Sun

Strange but true!

The Sun is a yellow dwarf star.

Its energy comes from nuclear fusion.

The centre of the Sun is 15 million °C.

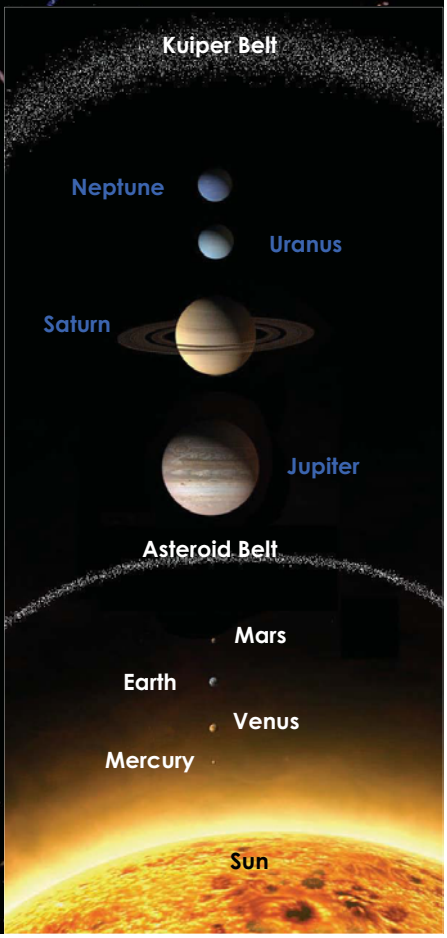
The Sun accounts for 99.9% of the Solar System's mass.

Helium (very rare on Earth) makes up about 24% of the Sun, where it was first observed. The rest of the Sun is mostly hydrogen.

The Sun, along with the rest of the Solar System, is about 4.6 billion years old.

Type of Star	G2V yellow main sequence dwarf
Number of Planets	8
Situation	Near Orion Arm about 25,000 light-years from centre of Milky Way Galaxy
Age	About 4.5 billion years

Parameter	Actual	Compared to Earth
Diameter	1,400,000 km	110 x bigger
Mass	$2*10^{30}$ kg	330,000 x heavier



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Beyond the Solar System

Oort Cloud

The Oort Cloud is a huge collection of billions of objects around the Sun at 300-100,000 Earth-Sun distances. The furthest of Oort Cloud objects are 1.5 light-years away, about 1/3 of the way to the nearest star.

It's a spherical cloud not a flat disk like the Kuiper Belt.

It is 1000 times further away than the Kuiper-belt, although the transition between the two is not clear: they might merge into each other.

Most of these objects are stony, dusty or icy particles of different sizes.

Stars

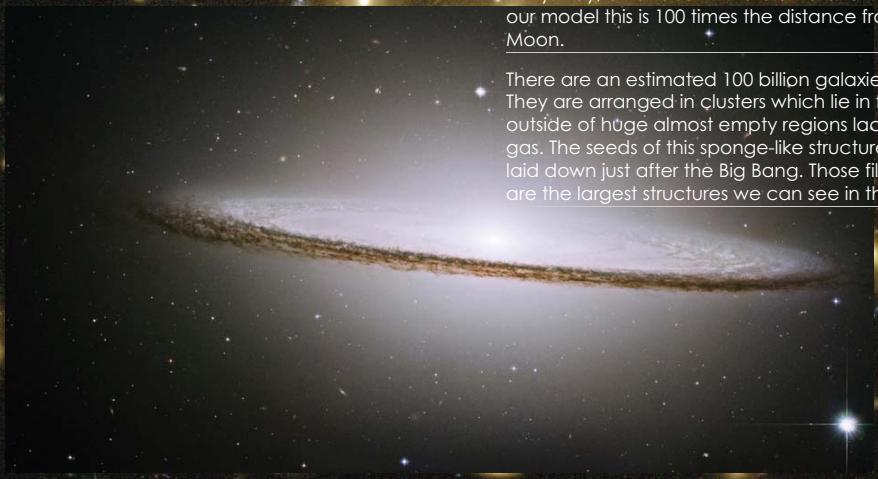
The closest star to the Sun at 4.22 light-years distance is Proxima Centauri. It is a red dwarf and so faint it is not even visible to the naked eye.

New stars are forming all the time in the dense spiral arms of our Galaxy. Old ones run out of hydrogen fuel and die, sometimes in spectacular explosions (supernova) and sometimes swelling to large red giants (as the Sun will in 5 billion years).

Galaxies and the Universe

There are an estimated 400 billion stars in our own galaxy, the Milky Way, a flat disc with a diameter of 100,000 light-years! In our model this is 100 times the distance from here to the Moon.

There are an estimated 100 billion galaxies in the Universe. They are arranged in clusters which lie in flat sheets lining the outside of huge almost empty regions lacking even traces of gas. The seeds of this sponge-like structure might have been laid down just after the Big Bang. Those filaments and voids are the largest structures we can see in the universe.



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Kuiper Belt

Strange but true!

There are many other small bodies orbiting the Sun at 30-50 Earth-Sun distances.

They consist mostly of ices (frozen methane, ammonia and water).

Some comets originate here, some in the Oort Cloud (see Beyond the Solar System poster).

Most Kuiper Belt Objects are on fairly eccentric orbits.

There are believed to be around 70,000 objects with diameters greater than 100km. We already know the location of about 1000 of them.

The furthest point of some short-period comets (e.g. Halley) is in this belt.

Pluto

The most famous of these objects is Pluto.

According to the International Astronomical Union (IAU) an object must meet three conditions to be considered a planet:

It must be in orbit around the Sun.

It must be massive enough that its own gravity should pull it into a sphere.

It must have cleared the neighbourhood around its orbit (by sweeping up all other objects).

The Stern-Levison parameter shows that Pluto has not met the third of these conditions. For dwarf planets like Pluto this number is about a million times smaller than for the true planets.

So Pluto is not a true planet. Instead it is a member of the Kuiper Belt.

Actually what we know as Pluto are two objects, Pluto (diameter 2390 km) and its (comparably very large) moon Charon (about 1200 km).

Pluto is now classified as a dwarf planet, although Pluto and Charon form a double-object. A name for this has not yet been decided on and is still subject of discussion.

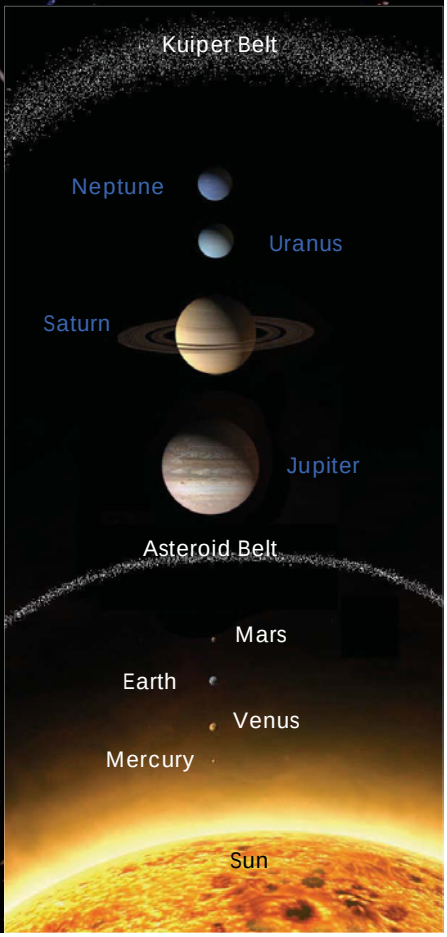
Pluto's orbit sometimes brings it closer to the sun than Neptune.

Pluto isn't the biggest object outside Neptune. Eris (2400 km diameter) is bigger.

Pluto, Eris, Makemake, Haumea and Ceres (in the asteroid belt) form the group of known dwarf planets. Most of the other big ones are candidates, but not yet confirmed.

Type of Object	Icy objects similar to comets
Surface Temperature (approx)	- 220°C
Year Length	100s of Earth years

Parameter	Actual	Compared to Earth
Diameter (approx)	30 – 1500 km	0.2% - 12%
Average distance from Sun	4500 - 8000 billion metres	30-50 x further
Total Mass (approx)	$6.0*10^{23}$ kg	10%



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♆ Neptune

Strange but true!

Traces of methane in the atmosphere account for the blue colour of both Neptune and Uranus.

Neptune has very active weather systems, driven by the strongest winds of any planet in the Solar System, with speeds as high as 2100 km/h.

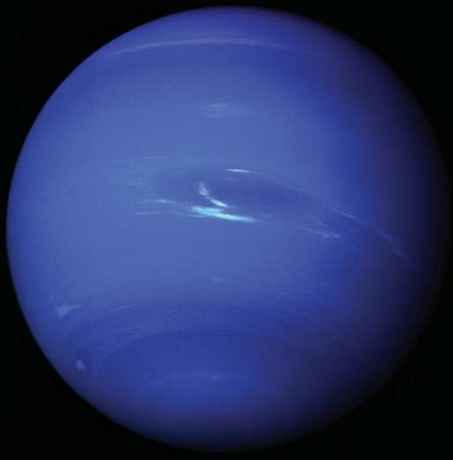
Neptune's outer atmosphere is one of the coldest places in the Solar System, with temperatures of –218 °C.

Neptune is named after the Roman god of the sea.

Like Jupiter and Uranus, Neptune has a faint ring system.

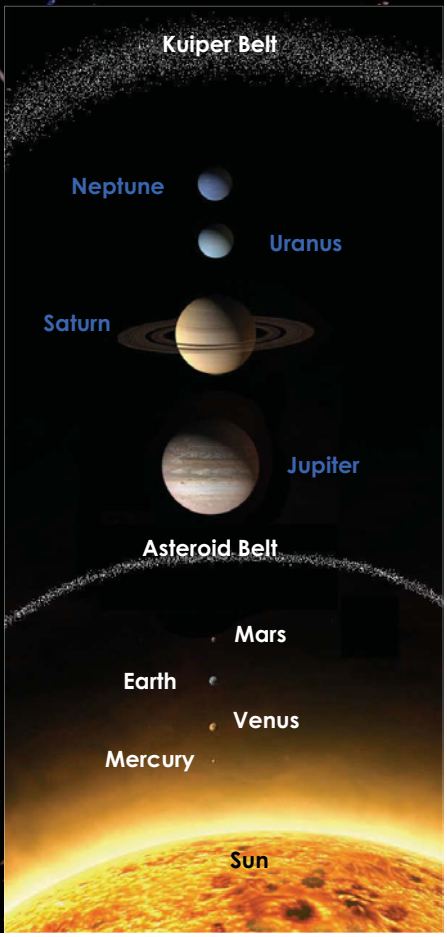
Neptune was FIRST calculated to exist from small wiggles in Uranus' orbit and THEN observed!

In 1613 Galileo observed Neptune very close to Jupiter, but either thought it was a star in the background or one of Jupiter's moons.



Type of Planet	Ice Giant
Number of Moons	13
Surface Temperature (varies with depth)	- 201°C
Day Length (sunrise to sunrise)	16.1-18.3 hours
Year Length	165 Earth years
Tilt of Axis of rotation	28.3°
Angle of orbit against plane of Earth's orbit	1.77°
Ovalness of orbit (0=circular)	0.011

Parameter	Actual	Compared to Earth
Diameter	49,500 km	3.9 x bigger
Average distance from Sun	4500 billion metres	30 x further
Mass	$1.0*10^{26}$ kg	17 x heavier



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Uranus

Strange but true!

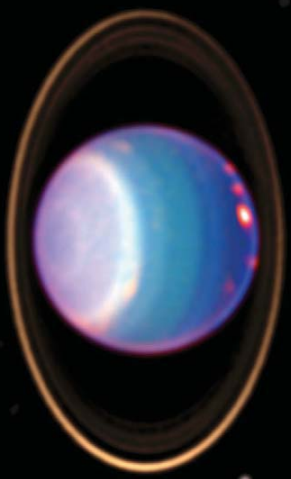
Uranus is only just visible with the naked eye and moves slowly so ancient astronomers never recognized it as a planet.

The Greek god Uranus was father of Saturn and grandfather of Jupiter, so it is an appropriate name for the third largest planet.

Uranus is lighter than its neighbour Neptune yet bigger in diameter. Traces of methane in the atmosphere account for both planets' blue colour.

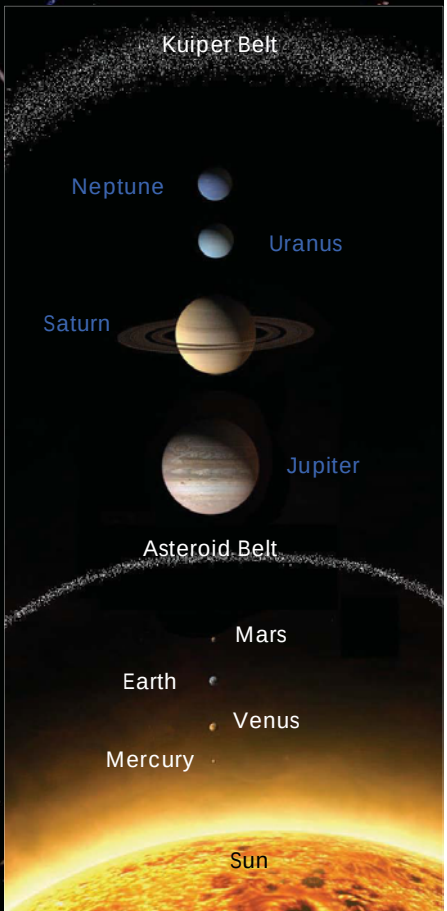
Its rotation axis is tipped over so it rotates nearly in the plane of his orbit around the sun. That means it 'rolls' along its orbit instead of spinning round it like the Earth does.

Uranus had been observed on many occasions before its discovery as a planet, but it was generally mistaken for a star. The earliest recorded sighting was in 1690 when John Flamsteed observed the planet at least six times, cataloging it as 34 Tauri.



Type of Planet	Ice Giant
Number of Moons	27
Surface Temperature (varies with depth)	-197°C
Day Length (sunrise to sunrise)	16-17 hours
Year Length	84 Earth years
Tilt of Axis of rotation	97.77°
Angle of orbit against plane of Earth's orbit	0.77°
Ovalness of orbit (0=circular)	0.044

Parameter	Actual	Compared to Earth
Diameter	51,000 km	4 x bigger
Average distance from Sun	2870 billion metres	19 x further
Mass	$8.7*10^{25}$ kg	15 x heavier



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♄ Saturn

Strange but true!

Saturn has a prominent system of rings, consisting mostly of ice particles with a smaller amount of rocky debris and dust.

Over sixty moons (e.g. Titan) orbit the planet, not counting hundreds of "moonlets" within the rings. Telesto, Tethys and Calypso share one orbit, following each other at 60° distance. That seems to be unique in the Solar System.

Jupiter, Saturn, Neptune and Uranus all consist mostly of hydrogen gas so they are called the 'gas giants'.

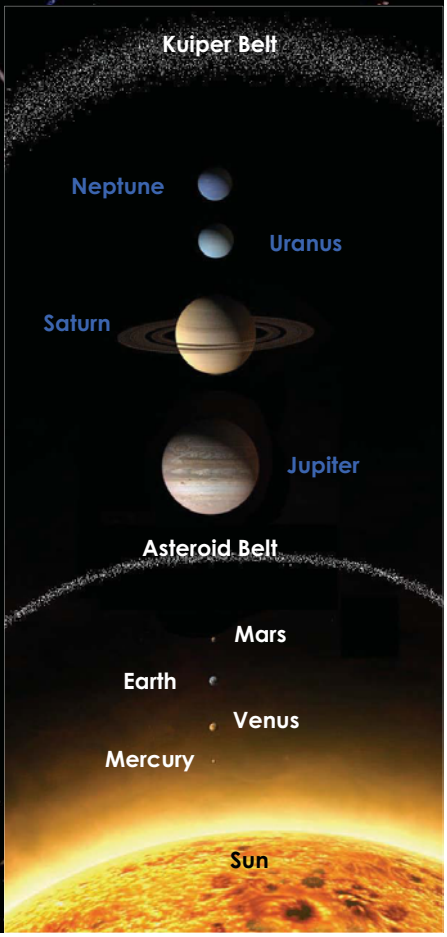
Saturn's mean density is so small it would float in water (if you would find enough of it!)

Saturn and Saturday are both named after the Roman god of agriculture and justice, Saturnus.

The rings are only about 20 metres thick!

Type of Planet	Gas Giant
Number of Moons	About 200
Surface Temperature (varies with depth)	-139°C
Day Length (sunrise to sunrise)	10 hours 14 min (at equator)
Year Length	29.5 Earth years
Tilt of Axis of rotation	26.7°
Angle of orbit against plane of Earth's orbit	2.49°
Ovalness of orbit (0=circular)	0.056

Parameter	Actual	Compared to Earth
Diameter	121,000 km	9.5 x bigger
Average distance from Sun	1430 billion metres	9.6 x further
Mass	$5.7*10^{26}$ kg	95 x heavier



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21 Jupiter

Strange but true!

Jupiter is basically a small star which is just too light to start nuclear fusion but its composition is nearly the same as that of the Sun!

Galileo first saw the four largest of Jupiter's 60+ moons (Io, Europa, Ganymede and Callisto) 400 years ago which is why we are celebrating astronomy this year!

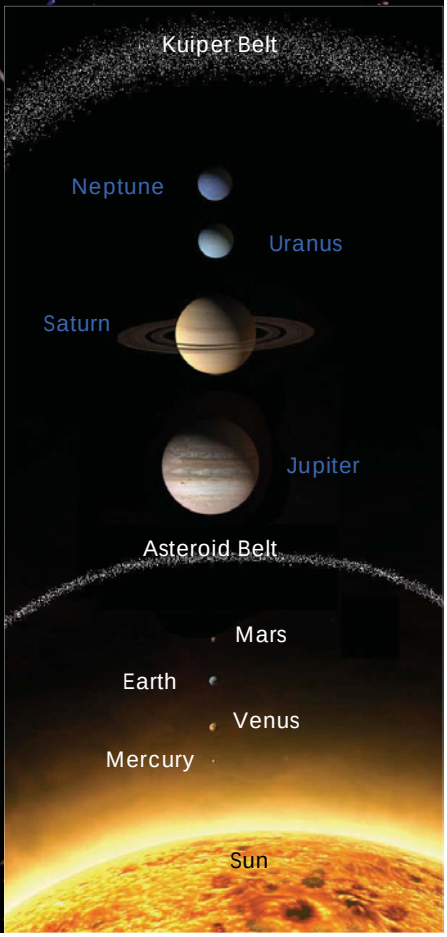
The moon Europa is very likely to host liquid water and is one of the likeliest places to find life outside the earth.

Perhaps the Romans knew Jupiter was the largest planet in the Solar System because they named it after Jove, king of the gods.

The famous red spot is a big storm system known to have existed for at least 300 years. The earth would fit into it entirely.

Type of Planet	Gas Giant
Number of Moons	63
Surface Temperature (night-day)	-108°C
Day Length (sunrise to sunrise)	9 hours 50 min (at equator)
Year Length	11.9 Earth Years
Tilt of Axis of rotation	3.13°
Angle of orbit against plane of Earth's orbit	1.31°
Ovalness of orbit (0=circular)	0.049

Parameter	Actual	Compared to Earth
Diameter	143,000 km	11 x bigger
Average distance from Sun	778 billion metres	5.2 x further
Mass	$1.9*10^{27}$ kg	318 x heavier



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Asteroid Belt

Image from www.astro.washington.edu

Strange but true!

The Asteroid belt consists mainly of millions of small bodies of rock and ice.

They probably represent a planet which failed to form because of the gravitation of its neighbour Jupiter.

The total mass of all the objects combined is only around 5% of that our Moon.

Some of the largest objects are Ceres, Pallas, Juno, Vesta, Astraea. Together they contain more than half mass of all main asteroid belt.

Ceres is so big (965 km) that it is now classified as a dwarf planet.

The smallest objects are the size of a grain of dust.

Asteroids which strike the Earth have probably played a major part in the history of life (perhaps causing the extinction of the dinosaurs for example) by creating a dramatic cooling of the Earth because of the dust produced when it created the Chicxulub crater in Mexico.

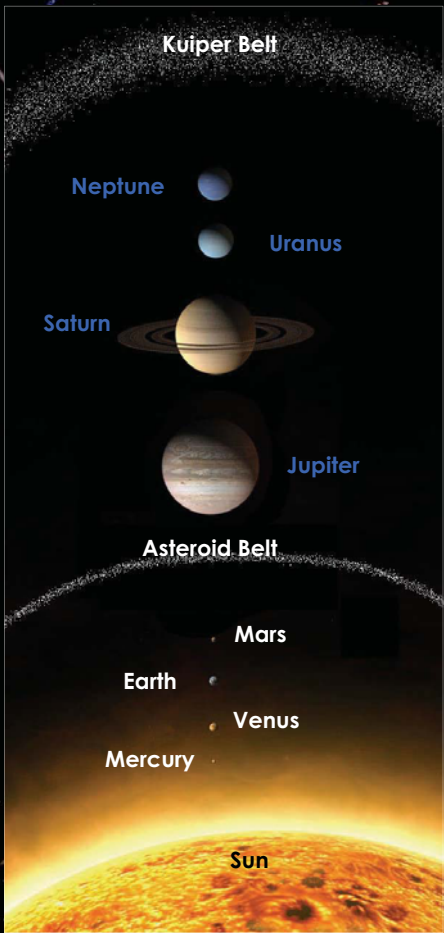
Statistically these impacts happen very 65-70 million years, so we are due for another one any day now!

When asteroids collide the debris can reach the Earth as meteorites.

Asteroids also exist on other places as well as the belt.

Type of Object	Minor planets and asteroids
Year Length	3 – 5 Earth years
Angle of orbit against plane of Earth's orbit	Mostly less than 30°
Ovalness of orbit (0=circular)	Mostly less than 0.4
Largest Objects	Ceres, Vesta, Pallas, Hygiea
Medium sized Asteroids	Over 200 are known larger than 100 km across.
Smaller Asteroids	Around 1 million known over 1 km across.
Smallest Asteroids	Size of dust particle

Parameter	Actual	Compared to Earth
Diameter	1 mm – 1000 km	tiny
Average distance from Sun	300 – 500 billion mtr	2.0-3.4 x further
Mass	9 *10^{20} kg	.02%



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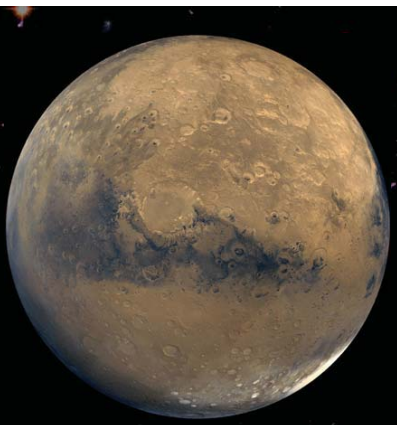
Mars



Strange but true!

Named after the Roman god of war, Mars is often referred to as the red planet because of the rust on its surface.

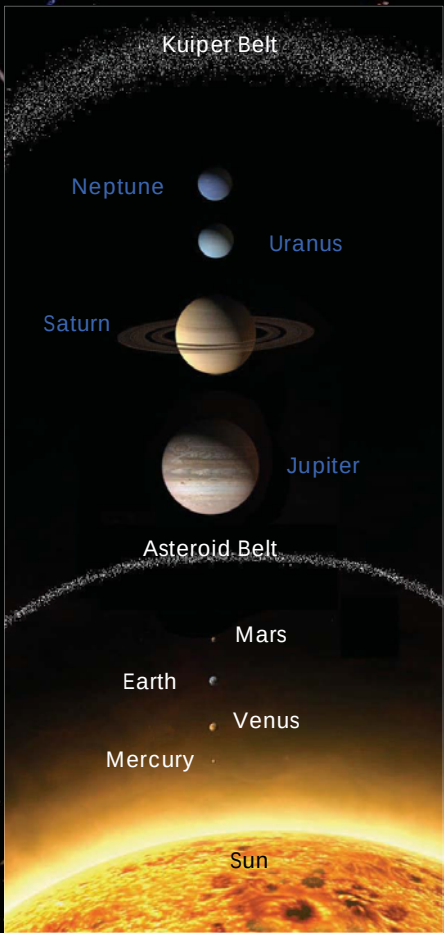
Mars' diameter is only half the Earth's, and only 11% of its mass, yet it contains the highest mountain (Olympus Mons), the longest and deepest canyon (Valles Marineris) and the largest impact crater known in the Solar System!

We know that water ice exists on mars today and that liquid water existed in the past.

Mars has two small moons, Deimos and Phobos.

Type of Planet	Terrestrial
Number of Moons	2
Surface Temperature (night-day)	-87°C to -5°C
Day Length (sunrise to sunrise)	24 hours, 39.5 minutes
Year Length	1.88 Earth years
Tilt of Axis of rotation	25.2°
Angle of orbit against plane of Earth's orbit	1.85°
Ovalness of orbit (0=circular)	0.093

Parameter	Actual	Compared to Earth
Diameter	6,800 km	53%
Average distance from Sun	228 billion metres	1.5 x further
Mass	6 *10^{23} kg	11%



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♁ Earth

Strange but true!

Earth's name can be traced back to the Hebrew 'erez', meaning ground.

It is the only place in the Universe where life is known to exist.

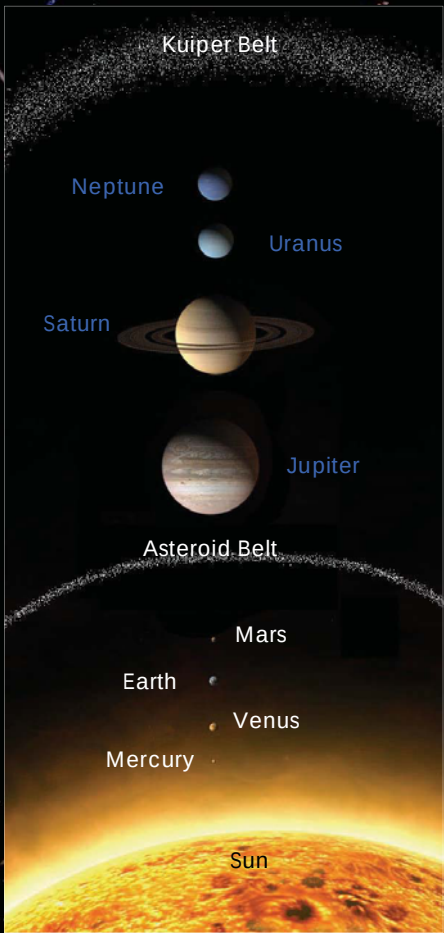
The Earth and Moon were probably formed from the debris after two earlier objects collided.

The Earth is exactly the right distance from the Sun for water to form a liquid, which is essential for life as we know it.

Life on Earth is protected from harmful cosmic radiation by the Earth's magnetic field. This field reverses every few hundred thousand years. We are due for another reversal any time now. We are not sure what the consequences might be.

Type of Planet	Terrestrial
Number of Moons	1
Surface Temperature (min-max)	-89°C to 57.7°C
Day Length (sunrise to sunrise)	1 day
Year Length	365.256 days
Tilt of Axis of rotation	23.4°
Ovalness of orbit (0=circular)	0.017

Parameter	Actual
Diameter	12,750 km
Average distance from Sun	150 billion metres
Mass	6 *10^{24} kg



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♀ Venus

Strange but true!

Venus is the brightest planet easily visible just before sunrise or shortly after sunset, for which reason it is often called the Morning or Evening Star.

It is named after the Roman goddess of love.

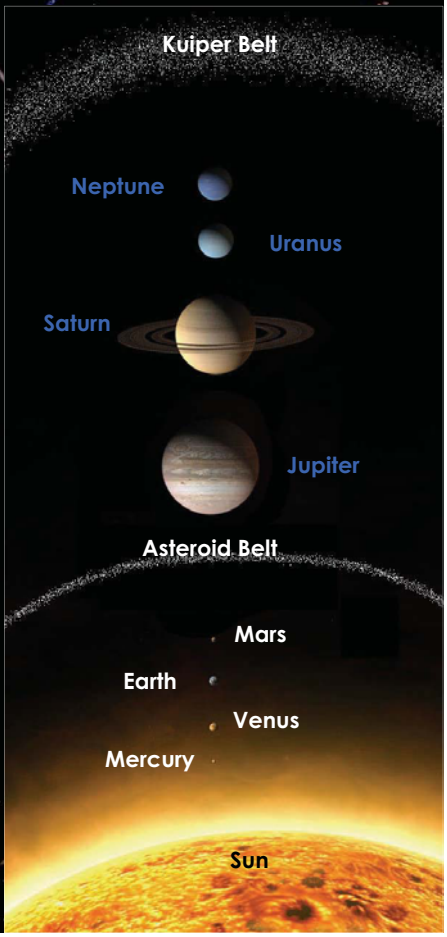
Venus is the hottest planet due to its big greenhouse effect. Lead and tin on the first man-made probes melted when they went there.

Venus' rotation is very unusual. It is the only planet that rotates clockwise (when seen from the north pole). The Sun, most planets and most moons rotate anti-clockwise, the same as the disc of gas and dust from which the solar system formed.

Apart from Venus the only other exception is Uranus which 'rolls' along its orbit. The reason for this strange spin is not known for certain. It might have been hit by a large asteroid.

Type of Planet	Terrestrial
Number of Moons	None
Surface Temperature (night-day)	189°C to 462°C
Day Length (sunrise to sunrise)	117 Earth days
Year Length	225 Earth days
Tilt of Axis of rotation	177°
Angle of orbit against plane of Earth's orbit	3.39°
Ovalness of orbit (0=circular)	0.007

Parameter	Actual	Compared to Earth
Diameter	12,100 km	95%
Average distance from Sun	108 billion metres	72%
Mass	$4.9*10^{24}$ kg	82%



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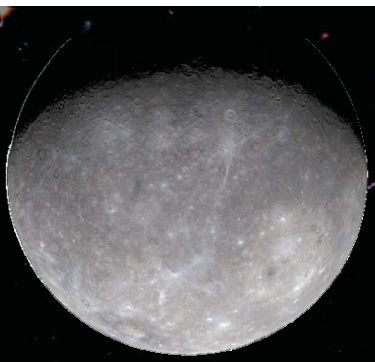
☿ Mercury



Strange but true!

Mercury is smaller than any other planet.

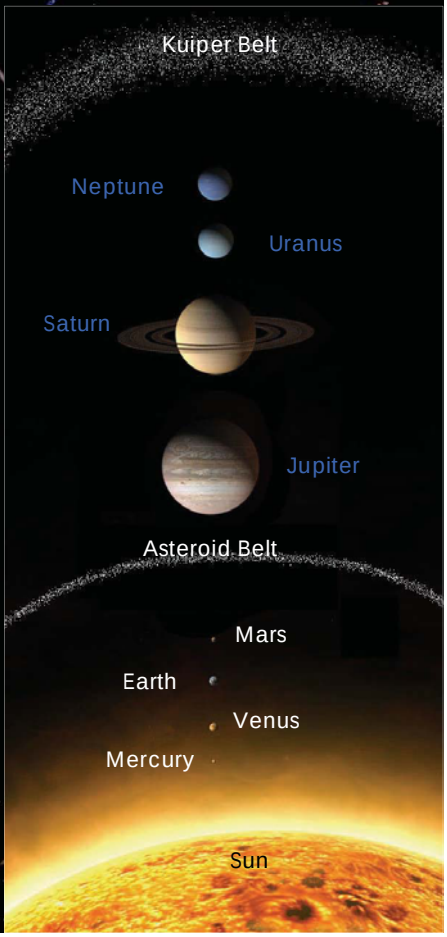
Having the shortest year of any planet (88 Earth days) Mercury takes its name from the high-speed Roman god.

Because it rotates very slowly, one day on Mercury lasts longer that one Mercurial year! In fact its spin and orbit are in a resonance so it rotates exactly twice (2 Mercurial days) for every three orbits (Mercurial years).

Although it is closest to the Sun Mercury is not the hottest planet! As Mercury has almost no atmosphere, Venus gets hotter because of the greenhouse effect.

Type of Planet	Terrestrial
Number of Moons	None
Surface Temperature (night-day)	-190°C to +110°C
Day Length (sunrise to sunrise)	88 Earth days
Year Length	88 Earth days
Tilt of Axis of rotation	1/30°
Angle of orbit against plane of Earth's orbit	7°
Ovalness of orbit (0=circular)	0.205

Parameter	Actual	Compared to Earth
Diameter	4,880 km	38%
Average distance from Sun	58,000,000 km	39%
Mass	$3.3*10^{23}$ kg	6%



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