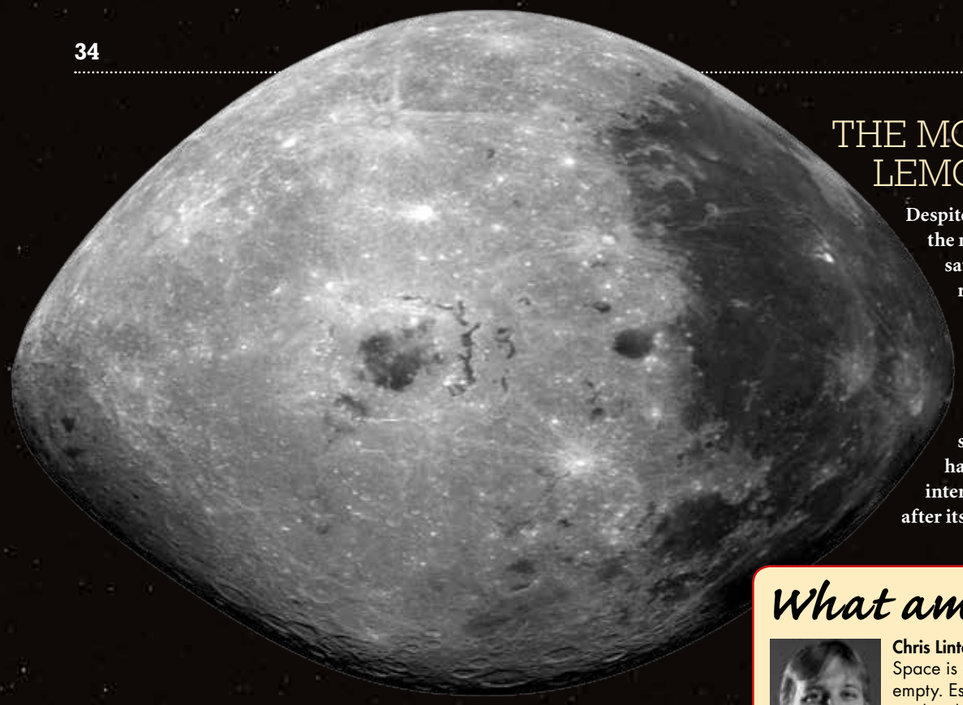
21 things you never knew about astronomy ...AND SPACE

Nicky Jenner presents the weirdest and most fantastic facts about Earth, the Solar System and beyond

What do lemons and raspberries have to do with space, just how dense is a neutron star and how powerful is a gamma-ray burst? Space is vast, and filled with weird and wonderful things. Some of the bizarre inhabitants and phenomena of our Universe are more astounding than even the most extreme Hollywood film or science-fiction novel. This selection of some of the most mind-boggling facts about our cosmos takes a bite-sized look at our intriguing planet, Moon, Solar System, Galaxy and Universe. How much do you really know about astronomy?

ABOUT THE WRITER

Nicky Jenner is a freelance writer, and an editor for the Hubble Space Telescope press office and ESA. Previously she was Hubble's European press officer.



THE MOON IS LEMON-SHAPED

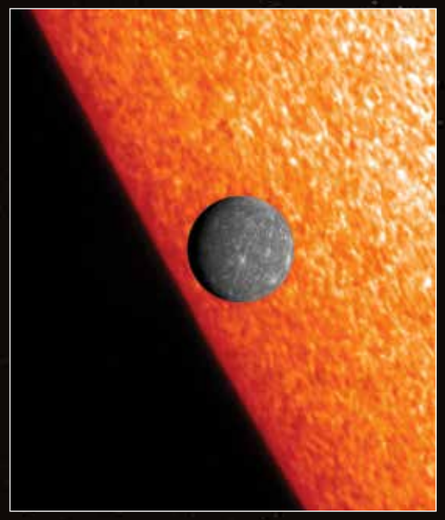
Despite its appearance in the night sky, our natural satellite is nowhere near round. In fact, the Moon is shaped like a lemon, with flattened poles and bulges on both the near and far side around its equator. This strange shape is thought to have been created during interactions with Earth soon after its formation.

CLOUDS AT THE CENTRE OF THE MILKY WAY SMELL OF RUM, TASTE OF RASPBERRIES AND ARE PACKED WITH BOOZE

In 2009, astronomers exploring a giant cloud of gas and dust at the centre of the Milky Way made a surprise discovery – the cloud was packed full of a chemical known as ethyl formate, which has a couple of intriguing properties: it is responsible for giving raspberries their flavour, and has the smell of rum. Another nearby region is also notable as it's full of ethyl alcohol, or ethanol, the type we use to make alcoholic beverages. It contains enough alcohol to supply every person on the planet with 300,000 pints of beer per day for the next billion years! If bottled at the source, the proof for this beer would be very low, with an alcohol content of less than one per cent, but as the cloud also contains plenty of other nasty chemicals, among them carbon monoxide and hydrogen cyanide, it would still leave you with quite a headache the next morning.

What amazes me

Chris Lintott, *The Sky at Night*
Space is empty. Really, really empty. Especially if you get out of our local galactic neighbourhood. If you set off from the Milky Way with your hand held out, by the time you reach the edge of our observable Universe you will have collected nothing but a few kilograms of hydrogen.



ON MERCURY, A DAY LASTS TWICE AS LONG AS A YEAR

Technically, one Mercurian day lasts 59 Earth days, while a year lasts 88. However, due to Mercury's very eccentric orbit and alignment with the Sun, the length of time from sunrise to sunrise, known as a 'solar day', is equal to 176 Earth days — twice as long as a Mercurian year.

IF YOUR SPACESUIT STARTED LEAKING, YOU COULD SURVIVE FOR A COUPLE OF MINUTES

Although films such as *Total Recall* show instant explosions and rapidly puffed-up spacesuits, the effects of being exposed to space are slightly less dramatic. Although it would definitely be unpleasant, you could survive for a couple of minutes.

After around 10 seconds, you would lose consciousness. The lower pressure of the vacuum would cause your blood to boil, along with other body fluids (the moisture on your tongue, for example) – but this boiling alone would not be fatal due to the pressure maintained by our blood vessels themselves. Gas bubbles would form in your bodily fluids, causing your body to swell up and bloat. The low humidity of space would cause you to cool down rapidly, and your eyes may freeze over. Within one to two minutes, the lack of oxygen would be deadly.

The stress of the situation may make these symptoms worse – you would become oxygen-deprived more quickly. A rapid decompression would cause damage to your lungs, eardrums and sinuses, along with bruising and bleeding from soft tissues.

GAMMA-RAY BURSTS CAN RELEASE MORE ENERGY IN 10 SECONDS THAN OUR SUN WILL IN ITS ENTIRE LIFE

Nothing in the Universe rivals the power unleashed during a gamma-ray burst, a brief but incredibly intense flash of high-energy radiation. There are many types of GRB: some are thought to form when a massive star implodes; others when two neutron stars merge together.

THERE ARE STARS WE WILL NEVER BE ABLE TO SEE

Ever since the Big Bang, most objects in space have been moving away from one another. In fact, cosmic expansion is actually accelerating. As regions of space are whizzing away from one another at an ever-increasing rate, the first population of stars to form in the Universe are now too far away for us to ever hope of spying them – even using the best present or future telescope. Hope is not lost; we can attempt to spot them indirectly via the energetic bursts of radiation they emit at the end of their lives.

ONE TEASPOONFUL OF NEUTRON STAR WOULD WEIGH THE SAME AS THE ENTIRE HUMAN POPULATION

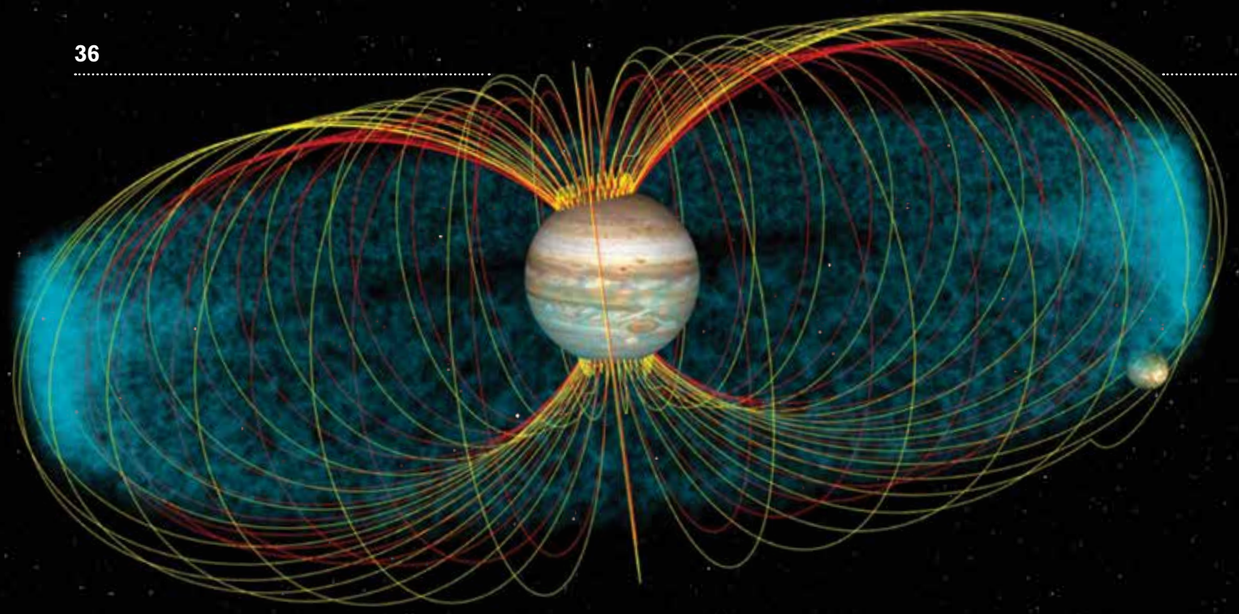
A neutron star's density is mind-boggling. These stars are composed almost entirely of neutrons packed together in a tiny radius. Just a teaspoonful of this material would weigh over a trillion kilograms — more than the weight of the entire human population (which reaches a few hundred billion kilograms). To make something as dense as a neutron star, the whole of humanity would need to be crammed into a space the size of a sugar cube.

BLACK HOLES HAVE THEORETICAL OPPOSITES KNOWN AS WHITE HOLES

Black holes are known for their voracious appetites; their influence is so strong that even light can't escape their gravity. But they have a theoretical converse – white holes. They are effectively the opposite of their dark relatives, spitting out light and matter instead of trapping it. So far, they are purely hypothetical objects; astronomers are contemplating how they could form in reality.

What amazes me

Marek Kukula, Public Astronomer at the Royal Observatory Greenwich
The Moon is thought to have formed after a collision between Earth and a Mars-sized body 4.45 billion years ago. The debris probably took less than a century to coalesce into the Moon; initially it would have been just a few Earth radii away, filling the sky and raising colossal tides.



NEPTUNE HAS ONLY COMPLETED ONE ORBIT AROUND THE SUN SINCE ITS DISCOVERY

Neptune takes a whopping 165 years to complete one full orbit around the Sun. Since it was discovered in 1846, Neptune only recently finished its first full post-discovery orbit in 2011. Demoted planet Pluto has yet to match this – it is not even close to completing one full, 248-year orbit since its discovery in 1930.

What amazes me

Sir Martin Rees, Astronomer Royal

Pulsars are amazingly precise clocks. If a pulsar's speed towards us altered, we could detect this within a year or two, even if the change was no bigger than the speed of the hour hand on your watch, despite the huge distances involved; even the closest pulsar to Earth is 280 lightyears away.

IF JUPITER'S MAGNETIC FIELD WERE VISIBLE, IT WOULD APPEAR BIGGER THAN THE MOON IN THE NIGHT SKY

The region of space in which a mass's magnetic field dominates is known as its magnetosphere. These regions surround planets, pulsars and even our Galaxy. The planets in our Solar System have magnetospheres that interact with and are shaped by the charged particles in the wind streaming from our Sun.

The largest magnetosphere in our Solar System surrounds Jupiter. Jupiter rotates very fast and has a very strong magnetic field, and its magnetosphere is filled with plasma from its volcanically active moon, Io. These features, coupled with the fact that the solar wind is slower and less dense at Jupiter than at Earth, lead to a very sizeable Jovian magnetosphere. It is easily big enough to contain a body the size of our Sun and, if visible, would be larger than the Moon in our night sky; quite an achievement considering that it is over 1,500 times farther away.

PLANETS CAN WANDER THROUGH SPACE WITHOUT A PARENT STAR

Not all planets form and stay around stars: astronomers estimate that there could be more than 200 billion of them floating free and drifting through our Galaxy. These 'rogue' planets were thought to have been kicked out of their home systems. While this is true for some, other planets may have formed completely independently of an accretion dise (as was the case for our Solar System) instead forming from the collapse of tiny, cold clouds known as globulettes.

THE SUN LOSES A BILLION KILOS PER SECOND

Particles in the Sun's upper atmosphere are so hot and energetic that they speed out into space as part of the solar wind. Our star sheds around 1.3 trillion trillion trillion particles every second. This equates to roughly one billion kilograms of matter per second, or one Earth every 185 million years.

What amazes me

Maggie Aderin-Pocock, *The Sky at Night*

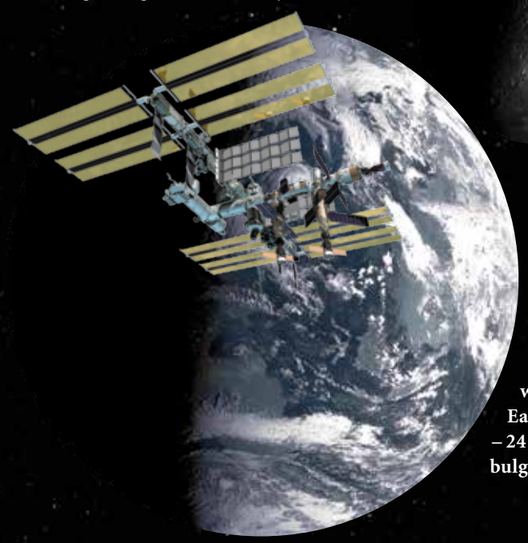
The Sun is so vast you can squish 1.3 million Earths inside. Its mass makes up nearly 99.9 per cent of the Solar System and its colossal power output is around 400 billion billion megawatts – put another way, the equivalent energy of 100 billion nuclear bombs every second.

VAST AMOUNTS OF WATER HAVE BEEN FOUND IN SPACE

Earth's oceans may not be that unique. Three of Jupiter's moons (Europa, Ganymede, and Callisto) and two of Saturn's (Enceladus and Titan) are thought to have underwater seas. Europa's ocean may contain over twice the volume of water found on Earth. However, the most water ever discovered surrounds a black hole some 12 billion lightyears away. This region contains vast amounts of water vapour, the equivalent of 140 trillion times the volume of water in Earth's oceans.

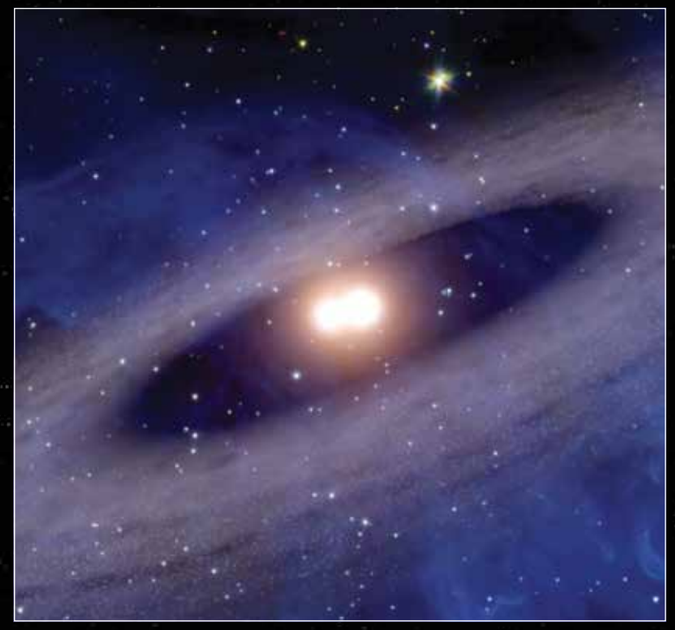
THERE IS GRAVITY ON THE ISS

Footage of astronauts on the ISS may give the impression of a gravity-free environment, but onboard gravity is actually only 10-11 per cent weaker than it is on Earth's surface. Astronauts float freely due to the ISS's continual state of free-fall, the same effect experienced by skydivers. The difference with the ISS is that it also has horizontal motion. As the ISS moves 'sideways' and falls towards Earth, the horizon curves away beneath it at the same rate, keeping the ISS in orbit and simulating a feeling of weightlessness for anyone on board.



MOST OF THE SUN-LIKE STARS IN OUR GALAXY ARE IN MULTIPLE STAR SYSTEMS

Our Sun may be a single star, but it is in the minority. Over half of the Sun-like stars in the Milky Way are part of multiple star systems, binaries or triplets, with stars orbiting around a common centre of mass. Most lower-mass stars like red dwarfs, however, live alone without a companion.



OUR DAYS ARE GETTING LONGER

Earth's spin speed is slowing: every year, it takes our planet a little longer to complete one full revolution on its axis. The change is miniscule, however. Every century, Earth slows by 1/500th of a second; 1,000 years from now, one day will be two hundredths of a second longer than today.

...AND THE MOON IS GETTING FARTHER AWAY EVERY YEAR

The Moon exerts a pull on Earth, causing our planet to be slightly egg-shaped. It affects water even more, creating tides and causing the oceans to pile up towards one side of the planet, forming a 'tidal bulge'.

This bulge is dragged around with the Moon as it orbits. As Earth rotates faster than the Moon – 24 hours versus 27.3 days – the bulge moves slightly ahead of the Moon's position in orbit. The Moon pulls back on it, effectively trying to slow it down and causing Earth's rotation rate to gradually slow down over time as a result.

As the two bodies interact through gravity, this tugging causes Earth to lose energy while the Moon gains energy. Because of this energy boost the Moon is slowly spiralling outwards, moving away from us by 3.8cm per year.