

ASTRONOMY

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Solar system,
Galaxies
And
Beyond



The wonders of space

About the article:

This article has been written to explore the beauty, mystery, and wonders of space — a domain that has always captured human imagination. It aims to share fascinating knowledge about how far we have come in discovering the universe beyond Earth, and to inspire curiosity about what still lies beyond.

To ensure accuracy, information was gathered from trusted Google platforms, library resources, Wikipedia, and astronomy-related articles. Every fact was carefully studied, understood, and presented in simple, meaningful words so that readers can easily grasp the concepts of space exploration. We read several articles and combined the knowledge we gained to create this piece, bringing together our ideas and understanding in one complete work.

Our interest in writing this article began after an inspiring session at PHSS, which encouraged us to express our curiosity and creativity through research-based writing.

Through this article, we hope to promote student research, creativity, and love for science, while unveiling the untold wonders of the vast universe.

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INTRODUCTION TO SPACE

When a curious person becomes more thoughtful, they start to ponder everything more deeply. Many questions arise in the mind of that person, such as:

Is this the only place in the universe where humans can live? Are there other planets? What exists outside our planet, and if something does, what is it? What will happen if someone goes out of the planet? Can humans live on other planets? How was everything formed? Was everything once just a small ball? All these questions are related to one word "space". Now the question arises, what is space?





INTRODUCING SPACE

Space is a vacuum (a place where there are no particles) Space is something we can't see, smell, or touch but it's everything and it's everywhere. Think about a small atom, its structure is something like this:

A nucleus and electrons revolving around the nucleus.

Think about how small an atom is but now suppose it's the size of a building. The nucleus would be the size of a grain of rice. If the nucleus is equal to the size of a grain of rice what is the other part of the building?

The rest of the part is all space. An atom is 99.99% made up of space which in turn means everything is made up of space and hence space is everywhere.

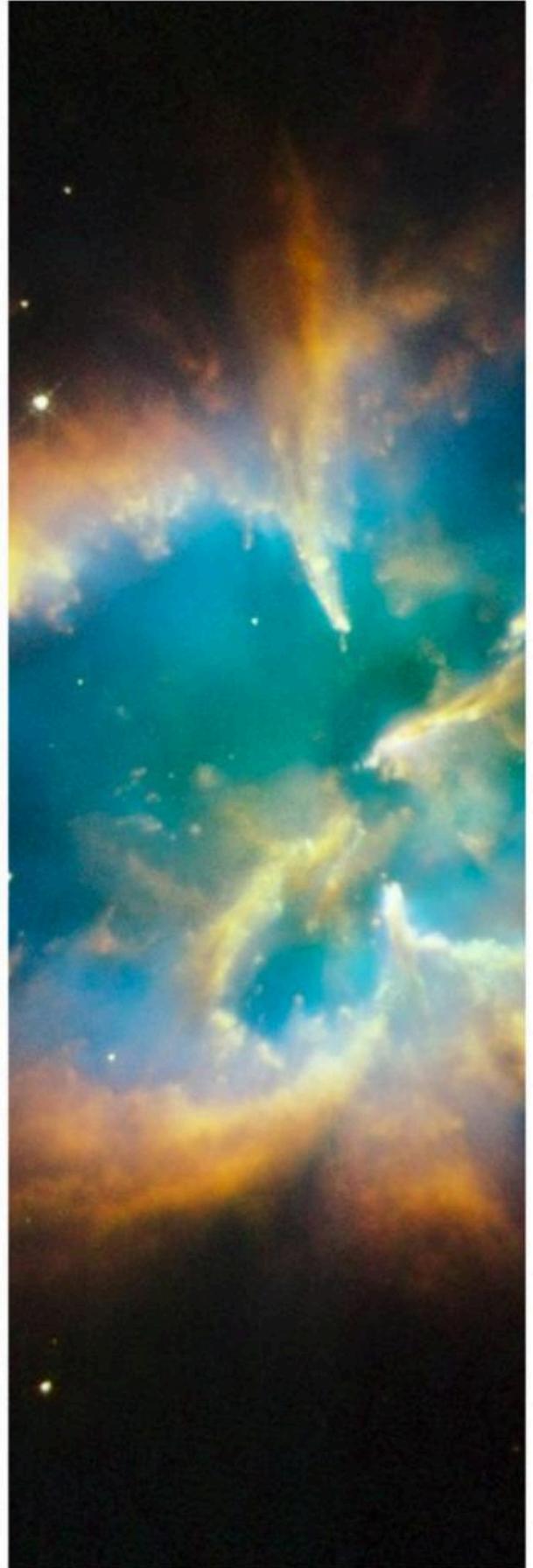
What if everything disappears the humans disappear, the cars the buildings, even the earth disappears, and all stars, planets, and galaxies disappear then what's left is nothing but space? Suppose space is a cloth that can twist, shrink, and expand. If you place an object on the cloth what will happen? The objects with massive mass will make other objects come close to it and this in turn causes the object to orbit around massive objects. This also explains how our solar system works. If you are still confused with what is space then think about a dancer on the stage. She will move with respect to her surroundings but what if you suppose the same dancer is in a space where there is nothing, she will still feel something moving her arms but what is it if there's nothing? That is space which means that space is everywhere but you cannot see it or touch it while you can feel it.

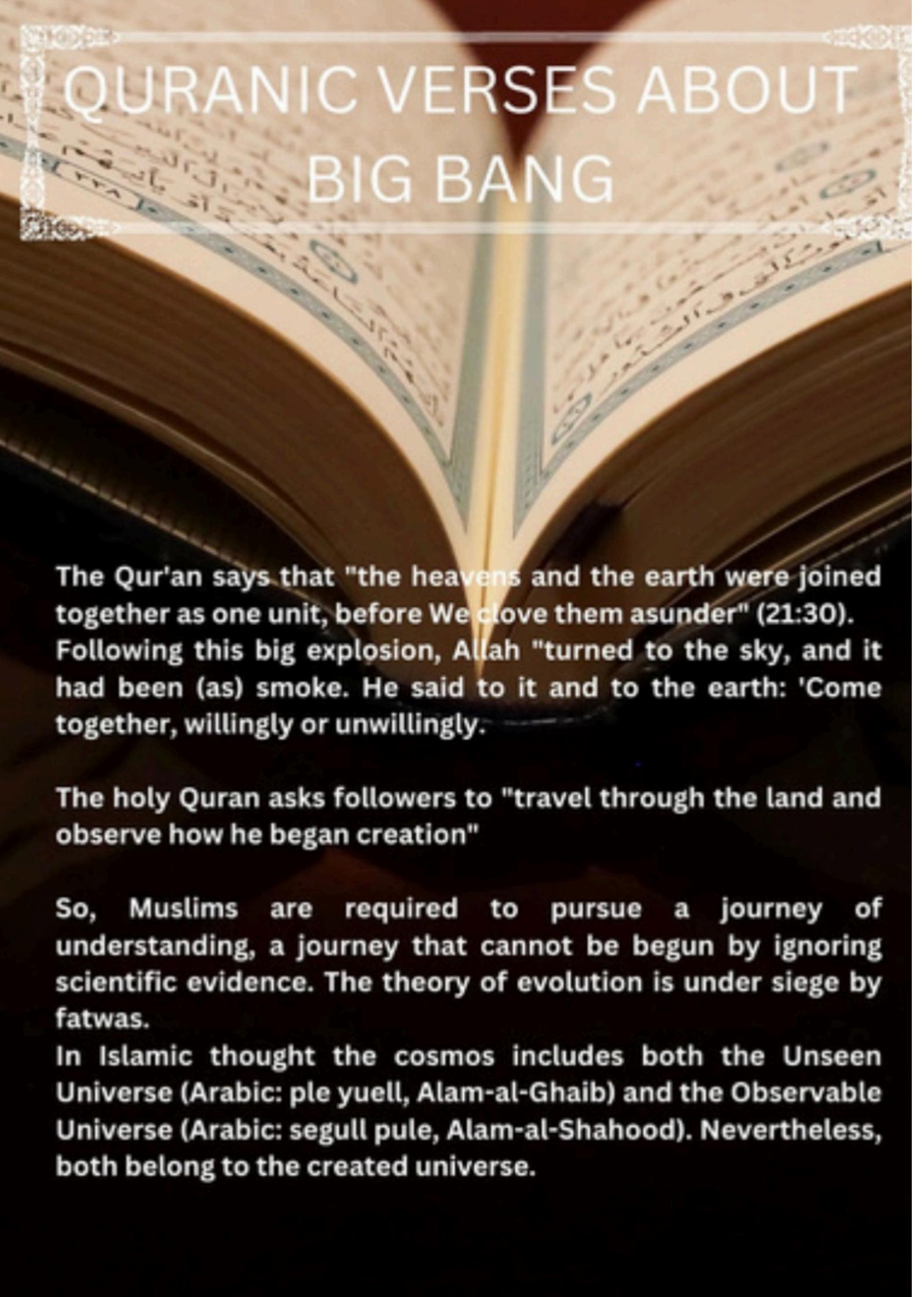
The Beginning Of Everything

THE BIG BANG

The Big Bang theory describes the expansion of the universe from an extremely hot and dense state. At the very beginning, there was nothing but a tiny “space ball” smaller than an atom, containing only energy. Gradually, it began to expand, and particles like protons and neutrons formed. As the universe grew and cooled, neutrons decayed into protons, creating the first hydrogen atoms. Over millions of years, hydrogen gas clumped together to form stars and galaxies. Radiation from these stars transformed hydrogen gas into plasma, allowing visible light to pass, marking the first appearance of light in the universe. This event set the stage for the creation of galaxies, stars, planets, and eventually life on Earth.

Recent research has added exciting details to the Big Bang story. Ultra-precise measurements of the cosmic microwave background from the South Pole Telescope have provided new insights into the universe’s first light. Studies suggest that dark energy, which drives cosmic expansion, may change over time rather than being constant, and some models even predict that the universe could eventually contract in a “Big Crunch.” New theories also explore “warm inflation,” meaning the universe may have expanded while particle interactions were already happening. These discoveries continue to refine and expand our understanding of how the universe began and evolved.





QURANIC VERSES ABOUT BIG BANG

The Qur'an says that "the heavens and the earth were joined together as one unit, before We clove them asunder" (21:30). Following this big explosion, Allah "turned to the sky, and it had been (as) smoke. He said to it and to the earth: 'Come together, willingly or unwillingly.

The holy Quran asks followers to "travel through the land and observe how he began creation"

So, Muslims are required to pursue a journey of understanding, a journey that cannot be begun by ignoring scientific evidence. The theory of evolution is under siege by fatwas.

In Islamic thought the cosmos includes both the Unseen Universe (Arabic: ple yuell, Alam-al-Ghaib) and the Observable Universe (Arabic: segull pule, Alam-al-Shahood). Nevertheless, both belong to the created universe.

Introducing Milky Way

What is Milky Way?

Milky way is a galaxy. It is the second biggest galaxy (first biggest galaxy: Andromeda galaxy]. It has an outermost covering which looks like path or way and the middle of milky way is hard to see as it's completely white just like milk. Milky way is the combination of more than 200 billion stars, planets (our solar system), gas and dust. It is very vast that even light takes about 100,000 years to pass from one end to the other of the milky way. In the middle of the Milky way there is a giant black hole (scientific name: Sagittarius A*), it gives gravity which attracts everything towards it. You can also say that the universe and Milky way were formed at the same time as the universe was formed about 13.7 billion years and Milky way was formed about 13.6 billion years ago. Scientist believe that Milky way will be destroyed after 4 billion years. Scientist also believe that our galaxy (Milky way) will collapse with Andromeda galaxy and these galaxies will together form the biggest galaxy.



ANDROMEDA GALAXY



In our neighborhood group of galaxies, Andromeda is the biggest galaxy. Among the most enigmatic galaxies is the Andromeda Galaxy. Prior to the 20th century, astronomers thought that the Andromeda galaxy was a nebula, or cloud of gas and dust. However, after much research, it was discovered that Andromeda is the largest galaxy and is located closest to our galaxy, the Milky Way. The Andromeda galaxy, which grows by colliding with smaller galaxies to become the biggest galaxy, is also known as the "hungry galaxy. Andromeda galaxy has two bright points. The more brighter part is believed to be the center of one of the galaxy which had collided with Andromeda galaxy. The less brighter point is considered as the center of Andromeda galaxy and in the center, there is the massive black hole of Andromeda galaxy. Scientists believe that after 4 billion years Andromeda galaxy will collide with our galaxy (Milky way) and this in turn will form the largest galaxy as our galaxy is also considered the second largest galaxy in our local group of galaxies and after these two galaxies collide, they will form the largest galaxy.



BLACK HOLE

Black holes are the most mysterious objects in the universe. Black holes have a very strong force of gravity through which not even light can escape. The boundary of a black hole is called the event horizon (point of no return). When something crosses the horizon, it collapses into the black hole singularity (infinitely small and infinitely dense point).

There are four types of black holes which are the following:

1. Stellar
2. Supermassive
3. Intermediate
4. Miniature

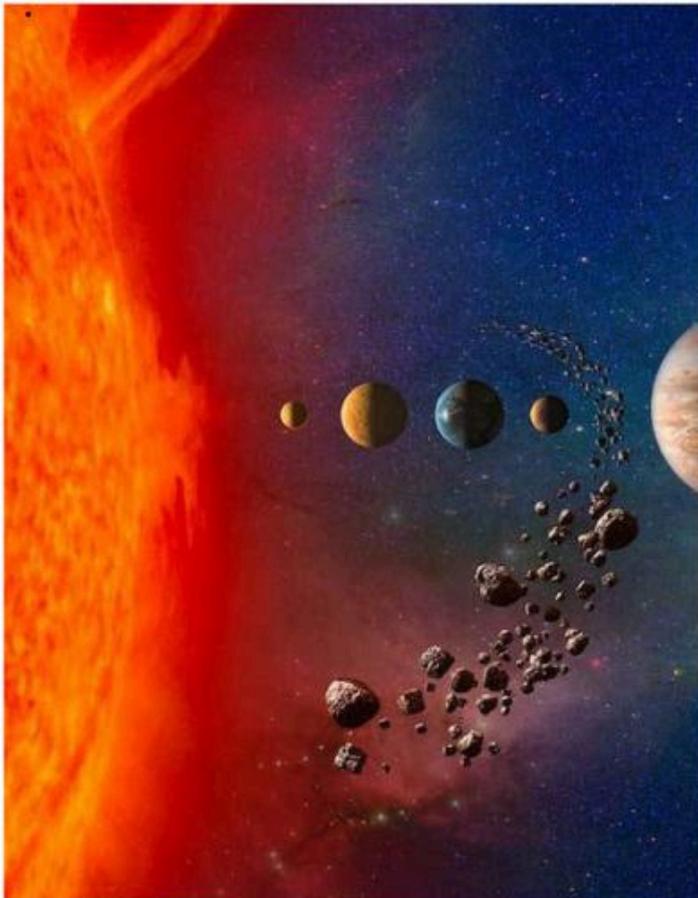
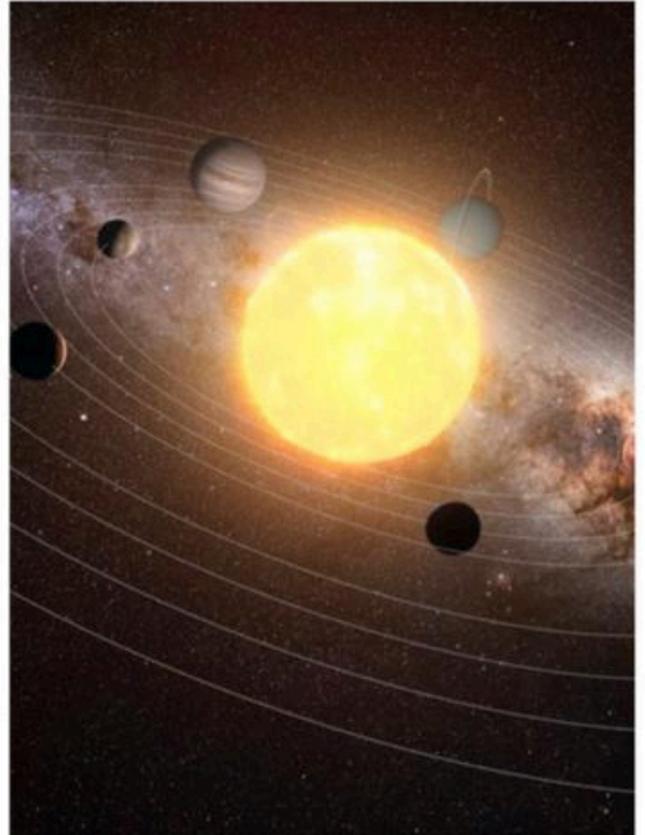
Stellar and supermassive are the most common. Stellar black holes are formed when massive stars die and collapse. These black holes are about 10 to 20 times more massive than our sun. Supermassive is large in comparison. These black holes are millions and billions of times more massive than our sun. These are mostly found in the center of massive galaxies. Black holes are invisible, so we can only feel them from the nearby matter such as accretion disks which are visible when gas and dust fall inside black holes and quasars which are visible when particles blast out of black holes. Cygnus X-1 was the first black hole discovered.

The Solar System

The solar system as a whole evolved from a dense cloud of interstellar gas and dust around 4.5 billion years ago. The cloud collapsed probably as a result of the shockwave from a nearby exploding star known as a supernova. When this dust cloud crumbled, it created a solar nebula, which is a whirling, swirling globe of particles.

Gravity drew more and more particles into the center. The pressure in the core eventually became so intense that hydrogen atoms began to unite and deliver helium, unleashing tremendous quantities of energy. Our Sun originated as a consequence, and it eventually gathered more than 99% of the easily obtainable matter.

Moreover, further, in the disk, the matter was also clustering collectively. These clusters interacted and expanded into larger and larger.



The structure

The sequence and structure of our solar system's planets and other things is corresponding the way the solar system evolved. When the solar system was young, only rough material could resist the heat.

As a consequence, the first four planets are tropical planets: Mercury, Venus, Earth, and Mars. They are all tiny and have rough surfaces.

However, components we have gotten used to viewing as ice, liquid, or gas settled in the young solar system's outer regions. Gravity attracted these components together, causing the gas giants Jupiter and Saturn, as well as the ice giants Uranus and Neptune

ONE OF THE BIGGEST STARS



THE SUN:

The Sun is a 4.5 billion-year-old star at the heart of our solar system, a hot, burning ball of both helium and hydrogen. Despite the Sun's distance from Earth, which is around 93 million miles (150 million kilometers), life as we know it wouldn't be possible on our planet without the Sun's energy. Our solar system's largest object is the Sun. To fill the volume of the Sun, 1.3 million Earths would be expected. Its gravity holds the solar system together, keeping everything from the biggest planets to the smallest bits of debris in orbit around it.

The Sun's core is the hottest part, with temperatures hitting 27 million degrees Fahrenheit (15 million degrees Celsius). Sun's gravity holds all the planets and if this force won't act then all the planets will go straight away in space. Life is not possible without sun. There are many stars in the universe but the sun is the closest star to Earth

NASA and other international space organizations continuously monitor the Sun with a number of satellites, researching everything from its atmosphere to its surface and even peeking inside the Sun with distinct instrument

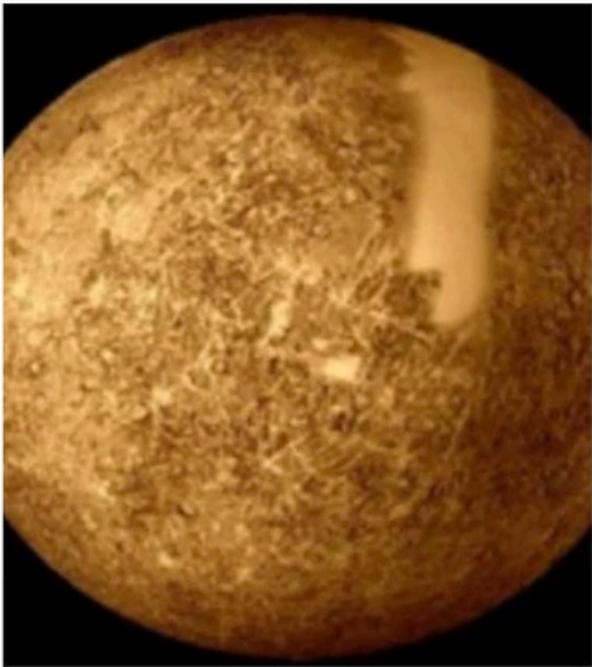
Such as : Parker Solar Probe, Solar Orbiter, SOHO, ACE, IRIS, WIND, Hinode, Solar Dynamics Observatory, and STEREO are among the spacecraft that have explored the sun.

THE SMALLEST PLANET

MERCURY

The smallest planet: mercury

Mercury is the smallest planet in our solar system. It is the closest planet to our sun. Although it's the closest planet to the sun but it's still not the hottest planet because it has no atmosphere to retain heat from the sun (the hottest planet is Venus). It is the smallest planet and is also shrinking.



Mercury is 58 million km far away from sun. Mercury takes 88 days to complete its orbit. Its force of gravity is 3.7 m/s*. It has mass of $3.285 \cdot 10^{23}$ kg (0.055 M \oplus). Its surface area is 74,8 million km². Mercury is one of the rocky planets. It is a little bigger than the Earth's moon, Mercury is cold at night. At night its temperature drops down -300 degree Fahrenheit. Mercury has a dull gray, rocky surface which is covered with a thick layer of dust. The surface is thought to be made up of igneous silicate rocks and dust. Mercury is one of the five planets that can be seen in the night sky without using a telescope or binoculars. The planet Mercury has been known since ancient times and observed for thousands of years by the people of many different cultures. Mercury has no moons.

THE HOTTEST PLANET

VENUS

Venus is the second planet from the sun and is earth's planetary Neighbor. It's a rocky planet. Venus is Earth's twin as both of these planets are similar in size and density. However, there are radical differences between these two planets. Venus is the hottest planet in the solar system because of the presence of carbon dioxide and clouds.

There are yellow clouds on Venus.

Venus is the only planet in the solar system that rotates clockwise. Venus takes about 243 earth days to spin around just once and its rotations very slow. Venus has two sunrises in a year.

Venus is entirely covered with a thick carbon dioxide atmosphere and sulphuric acid clouds which give it a yellowish



EARTH

The water planet: Earth

Earth is the third planet from the sun and is the only planet where life has originated and found habitability. Earth is made up of about 70% water and 30% land. Earth is a rocky planet. Earth is sphere which means it's not flat and not a circle either. Earth has one moon (The moon is also drifting away from Earth).

Earth is 149.6 million km far away from sun. Earth is 4.543 billion years old which rounds up to 4.5 billion years. Earth's radius is 6,371km. Earth has 148.9 million km square land area. Earth's surface is about 510.1 million km square. Earth orbits the sun at an average speed of 67,000 mph or 18.5 miles a second. The Earth is made up of four major layers, beginning with an inner core in the planet's center, which is surrounded by the outer core, mantle, and crust.

The inner core is a solid sphere consisting of iron and nickel metals with a radius of 759 miles (1,221 kilometers). The temperature may reach 9,800 degrees Fahrenheit (5,400 degrees Celsius) there.

The outer core surrounds the inner core.

This layer is approximately 1,400 miles (2,300 kilometers) thick and is composed of iron and nickel fluids.

Earth is the only planet with a single moon.

Our Moon is the brightest and most well-known object in the night sky. In many respects, the Moon is responsible for Earth being such a wonderful place to live.





THE RED PLANET

MARS



Mars is the fourth planet and the furthest terrestrial planet from the sun. Mars is known as the red planet because of the reddish color of its surface which is due to finely grained iron oxide dust in the soil.

Mars look hot but mars is actually pretty cold. In orbit, mars is about 50 million miles farther away from the sun than the Earth which means it gets a lot less light and heat to keep it warm. Mars also has a hard time holding on to the heat it does get.

Mars has two moons called Deimos and Phobos. Mars is smaller than earth with diameter of 4217 miles.

Mars is the second smallest planet in the solar system. Mars is also about 4.5 billion years old. Mars takes 687 days to complete its orbit around the sun.



JUIPTER

THE LARGEST PLANET

Jupiter is the fifth planet from the sun and is the largest planet in our solar system. Jupiter is covered with swirling cold strips. Jupiter is a gas giant and does not have a solid surface but it may have a solid inner core about the size of Earth.



Jupiter has 80 moons. A year on Jupiter is the same as 118 earth years. Jupiter is known for its stripes and the its large red spot. Jupiter's four largest moons (Io, Erops, Ganymeda and Callisto) are known as Galilean satellites. Jupiter is made up of 90% hydrogen which exist in outer layers as gas. Jupiter takes 12 years to complete its orbit Jupiter's radius is 69.911 km. It's mass is 898×10^{427} kg. Jupiter is about 778.5 million km far away from the sun.

SATURN

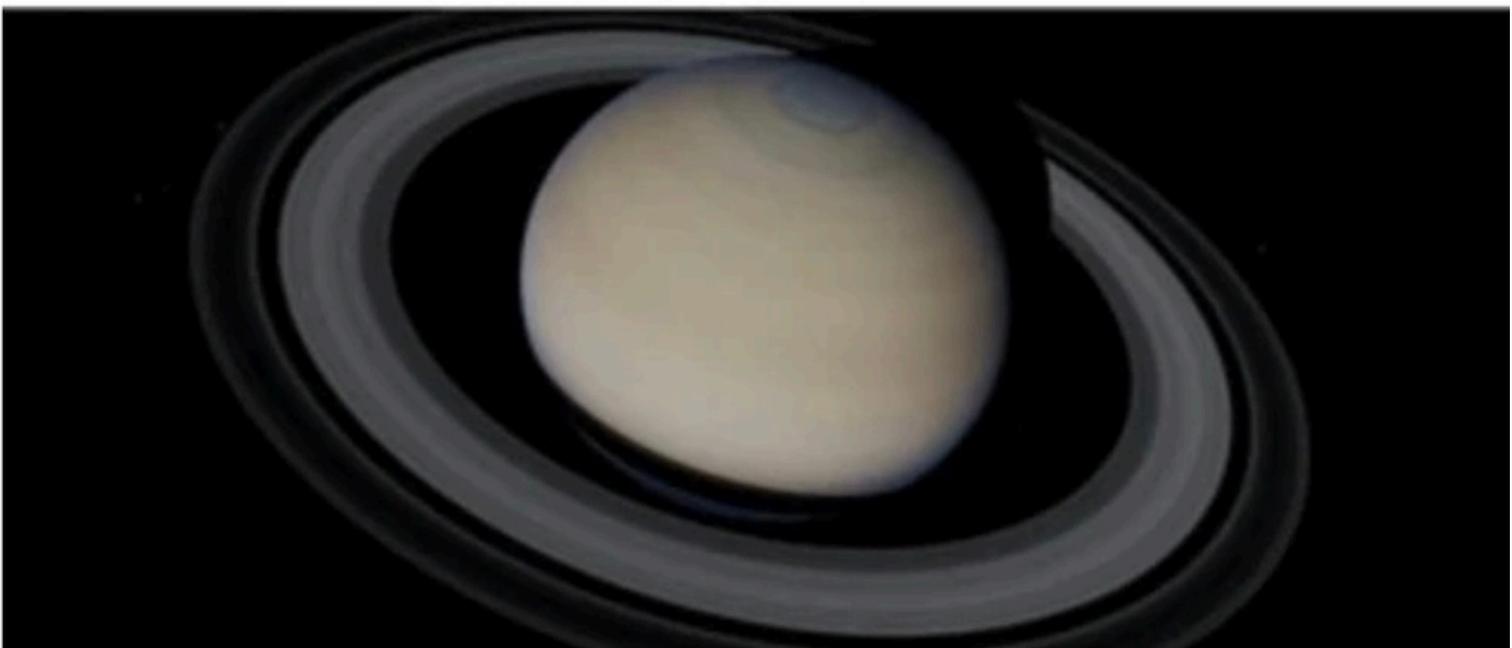
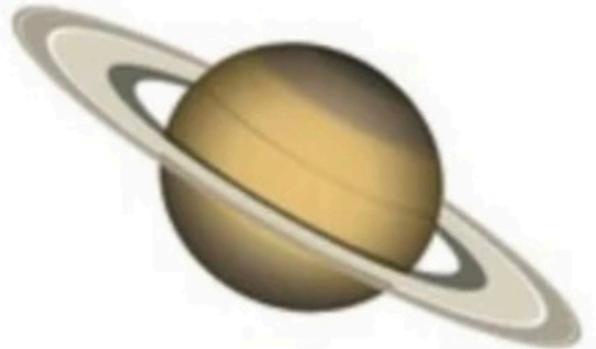
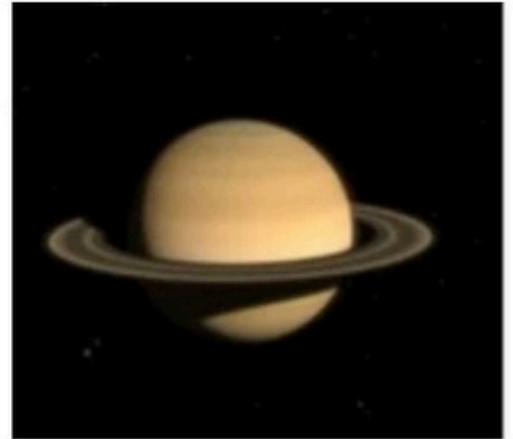
THE RING PLANET

Saturn is the sixth planet from the sun and is the second largest planet in the solar system.

Saturn has rings (these rings are not solid). Saturn has more moons than any other planet in the solar system (Saturn has a moon bigger than mercury).

Saturn is a giant ball made mostly of hydrogen and helium. Its atmosphere has traces of Ammon, phosphine, water vapor and hydrocarbons giving it a yellow brown color.

Saturn is 14.3 billion km far away from sun. Saturn takes 29 years to complete its orbit. Saturn's temperature is -22 degrees F (-140 degrees C)

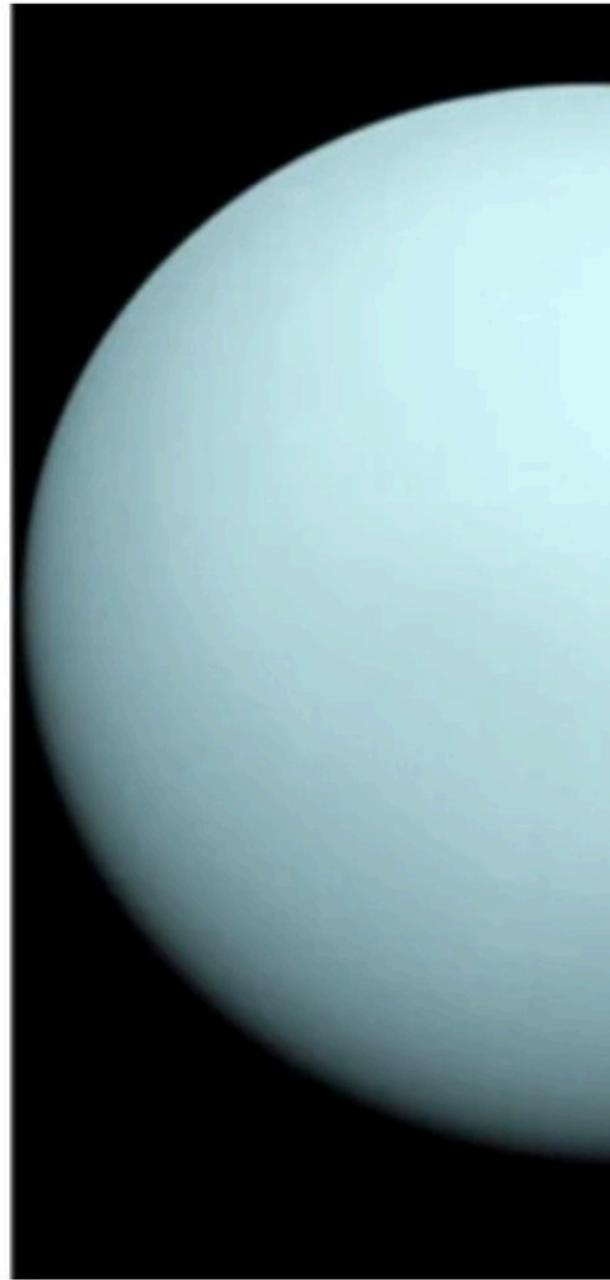


THE ICE GIANT

Uranus is the seventh planet from the sun with the third largest diameter in our solar system. Uranus is a gaseous cyan ice giant.

Uranus is mostly made up of water, ammonia, and methane. Uranus was the first planet discovered through a telescope. Uranus is nicknamed as "the ice giant". Uranus has 13 rings and 27 moons. Uranus holds record for the coldest temperature ever measured in the solar system which is

-224 degrees C. Uranus is about 4.6 billion years old. Uranus takes 84 years to complete its orbit. Uranus is about 2.87 billion km away





THE BLUE PLANET

Neptune is the eighth planet in the solar system and the furthest planet from the sun. Neptune is the fourth largest planet in our solar system. Neptune is 80% made up of water, hydrogen, helium, methane, and ammonia.

The predominant blue color of Neptune is the result of absorption of red and infrared light by Neptune's methane atmosphere.

Neptune's temperature is -214 degrees C. Neptune and Uranus are very similar that scientists consider Neptune and Uranus as planetary twins. Neptune has 17 moons. Neptune takes 165 years to complete its orbit. It has a radius of 24,622 km. Neptune is 4.495 billion km far away from the sun.



DWARF PLANETS

The dwarf planet is a celestial body resembling a small planet but lacking certain technical criteria that are required for it to be classed as such.

In simple, dwarf planets are round in shape and orbit the sun just like eight major planets.

But unlike planets, dwarf planets are not able to clear their orbital path so there are no smaller objects at roughly the same distance from the sun.

It is mostly smaller than a planet (smaller even than earth's moon but is not moon). The first five recognized dwarf planets are Ceres, Pluto, Eris, Makemake, and Haumea and they are all uniquely mysterious.

DWARF PLANETS



ERIS:

Eris is often so far from the sun that it's atmosphere collapses and freezes on the surface in an icy glaze. The coating gleams brightly reflecting as much sunlight as freshly fallen snow.

How Eris got its name:

Eris is named for the Ancient Greek goddess of discord and strife

Discovered: 2003

Location: Kuiper Belt



HAUMEA:

Oddly shaped Haumea is one of the fastest rotating large objects in our solar system. The quick spin elongated the dwarf planet into a unique shape. It is roughly the same size as Pluto.

How Haumea got its name:

Haumea is named for the Hawaiian goddess of childbirth and fertility.

Discovered: 2003

Location: Kuiper Belt



MAKEMAKE:

Makemake holds an important place in the solar system because it- along with Eris- was one of the objects whose discovery promoted the International Astronomical Union to consider the definition of a planet to create a new group of dwarf planets.

How Makemake got its name:

Makemake is named after the god of fertility in Ralanuni mythology.

Discovered: 2005

Location: Kuiper Belt

DWARF PLANETS



PLUTO:

Pluto was long considered our solar system's ninth planet. But after the similar intriguing worlds deeper in the distant Kuiper Belt, icy Pluto was classified as dwarf planet.

How Pluto got its name:

Pluto is named after the Roman god of the underworld.

Discovered: 1930 Location:

Kuiper Belt



CERES:

Scientists describe Ceres as "Embryonic planet". Gravitational perturbations from Jupiter billions of years ago prevented it from becoming a full-fledged planet.

Ceres ended up among the leftover debris of planetary formation in the main asteroid belt between Mars and Jupiter.

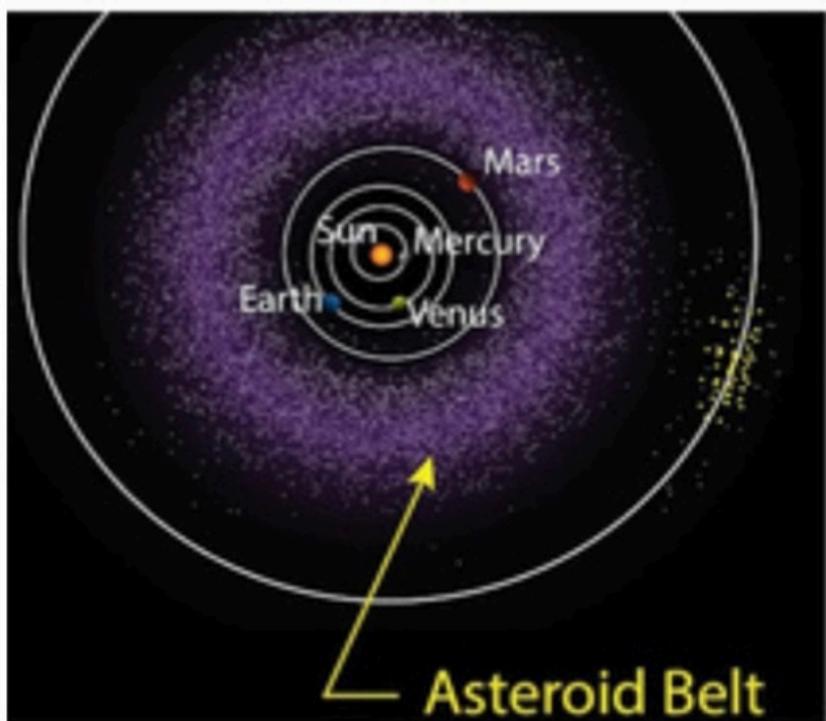
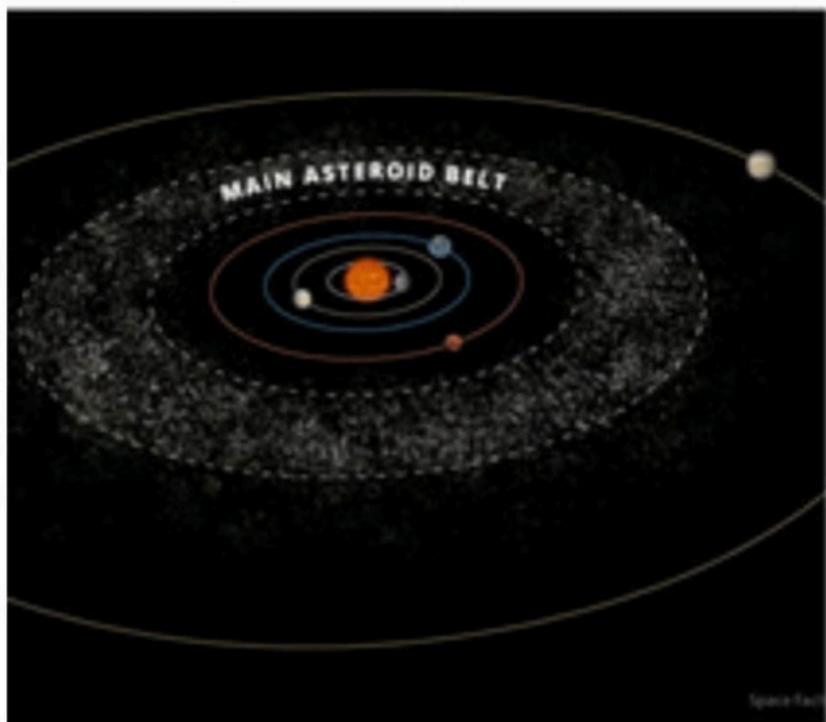
How Ceres got its name:

Ceres is named for the ancient Roman goddess of corn and harvests.

Discovered: 1801 Location:

Asteroid belt

Asteroid Belt

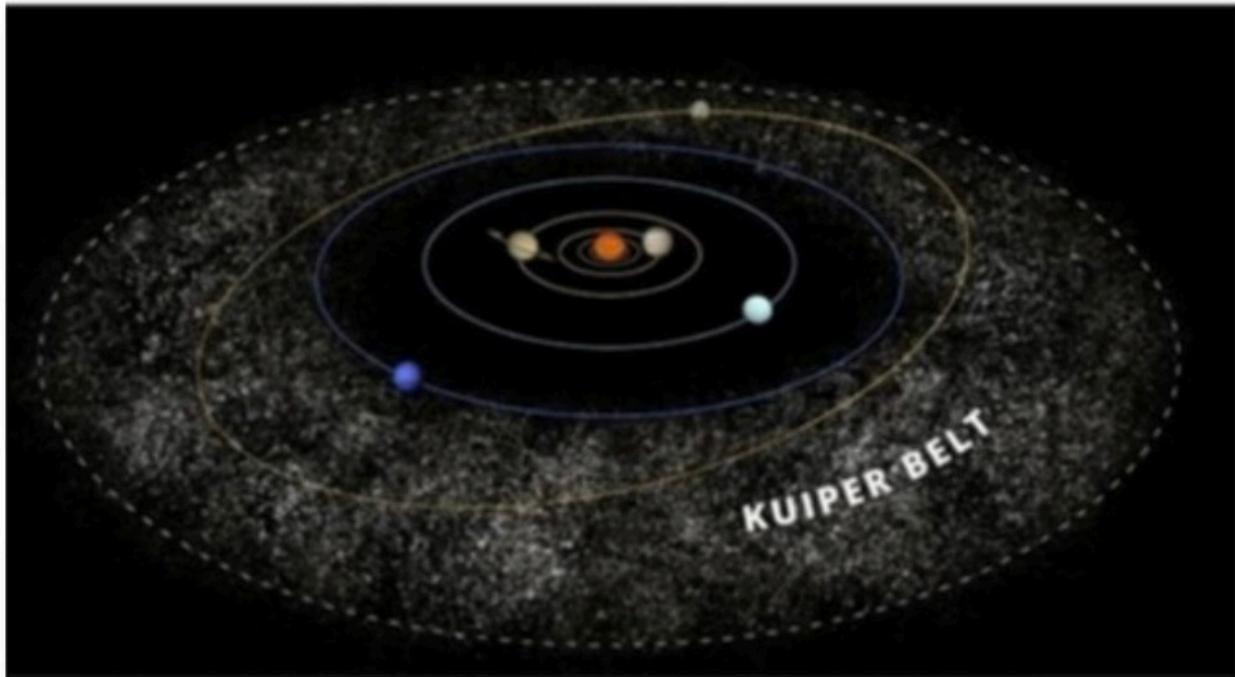


The asteroid belt is a torus-shaped region in the Solar System. Its location is between the two planets named Mars and Jupiter. The belt is estimated to contain between 1.1 and 1.9 million asteroids larger than 1 kilometer (0.6 miles) in diameter, and millions of smaller ones.

The asteroid belt got its name because it contains asteroids and wraps around the Sun like a belt.

Mercury, Venus, Earth, and Mars are the planets that are protected from the asteroids (present in the asteroid belt) because the giant planet Jupiter is exerting its gravitational force on the asteroids in the belt.

KUIPER BELT



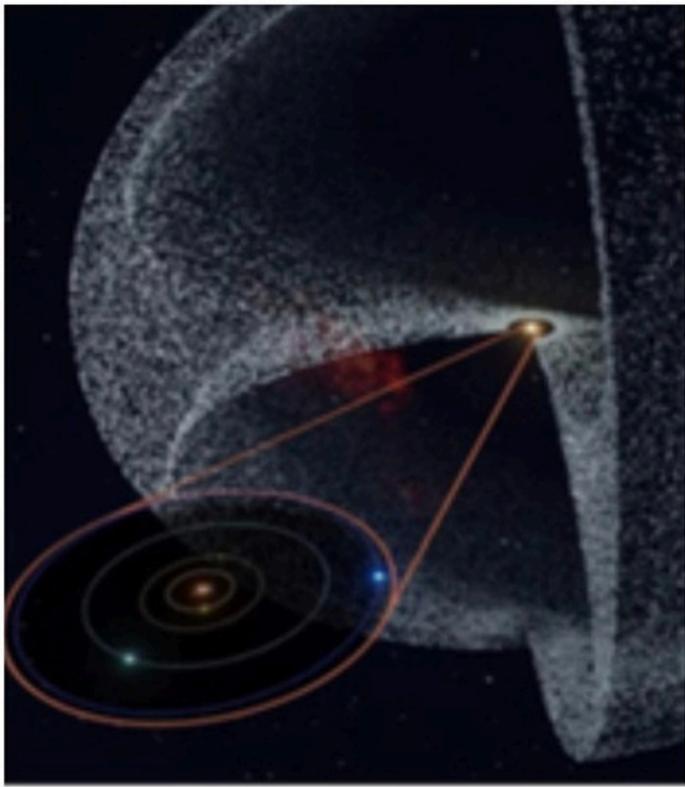
The Kuiper belt is a circumstellar disc in the outer Solar System, extending from the orbit of Neptune at 30 astronomical units to approximately 50 AU from the Sun. It is similar to the asteroid belt, but is far larger-20 times as wide and 20-200 times as massive. The Kuiper Belt is a huge region in our solar system's cold, outer reaches beyond Neptune's orbit.

It is sometimes referred to as the "third zone" of the solar system. Astronomers believe this region contains millions of tiny, frozen objects, including hundreds of thousands larger than 60 miles (100 kilometers). Pluto, for example, is more than 600 miles (1,000 kilometers) wide. In addition to rock and water ice, Kuiper Belt objects include a variety of additional frozen substances such as ammonia and methane.

It's primarily made up of icy objects, dwarf planets, dust, and comets. The Kuiper Belt is home to millions of rocky and icy objects referred to as either Kuiper Belt objects (KBOs) or trans-Neptunian objects (TNOs). The Kuiper Belt is a source of comets, as it very slowly erodes itself away. Pieces produced by colliding KBOs can be pushed by Neptune's gravity into orbits that send them sunward, whereas Jupiter's gravity further corrals them into short loops lasting 20 years or less.

The region is named after astronomer Gerard Kuiper, who presented a scientific study about objects beyond Pluto in 1951. The Edgeworth-Kuiper Belt is named after astronomer Kenneth Edgeworth, who described objects beyond Pluto in articles published in the 1940s. Some scientists prefer to refer to it as the Trans-Neptunian Region, and Kuiper Belt objects (KBOs) as trans-Neptunian objects, or TNOs.

THE OORT CLOUD



Introduction to Oort Cloud

The furthest part of our solar system is called the Oort Cloud. Even the closest Oort Cloud objects are believed to be much further from the Sun than the Kuiper Belt's outermost regions. The Oort cloud, sometimes called the Opik-Oort cloud, is theorized to be a vast cloud of icy planetesimals surrounding the Sun at distances ranging from 2,000 to 200,000 AU. Objects in the Oort Cloud are not found beyond the pull of the Sun's gravity.

Beyond the Oort Cloud are the termination shock and heliopause. While the inner solar system is protected from many external forces, the Oort Cloud occasionally encounters large forces that affect the orbits of the icy bodies.

The Oort Cloud is thought to be a massive spherical shell that surrounds the remainder of the solar system, in contrast to the orbits of the planets and the Kuiper Belt, which mainly lie in the same flat disk around the Sun. It resembles a gigantic, thick-walled bubble made of frozen space rocks that can be as large as mountains.

There could be billions or trillions of objects in the Oort Cloud. The Oort Cloud is a predicted collection of icy objects farther away than everything else in the solar system. It fits with observations of comets in the planetary region of the solar system, but scientists have yet to observe any object in the Oort Cloud itself. Comets' home extended-period comets are thought to originate from the Oort Cloud because of their extraordinarily extended orbital periods. For instance, the comet C/2013 A1 Siding Spring, which flew extremely near to Mars in 2014, won't make its way back to the inner solar system for around 740,000 years. The distance between the Sun and the Oort Cloud is so great that astronomical units, rather than the more usual miles or kilometers, are useful for describing it. The separation between Earth and the Sun is measured in astronomical units (AU)

with its regular orbit, Pluto can go up to 50 AU from the Sun or as distant as 30 AU from it. However, it is believed that the inner boundary of the Oort Cloud lies between 2,000 and 5,000 AU from the Sun. The distance between the outer edge and the Sun might be 10,000 or perhaps 100,000 AU, or around 1/4 to 1/2 the distance between the Sun and the nearest nearby star. Though long-period comets observed among the planets are thought to originate in the Oort Cloud, no object has been observed in the distant Oort Cloud itself, leaving it a theoretical concept for the time being. But it remains the most widely-accepted explanation for the origin of long-period comets.

ASTERIODS



A minor planet that circles in the inner Solar System but is neither a genuine planet nor a comet is known as an asteroid. They are airless, cold, metallic, or stony bodies.

Asteroids, sometimes called minor planets, are rocky, airless remnants left over from the early formation of our solar system about 4,6 billion years ago.

Asteroids come in a wide range of sizes and shapes, from 1-meter boulders to a dwarf planet with a diameter of about 1000 kilometers. They are black in color and most likely made of silicate and clay rocks.

The largest asteroid is called Ceres. It is about one-quarter the size of the moon and orbits the sun between Mars and Jupiter in a region called the asteroid belt.

Unlike most asteroids, Ceres is spherical in shape.

Asteroids are some of the solar system's oldest objects. Nickel-iron alloys and silicate minerals make up the S-types ("stony").

The nickel-iron M-types are metallic.



METEOROIDS

A meteoroid is a small rocky or metallic body in outer space. Meteoroids are distinguished as objects significantly smaller than asteroids, ranging in size from grains to objects up to a meter wide. Objects smaller than meteoroids are classified micrometeoroids or space dust. Meteoroids are objects in space that range in size from dust grains to small asteroids. Think of them as "space rocks." When meteoroids enter Earth's atmosphere (or that of another planet, like Mars) at high speed and burn up, the fireballs or "shooting stars" are called meteoroids



Many meteoroids are created by the collision of asteroids that circle the sun between the trajectories of Mars and Jupiter in a region known as the asteroid belt. Asteroids collide and create crumbly debris known as meteoroids. Meteoroids are sometimes known as shooting stars or falling stars.

INTRODUCING



Comets are frozen leftovers from the formation of the solar system composed of dust, rock, and ices. When the gravity of a massive passing body, such as a star, becomes powerful enough, large pieces of ice are drawn away from the cloud and toward the sun. As the ice ball approaches the sun, the sun's radiation begins to melt some of the ice that makes up the comet. Scientists sometimes call comets dirty snowballs or snowy dirtballs, depending on whether they contain more ice material or rocky debris. Comets have a natural life span of 5 to 14 years and may live even longer in optimal conditions. Meteors (or shooting stars) are very different from comets, although the two can be related.

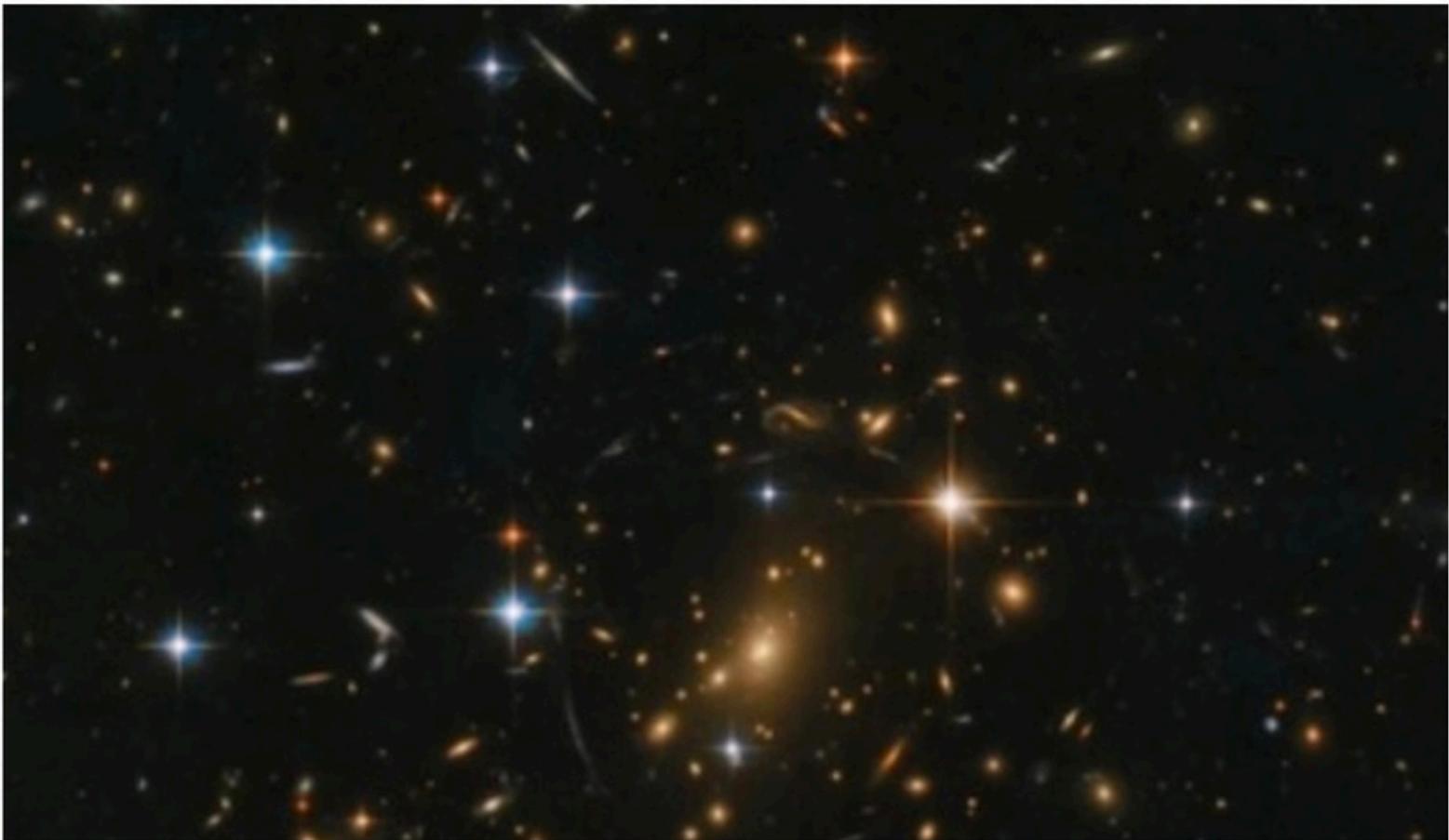
COMETS

DARK MATTER

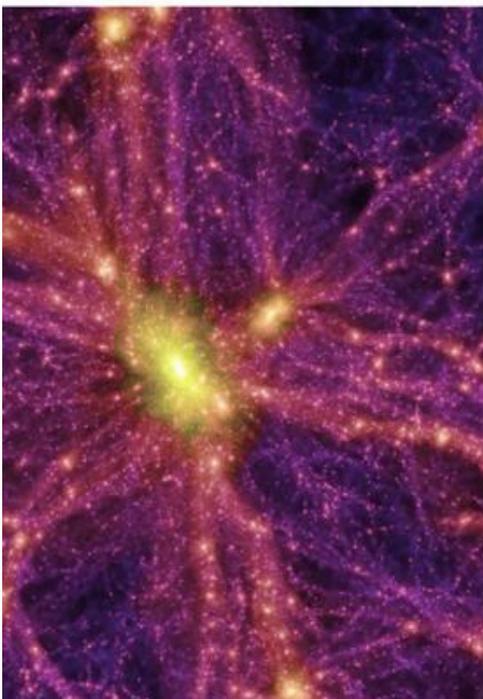
Dark matter is made up of particles that do not absorb, reflect, or emit light, making them invisible to electromagnetic radiation. Dark matter is stuff that cannot be seen by the naked eye. Dark matter is a hypothetical form of matter thought to account for approximately 85% of the matter in the universe.

Dark matter played an important role in the formation of galaxies. Researchers use astronomical surveys to build maps of the location of dark matter in the univers based on how the light from distant galaxies bends as it travels to us.

We know dark matter exists because of the influence it has on items that we can see with our own eyes. Because dark matter does not interact with light, it is unaffected by electromagnetic force, which means it just flows through conventional matter without noticing or caring.



DARK ENERGY



Dark energy is an undiscovered kind of energy that impacts the universe on the biggest scales in physical cosmology and astronomy. The earliest observational evidence for its existence came from supernova observations, which revealed that the universe is expanding at an accelerating rate rather than at a constant rate. Understanding the evolution of the cosmos necessitates knowledge of its initial conditions and composition. Prior to these findings, physicists believed that all kinds of matter and energy in the universe would simply impede the expansion over time. The cosmic microwave background (CMB) measurements indicate that the universe began in a hot Big Bang, from which general relativity explains its history and subsequent large-scale motion. There was no way to explain the universe's accelerated expansion without introducing a new type of energy. There are active fields of cosmology research to understand the underlying nature of dark energy as of 2021. Assuming the lambda-CDM model of cosmology is correct, best current measurements show that dark energy contributes 68% of all energy in the present-day observable cosmos as of 2013. Dark matter and conventional (baryonic) matter provide 26% and 5% of the mass energy, respectively, whereas other components such as neutrinos and photons contribute very little.

The density of dark energy is exceedingly low: $6 \times 10^{-10} \text{ J/m}^3$ ($7 \times 10^{-30} \text{ g/cm}^3$), substantially lower than the density of light energy.

Astronomers theorize that the faster expansion rate is due to a mysterious, dark force that is pulling galaxies apart. One explanation for dark energy is that it is a property of space. Albert Einstein was the first person to realize that empty space is not nothing.

SATELLITE



A satellite is a small object that orbits or revolves around, a larger object in space. There are two kinds of satellites: natural (such as the moon orbiting the Earth) or artificial (such as the International Space Station orbiting the Earth). All the planets in the solar system except Mercury and Venus have natural satellites.

Satellites are launched from the ground to orbit at altitudes high enough to escape orbital decay caused by the atmosphere.

Satellites can then adjust or maintain their orbits using propulsion, which is often provided by chemical or ion engines. As of 2018, around 90% of satellites circling the Earth are in low Earth orbit or geostationary orbit; geostationary means the satellites remain stationary in the sky.

Some imaging satellites chose a Sun-synchronous orbit so that they may survey the entire globe in similar lighting conditions. As the quantity of satellites and space junk in orbit above Earth grows, so does the risk of collision. A few satellites orbit other bodies (such as the Moon, Mars, and the Sun) or many bodies at once (two in a halo orbit, three in a Lissajous orbit).

Earth observation satellites collect data for reconnaissance, mapping, and monitoring of the weather, ocean, and forest, among other things. Space telescopes use the near-perfect vacuum of space to examine objects over the whole electromagnetic spectrum.

Satellites have a variety of uses, including communication relay, weather forecasting, navigation, broadcasting, scientific research, and Earth observation. They are also used to look outward at the solar system for research and data-gathering purposes. Communications satellites can convey information to remote locations because they can see a vast section of the Earth at once.

Satellite signal delay and orbit predictability are utilized in satellite navigation systems such as GPS. Space probes are satellites built for robotic space exploration beyond the Earth's orbit, whereas space stations are essentially crewed spacecraft. On October 4, 1957, the Soviet Union launched Sputnik 1, the first artificial satellite into Earth's orbit.