



# Earth and Space



## PLANETS

Terrestrial planets: Mercury, Venus, Earth and Mars. They are rocky.

Jovian planets: Jupiter, Saturn, Uranus and Neptune. They are gaseous (some have solid cores).

**MERCURY:** Only slightly larger than Earth's moon. Can be between -173 and 427 degrees. Has a very thin atmosphere and cannot absorb meteor impacts. As a result, it has many craters. NASA's MESSENGER spacecraft orbited for 4 years to collect information. Orbit is 88 days, one day is 58.6 Earth days. It is named for the messenger of the Roman gods.

**VENUS:** Atmosphere is toxic (96% CO<sub>2</sub>) and the pressure would crush a human. Similar in size to Earth. It spins in the opposite direction to the other planets. Named for the Roman goddess of love and beauty. Orbit is 225 days, one day is 241 Earth days. You can't see its surface because of clouds of sulfuric acid. Mariner 2 orbited in 1962, and Venera 7 landed on Venus in 1970.

**EARTH:** The only planet we know that has life. Atmosphere is mainly oxygen and nitrogen. 1/3 water. Named after Anglo-Saxon word 'erda' which means ground or soil, but nearly every language has a different name for it.

**MARS:** Cold and dusty. The dust is iron oxide (rust!) which gives it a red tint. It has storm, but with dust instead of water. Scientists think that it used to be wet and warm, like Earth, but the atmosphere has got thinner over time, making the existence of water impossible. It does, however, have small amounts of ice. Named after Roman god of war. Orbit is 687, day is the same (near enough) as Earth. Soviet Union sent first probes in 1971.

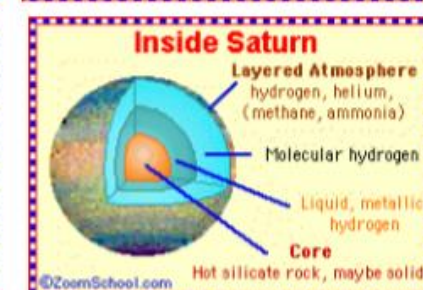
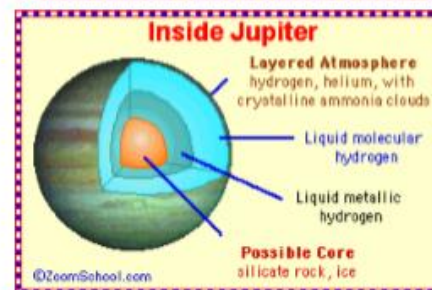
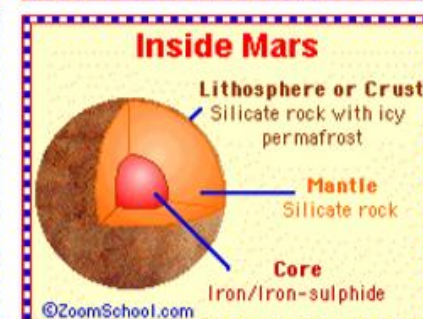
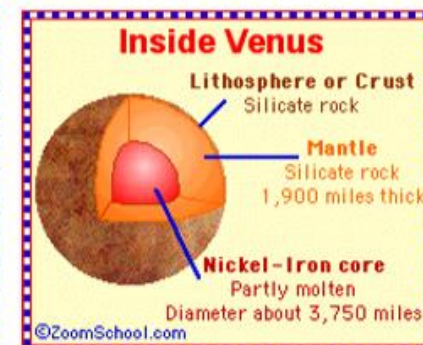
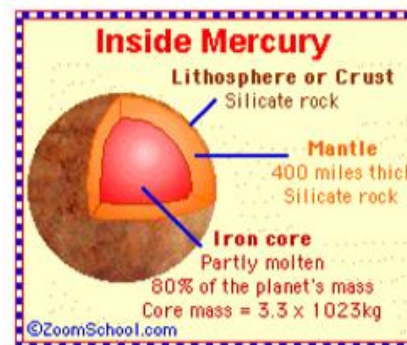
**JUPITER:** biggest planet in our solar system and has the most mass. Mainly hydrogen and helium. It has a Great Red Spot, which is a giant storm that has been going on for hundreds of years. Strong magnetic field, at least 79 moons (the largest is bigger than Mercury). Named for the ruler of Roman gods. Orbit is 12 years, day is 10 hours. In 1973, spacecraft began flybys to observe. One of the moons—Europa—is being investigated for life, as it seems that there is water under the surface.

**SATURN:** Has rings made of rock and ice. Mostly hydrogen and helium. Named for the Roman god of agriculture. Orbit is 29.5 years, day is 10.5 hours. Has at least 62 moons. First flyby in 1979.

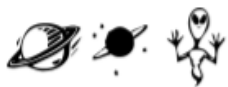
**URANUS:** Orbits on its side, so it has extreme seasons that can last over 20 years. Methane in the atmosphere gives it the blue-green tint. It has faint rings. Orbit is 84 years, day is 18 hours, named after the Greek god of the sky. Has the coldest atmosphere of -224 degrees. Primarily helium and hydrogen, but with ice and rock at the core.

**NEPTUNE:** Very strong winds, sometimes faster than the speed of sound. Named after the Roman god of water. Orbit is 165 years, day is 19 hours. Has 14 moons. Flybys began in 1989..

## INSIDE THE PLANETS



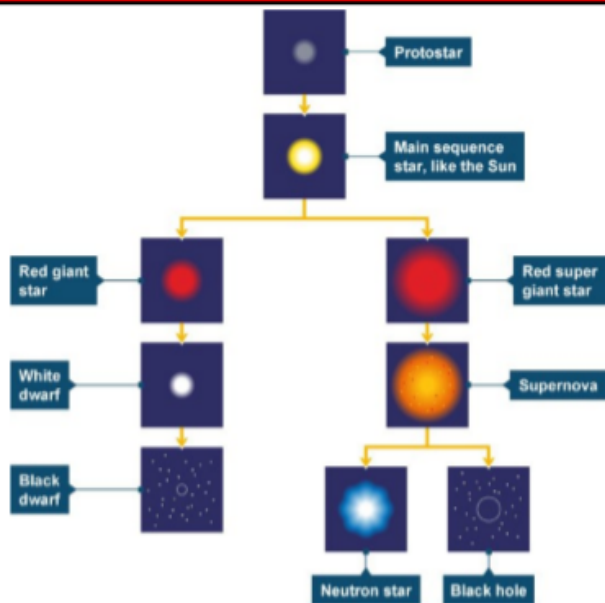




# Earth and Space



## LIFECYCLE OF A STAR



**Beginning life:** stars start as clouds of dust and gas. Gravity draws this all together and small stars form.

**Protostar:** a young star that is still gathering mass from its parent molecular cloud. Usually lasts about 1,000,000 years.

**Brown Dwarfs:** these stars have masses that are too small to allow temperatures high enough for nuclear fusion to begin. They shine dimly and then die away.

**Main Sequence (dwarf stars):** fuse hydrogen atoms to form helium atoms in their cores. 90% of stars are main sequence. This stage can last anywhere between a few million years, to hundreds of billion years, depending on heat and size. The sun is about 5 billion years through its predicted 10 billion year main sequence lifespan.

- Main sequence stars can be categorised as: O, B, A, F, G, K and M. It is based on temperature, the first being the hottest, the latter being the coolest. O and B are bright but uncommon, M stars are common but dim. The sun is a G star.

**Red Giant:** When a star consumes all of its core hydrogen, fusion stops. A shell of hydrogen around it ignites, causing rapid expansion. It can grow to 100 times its main sequence size.

**White Dwarf:** when a star runs out of hydrogen and can no longer draw higher elements into a fusion reaction, it becomes a white dwarf. It collapses inwards and gradually cools.

## CRAZY SPACE FACTS

- On the ISS, all water has to be recycled. Shower water, urine, sweat, condensate and runoff from sinks all goes through a system to create clean, drinkable water.
- The Earth's oldest rock was found on the moon. When the asteroid that killed the dinosaurs hit the Earth, it would have caused debris to exit the atmosphere. The moon was three times closer to Earth than now, so the Earth rocks would have easily collided with the moon.
- The sun is a continuous thermo-nuclear explosion. It would be incredibly loud, if space was not a vacuum.
- In space, astronauts use electrolysis to create new oxygen. This process breaks down water into its 2 hydrogens and one oxygen, then bonds two oxygens together to create O<sub>2</sub>.
- The ISS orbits the Earth every 90 minutes. The astronauts see a sunrise or sunset every 45 minutes. They follow GMT though.
- In space, you can feel your insides moving around inside you. Everything floats in low-gravity, including your insides. This makes going to the toilet incredibly hard, and it causes swelling as your blood floats.

**Black Dwarf:** a white dwarf that has cooled to a point where it no longer gives out heat or light. No black dwarfs exist, because the time it takes for a star to reach this point is longer than the age of the universe.

**Supergiant:** the largest stars in the universe. They consume fuel at a huge rate and will consume all the fuel in their core within a few million years. Live fast, die young stars. **Supernova:** a gigantic explosion that marks the destruction of a star. It causes a massive flash of light that then dies away. It scatters material in a huge shockwave, and it can trigger the formation of new stars.

**Neutron Star:** After a supernova, the remaining core of the star becomes a neutron star. It is composed entirely of neutrons as the intense gravity of the neutron star crushes protons and electrons together to create neutrons. These are the smallest and densest stars.

**Black Hole:** a region of space where the gravitational pull is so strong that light cannot escape. When a supernova happens, matter can be highly compressed, causing a black hole.

## EXTRA PLANETS

**Dwarf Planets:** there are 5 known dwarf planets: Pluto, Ceres, Eris, Makemake, Haumea. To be considered a planet, a celestial body must have cleared its orbit of smaller bodies.

**Planet X:** Scientists have run mathematical models, and investigated the orbits of various dwarf planets and objects, that suggest there is a ninth planet, running a huge, elongated orbit much further out than Pluto. Scientists predict that the orbit takes between 10,000 and 20,000 years.

## BOOKS

See Inside Space - Katie Daynes.

If you Were the Moon - Laura Purdie Salas.

First Big Book of Space - National Geographic Kids.

Look to the Stars - Buzz Aldrin.

Moonshot: the Flight of Apollo 11 - Richard Jackson Books.



# Earth and Space



## VOCAB

**Asteroid:** a small rocky body orbiting the sun. Most occupy the asteroid belt (sparse, not like in the films).

**Comet:** has a nucleus of ice and dust. Has a 'tail' of scattered dust and gas.

**Galaxy:** a collection of stars and planets, held together by gravitational attraction.

**Meteoroid:** rock fragments derived from comets. When it enters the Earth's atmosphere, the pressure heats it and it becomes a meteor with a fiery tail.

**Milky Way:** our galaxy. Formed 10 billion years ago.

**Solar System:** a group of planets and objects that orbit a star.

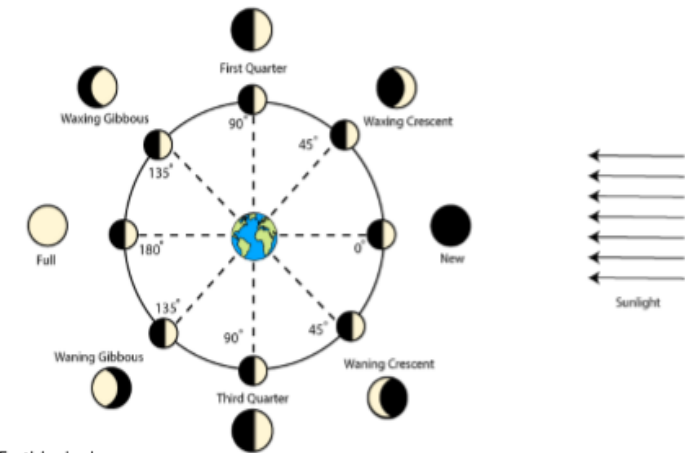
**Sun:** the G type Yellow Dwarf star at the centre of our solar system.

**Orbit:** repeated movement of an object around another object.

**Universe:** all existing matter and space. Currently believed to be about 10 billion lightyears in diameter and containing a vast number of galaxies. It has been expanding since the Big Bang 13 billion years ago.

## PHASES OF THE MOON

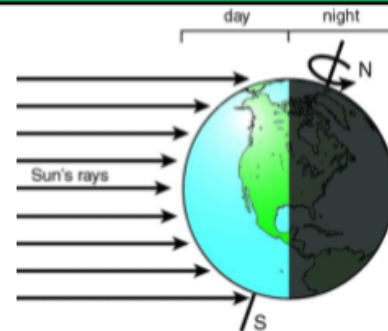
- The moon takes 27.7 days to orbit the Earth.
- It also takes 27.7 days to spin on its axis, which is why we only ever see its near side.
- A lunar month is 29 days and 12 hours.
- The moon ALWAYS has a lit side and a far side. How much of the lit side we see determines the moon phase.
- The phase of the moon we see depends on from what direction the sunlight is hitting it, and the angle we see that from Earth.
- New Moon:** The moon is between the Earth and the sun, so we only see dark. The lit side is facing the sun.
- Waxing Crescent:** The moon has moved slightly to the East of the sun, so we see a sliver of the lit side. Waxing means growing.
- First Quarter (half full):** The moon is 90 degrees away from the sun, a quarter of its way through its orbit. We can see half of the lit side, half of the far side.
- Waxing Gibbous:** gibbous means 'swollen'. We see 3/4 of the lit side, 1/4 far side.
- Full Moon:** the Earth is between the moon and the sun, so we see the entire lit side.
- Once at half its orbit, it repeats the phases in the opposite order: waning gibbous, third quarter, waning crescent, new moon.



**Solar Eclipse:** When the moon is exactly between the sun and the Earth and the Earth passes through the moon's shadow. The sun is 400 times bigger than the moon, but it is also 400 times further away, so the moon covers the sun perfectly. This can only be seen during the day.

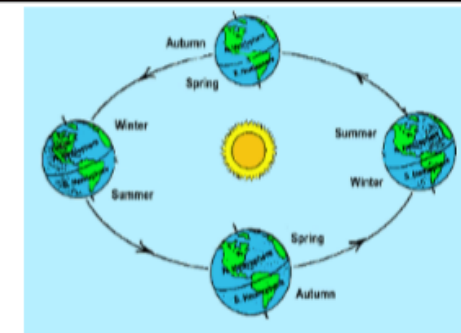
**Lunar Eclipse (blood moon):** When the Earth is positioned exactly between the sun and the moon, and the moon passes through the Earth's shadow. This can only be seen at night.

## DAY AND NIGHT



- The parts of the Earth facing the sun are lit up by it, causing day.
- The part of the Earth facing away from the sun are dark, night.
- The rotation of the Earth causes day and night. It rotates on its axis once every 23 hours and 56 minutes. It always rotates anti-clockwise, meaning that the sun always appears to rise in the East and set in the West.
- Because the Earth is tilted on its axis, days get longer and shorter. In July, the Northern hemisphere is tilted towards the sun, so the days are longer. Opposite in December.
- During March and September, the hemispheres are tilted about evenly, so day and night equal out.

## SEASONS



- The tilt of the Earth's axis causes seasons.
- Scientists think that, long ago, an impact caused the Earth to tilt on its axis.
- During June, the Northern hemisphere is tilted towards the sun, meaning the sun's impact is more direct, the temperature is warmer and the day is longer. As the Southern hemisphere is also tilted away, the sun's impact is less dramatic, making it colder and darker for longer.
- The equinox is when day and night are the same length. There are two— one in September and one in March.