material by water thus increasing the oceanic floor weight.

Tidal Hypothesis

Tidal hypothesis was given by James Jeans which was similar to the planetesimal hypothesis by Chamberlin.

It was based on following axioms:



- The solar system was formed from the sun and another intruding star.
- In the beginning the sun was a big incandescent gaseous mass of matter.
- Beside the sun there was another star bigger than the sun called the intruding star.
- The primitive sun was stationary and was rotating on the axis and the primitive star was moving around the sun in such a way that it was destined to come near it.
- There was a great impact of the tidal force of the intruding star on the surface of the primitive sun.
- James Jeans postulated that the massive gravitational force of an intruding star forced the material of the primitive sun to come out which became the building materials of the future planet.

Evolution of filament

- When intruding star came nearest to the sun, it exerted maximum gravitational pull on the sun which he termed as gaseous tidal force which pulled up a gaseous filament which was several kilometers in length. After detachment from the primitive sun the filament tried to maintain its pace with the intruding star which

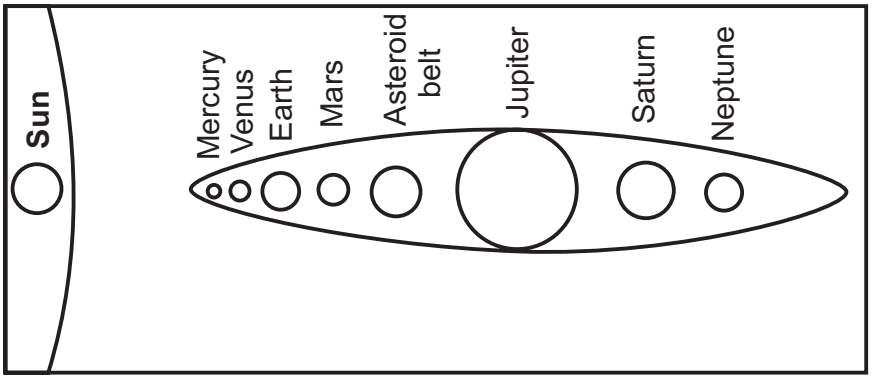
it failed and ultimately it started revolving around the sun. The filament later on was condensed and cooled down which led to its contraction and breaking it into pieces which ultimately became planets.

- The bigger planets cooled down slowly and hence they ejected a larger number of satellites.
- The smaller planets cooled down rapidly hence they had a lesser number of satellites.

Evidence in favour of hypothesis

Shape and ordering of planets

- Order of planets is large in the middle.



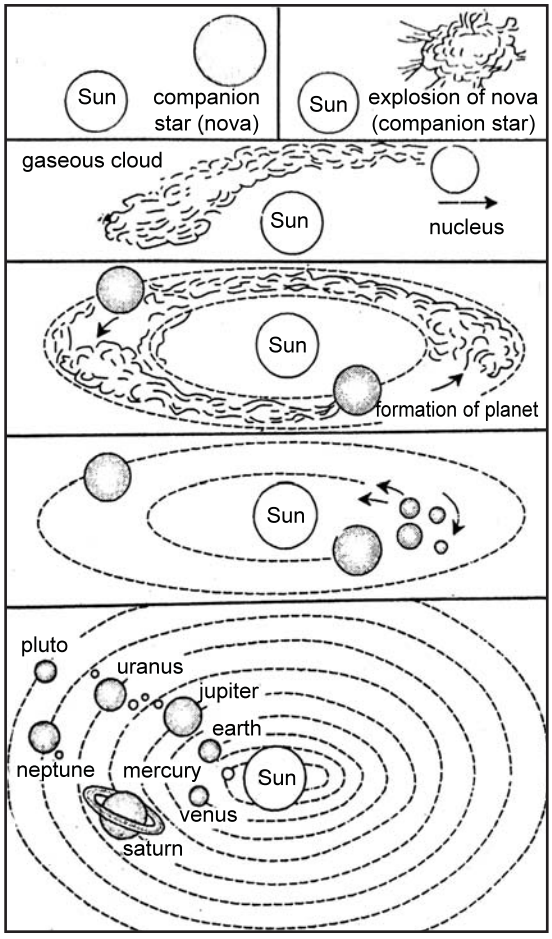
- They comparatively seem to be contained in a filament like structure.

Shape and ordering of satellites

- Shape and ordering of satellites is similar to planets which further strengthened the tidal hypothesis.

Modification of Jeffreys

Collision hypothesis: Harold Jeffreys gave a collision hypothesis according to which there were three celestial bodies in the being, a primitive sun, an intruding star and a companion star of primitive sun. Due to head on collision of companion star and intruding star the debris were shattered forming planets.



Supernova Hypothesis (given by Hoyle)

According the supernova hypothesis there were two stars

- Primitive sun
- Companion star
- Companion star was of giant size and later on became supernova
- According to Hoyle, in primitive sun nuclear fusion occurred according to which lighter elements nuclei fuse together to form heavier atom nucleus releasing a greater amount of energy.
- Due to vastness of companion star it had more energy released due to fusion and hence the companion

star which upto then had converted into a supernova had exploded spreading an enormous amount of dust revolving around primitive sun.

- The dust emitted due to the explosion of a companion star resulted in the spread of dust like a circular dice around the sun, which was the building material for the formation of a future planet.
- After condensation of the dust material of supernova planets were formed.

Interstellar Dust Hypothesis: by Otto Schmidt (Russian Scientist)

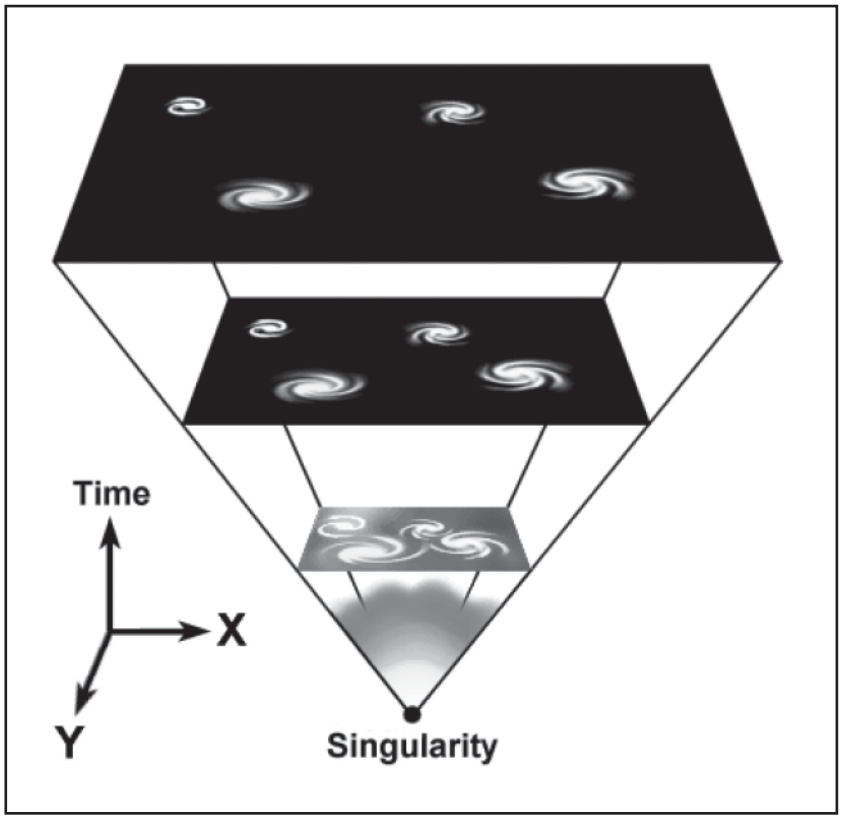
According to this theory dark matter is found in universe in the form of gas and dust cloud. Although the origin of this dark matter is not known, it has been assumed that these dark matter come from the meteors and stars. According to this theory, the sun during its galactic revolution around the central part of the Milky Way galaxy captured some dark matter which accumulated to form a flat disc revolving around it. These dark matters later constituted planets.

Big-Bang Theory (Expanding Universe Theory) (By Edwin Hubble)

Big-Bang theory was based on evidence received from COBE (Cosmic Background Explorer).It explained that the universe contained many millions of galaxies, each galaxy having thousands of stars and each star having planets around them.

Theory:

- A Belgian priest named Georges Lemaitre 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 called Singularity. 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 the 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.

Formation of Moon

Theory of George Darwin

- Initially both earth and moon were part of a single mass rotating body. The whole mass became dumb bell shaped body and eventually broke. Pacific Ocean (depression) was created by separation of the moon from earth.

Modern theory

- Modern theory states that formation of moon is the recent of giant impact or big splat.
- Shortly after formation of Earth a body of mass equivalent to three times the mass of Mars collided with the Earth which led to formation of the Moon. During the formation of moon earth was slightly heated. It happened due to the process of differentiation. The earth forming material turned into a different layer.

Status of Pluto

Pluto was discovered in 1930, but the International Astronomical Union (IAU) deprived it of its planet status.

Criteria to be planet:

- It must have its own orbit and it revolves around the sun on this particular orbit.
- It must be massive to be a sphere under its own gravitational force.
- It must have the neighbouring celestial bodies cleaned around its orbit and it must not intersect with the orbit of another body.

- **Clearing the neighborhood:** Means that it must be dominant so that during its interaction with other celestial bodies it may consume them or push them away with its gravitational pull. But Pluto is only 0.07 times heavier than bodies around it. So Pluto has been designated as Dwarf planet Pluto is second largest dwarf planet after largest Eris (9th largest celestial body orbiting sun), Mickmick, Hiris, Homea, are all other dwarfs.

Geological Time Scale of the Earth

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

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 quantities 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 a thick atmosphere, mostly of helium and hydrogen.
- All the planets were formed in the same period sometime about **4.6 billion years ago**.

Why is Venus 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.

- Until 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 the 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.

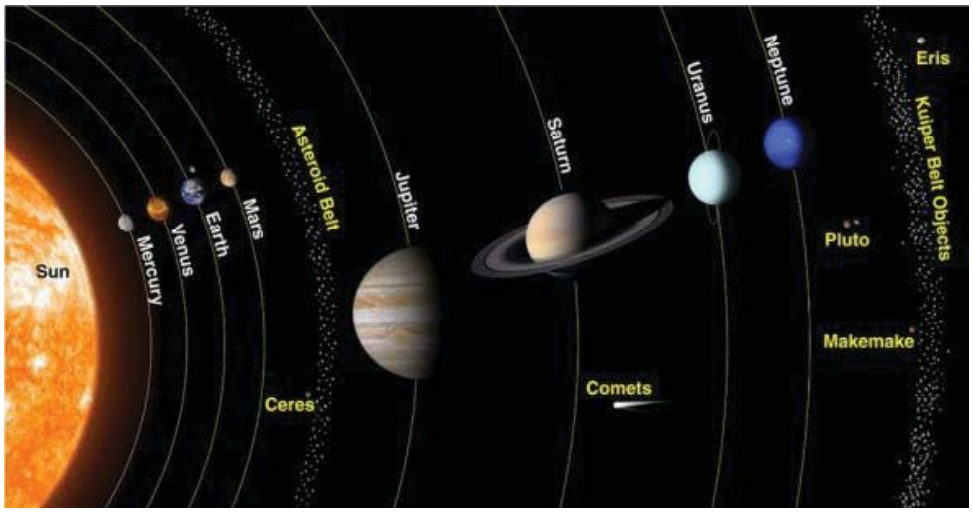
Formation

- 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 led 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 itself-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 itself-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

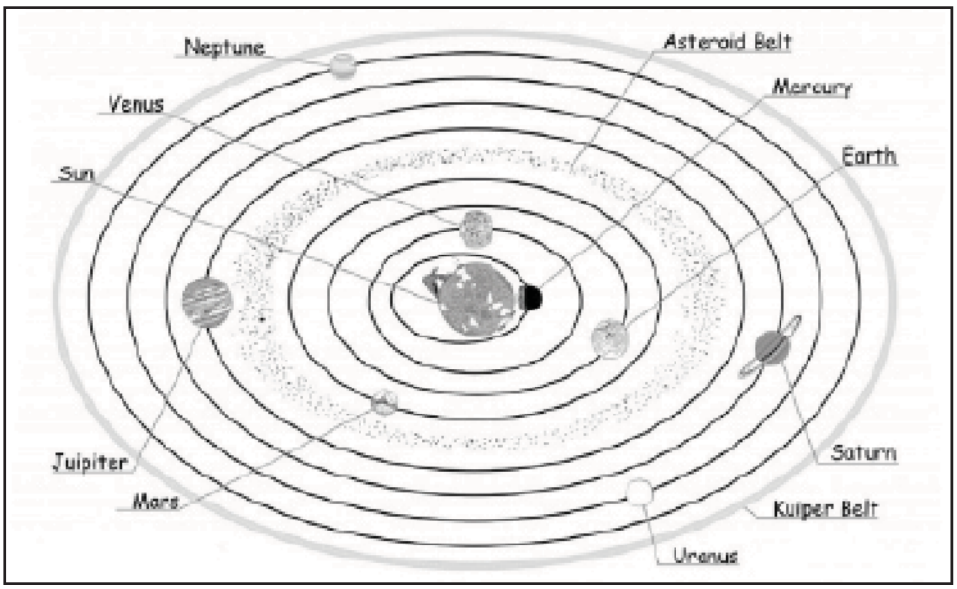
- **Small planets:** Mercury, Venus, Earth, Mars. (The small planets have diameters less than 13000 km.)
- **Giant planets:** Jupiter, Saturn, Uranus and Neptune. (The giant planets have diameters greater than 48000 km. The giant planets are sometimes also referred to as gas giants.)

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.)

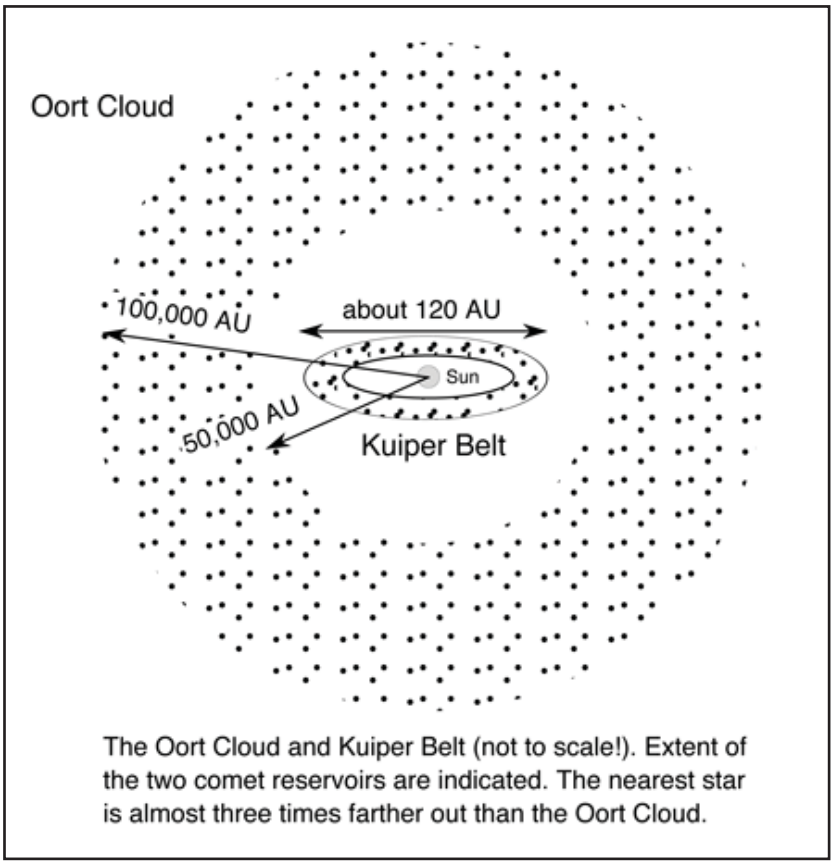


The Solar System								
	Mercury	**Mercury**	**Earth**	**Mars**	**Jupiter**	**Saturn**	**Uranus**	**Neptune**
Distance	0.387	0.723	1.000	1.524	5.203	9.539	19.182	30.058
Density	5.44	5.245	5.517	3.945	1.33	0.70	1.17	1.66
Radius	0.383	0.949	1.000	0.533	11.19	9.460	4.11	3.88
Satellites	0	0	1	2	>53	About 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/cm3 # 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 ice. 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 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.

The Kuiper-Edgeworth Belt is named for the astronomer Gerard Kuiper. The Kuiper Belt extends from roughly the orbit of Neptune (at 30 AU out to about 55 astronomical units) from the Sun.

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 a 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 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 distances is the Astronomical Unit (AU). One AU represents the distance of 150 million kms (the distance between Earth and Sun).

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