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Sir David Attenborough turns 100

**Broadcaster, natural historian,
conservationist, writer**

Sir David Frederick Attenborough is an English broadcaster, natural historian, and writer, and is still active today. He began his career as host of the BBC talk show, *Zoo Quest*, in 1954. He went on to be the narrator for nine documentary series forming *The Life Collection*, *Natural World* TV series, *Wildlife on One*, and others, including the most famous *Planet Earth*

series, the *Blue Planet* series, and the *Frozen Planet* series.

Early Life

David Frederick Attenborough was born on 8 May 1926 in England. He spent his childhood collecting fossils, stones and natural specimens. He won a scholarship to Clare College, Cambridge in 1945 to study geology and zoology, and obtained a degree in natural sciences. He joined the BBC as a radio talk producer; his association with natural history programmes began when he produced and presented the three-part series *Animal Patterns*, which led to *Zoo Quest*.

TV Series

Beginning with *Life on Earth* TV series in 1979, Attenborough set about creating a body of work which became a benchmark of quality in wildlife film-making. By treating his subject seriously and researching the latest discoveries, Attenborough and his production team gained the trust of scientists, who responded by allowing him to feature their subjects in his programmes.

Innovation was another factor in *Life on Earth*'s success: new film-making techniques were devised to get the shots Attenborough wanted, with a focus on events and animals that were up till then un-filmed. International air travel enabled the series to be devised so that Attenborough visited several locations around the globe in each episode, sometimes even changing continents in one sequence. Although appearing as the on-screen presenter, he restricted his time

on camera to give more time to his subjects.

Five years after the success of *Life on Earth*, the BBC released *The Living Planet*, a series focussed around the theme of ecology, the adaptations of living things to their environment. It was a critical and commercial success. In 1990, *The Trials of Life* completed the original *Life* trilogy, looking at animal behaviour through the different stages of life.

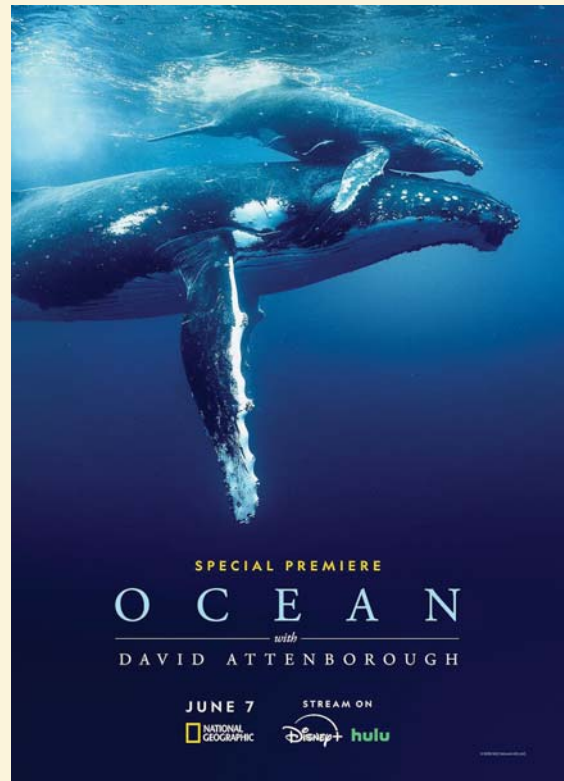
In the 1990s, Attenborough continued to use the “*Life*” title for a succession of authored documentaries. Although past normal retirement age, he then embarked on a number of more specialised surveys of the natural world, beginning with plants. He then turned his attention to birds, mammals, and invertebrates! He completed the set with *Life in Cold Blood*, on reptiles. Each became a memorable series with beautiful camera footage and excellent commentary by him.

Alongside the *Life* series, Attenborough continued to work on other television documentaries, mainly in the natural history genre. He wrote and presented a series on man’s influence on the natural history of the Mediterranean basin, in 1987. Two years later, he demonstrated his passion for fossils in *Lost Worlds*, *Vanished Lives*. The photo shows Attenborough with a bird-eating spider in 2005 during an episode of *Life In the Undergrowth*.

Attenborough narrated every episode of *Wildlife on One*, a **BBC One** wildlife series that ran for 253 episodes

between 1977 and 2005. At its peak, it drew a weekly audience of eight to ten million, while the 1987 episode “Meerkats United” was voted the best wildlife documentary of all time by BBC viewers. In this episode, the filmmakers built high trust with a wild group of meerkats in southern Africa, capturing rare, intimate footage of mob cooperation, pup-rearing, foraging, and sentinel watch. He has narrated over 50 episodes of *Natural World*, **BBC Two**’s flagship wildlife series.

His *Planet Earth* 2006 TV series was the biggest nature documentary ever made for television and the first BBC wildlife series to be shot in high definition. In 2009, Attenborough co-wrote and narrated *Life*, a ten-part series focussing on extraordinary animal behaviour, and



narrated *Nature's Great Events*, which showed how seasonal changes trigger major natural spectacles.

In 2011, the *Frozen Planet* series was made on the natural history of the polar regions. For *Planet Earth II*, Attenborough returned as narrator and presenter. He made several more series in the following decade, on *Birds*, *Dinosaurs*, *Prehistoric Planet*, culminating in the *Ocean* movie just last year, in 2025. It is a British documentary film which explores the importance of the Earth's oceans and the threats they face. It is narrated by David Attenborough.

Environmentalist advocacy

Attenborough's earlier work focused primarily on the natural world; however, his later work has been more vocal in support for environmental causes. He has advocated for restoring planetary biodiversity, limiting population growth, switching to renewable energy, and mitigating climate change.

Attenborough has been criticised for not giving enough prominence to environmental messages. He has earlier said that repeated messages on threats to wildlife in programming could be a "turn-off" to viewers.

By the turn of the millennium, Attenborough's authored documentaries included more environmental awareness. In *State of the Planet*, 2000, he used the latest scientific evidence and interviews with leading scientists and conservationists to assess the impact of human activities on the natural world.

He later turned to the issues of global

warming in his *The Truth about Climate Change*, 2006, and human population growth, *How Many People Can Live on Planet Earth?*, 2009. He contributed a programme which highlighted the plight of endangered species on Earth.

In 2019, Attenborough narrated *Our Planet*, an eight-part documentary series, for Netflix. This series emphasised the destructive role of human activities throughout the series. In 2022, the United Nations Environment Programme recognised Attenborough as a Champion of the Earth "for his dedication to research, documentation, and advocacy for the protection of nature and its restoration".

Attenborough was a key figure in the build-up to the 2021 United Nations Climate Change Conference and gave a speech at the opening ceremony. In it he stated that humans were "the greatest problem solvers to have ever existed on Earth" and spoke of his optimism for the future, finishing by saying, "In my lifetime I've witnessed a terrible decline. In yours, you could and should witness a wonderful recovery."

While admiring the many varied contributions of this amazing person, we can only hope that he is right!

Sources:

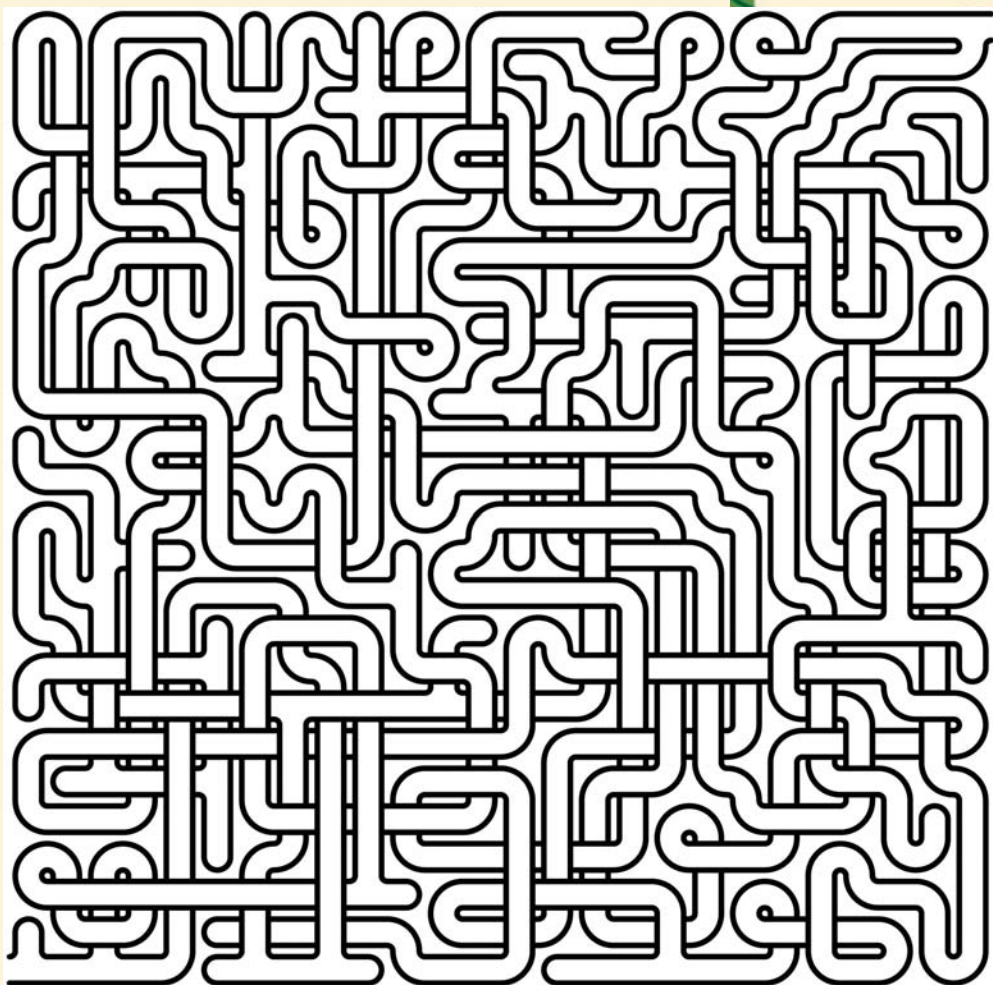
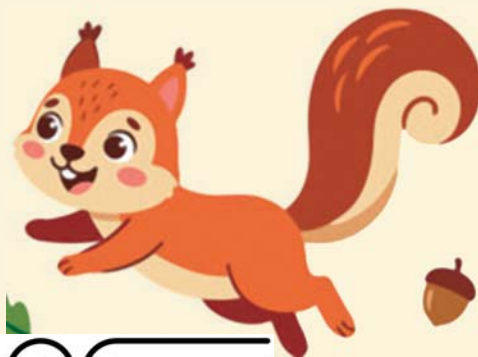
Wikipedia,

<https://www.theguardian.com/tv-and-radio/2019/oct/22/david-attenborough-climate-change-bbc>;

Pictures from Wikipedia and the BBC



Find the way!



International Space Station (ISS)

Hitchhikers guide to the ISS

Zareena, Mookayi and Mari



Coming out of the virtual reality (VR) dome, Zareena, Mookayi and Mari could not stop chatting about the **International Space Station (ISS)**. They had just watched it fly past Earth: a floating laboratory the size of a football field. They had found that it had been

floating in space since 1998. And there have been people living there constantly for more than twenty-five years—longer than they have been alive!

“Did you see how big it is?” Zar asked. The structure measures three hundred and fifty-six feet from end to

Spot the ISS from your location!

The ISS orbits Earth 16 times a day, taking 2-6 minutes to go past your own sky from west to east. Since it is only 400 km away, it can easily be seen with the naked eye with a clear sky. Spot the ISS from your location by looking for a bright, steady, non-blinking star-like point of light moving in the sky. Use the NASA “Spot the Station” app on your mobile phone or use the free non-app based ISS tracker orbitalradar.com, to see where ISS is now, and when it will be overhead at your location. If you are truly adventurous, you can spot (with a good camera) the ISS as it speeds past the moon in seconds, *as in this photo on page 8 by A. James McCarthy.*

end! That's 109 meters. And it weighs over 400 tons."

Mooks nodded. "It's 400 kilometers up above us. It goes round the Earth every ninety minutes!"

The ISS

"The ISS is really a truly international project," Mari said. "No one country possesses it. Instead, there are fifteen partner nations working together, including the United States, Russia, Japan, Canada, and the countries of the European Space Agency. All partners brought something exceptional."

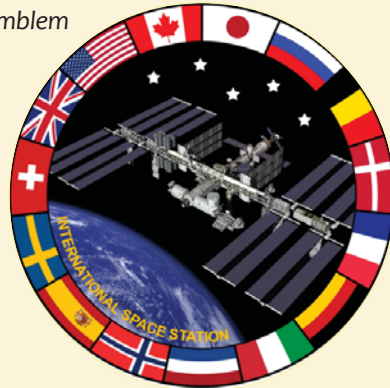
"I think the United States and Russia supplied most of the main structure and the rockets that take astronauts into space," Zar said hesitantly. "Canada has created a seventeen meter-long robotic arm, Canadarm2, that helps catch visiting cargo ships and carry heavy equipment."

"True," Mooks responded vigorously. "Japan and Europe built their own laboratory modules, where scientists may do tests that cannot be done on Earth."

"Over 250 people from twenty countries have visited," said Mari. "They have run more than 2,500 experiments—looking at changes in human bodies, producing plants, and even trying out 3-D printers."

Usha, Mari's mother, a biologist who had been listening, grinned. "You recall a whole lot. But here's something the VR show may have overlooked. The ISS is

ISS emblem



full of invisible passenger microbes," she continued, as the three girls crowded around her.

"You mean germs?" Mooks asked, surprised. In space?"

Hitchhikers

"Absolutely," answered Usha. "In a recent, enormous study called **3D Microbial Mapping**, researchers collected over eight hundred samples from nine modules, dining tables, gym equipment, and even the bathroom."

"But here's the surprising thing," Usha continued to explain. "The ISS has substantially less microbial variety than practically any other structure on Earth, including hospitals. It's at the far end of what scientists term an 'industrialization gradient.' It's the most sterile, human-dominated, microbiological environment they've encountered."

The International Space Station has a unique and extreme microbial and chemical environment driven by use patterns.



ISS against moon

Zar frowned. "Is that bad?"

"Could be," Usha said. "Our immune systems require exposure to innocuous environmental micro-organisms in soil and water to stay balanced. Those free living bacteria are almost non-existent on the ISS. Instead, 3 out of 4 microorganisms come from one place: human skin."

Mari stroked her arm. "So, do astronauts essentially live with cells shed from their skin?"

"That's right," Usha responded. "And that lack of variety, combined with stress and radiation, may lead to skin rashes and immune issues that crews often face."

"Each area has its own microbial signature," she added. "The dining module has food-related bacteria. Bathrooms harbor germs from human waste. And what was the most frequent form of life on the station? *Staphylococcus*. This is the same type of

bacteria that is currently on your skin.”

“What else is up there?” Mari asked.

Usha answered, “Scientists have found *Pseudomonas*, a very tough bacterium that can survive almost anywhere. Additionally, *Pantoea*, which is commonly found on food, and *Bifidobacterium* have also been discovered. Some are benign. Others could induce sickness if left unchecked.”

“And it’s not just bacteria,” Usha said. “The investigation also found human viruses on surfaces, including *Epstein-Barr*, a virus that can cause **mononucleosis**; *herpes* virus, which can cause cold sores and genital infections; and even *papilloma* viruses, which are associated with warts and certain cancers. Astronauts’ immune systems can become compromised by spaceflight, leading to the reemergence of those infections.”

Mooks looked uneasy. “So the walls themselves could tell you if someone’s immune system is failing?”

“That’s what researchers are looking at,” Usha added. “Monitoring the surface might offer an indirect window into the health of the crew.”

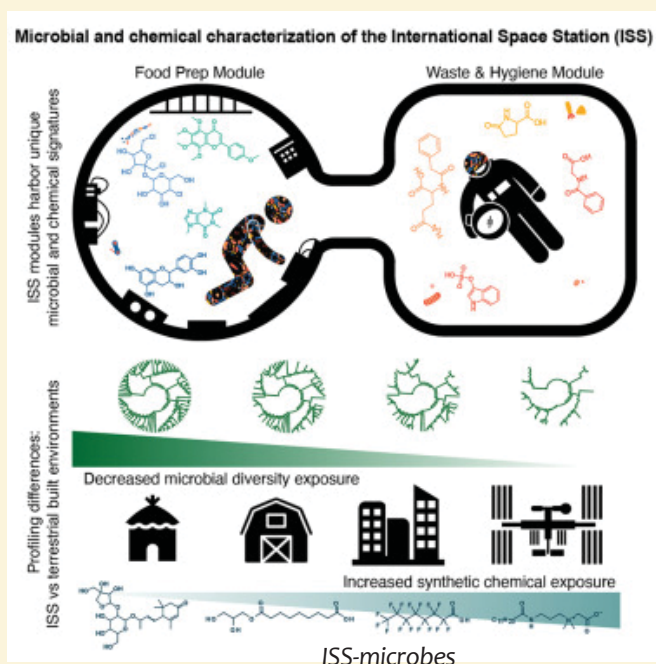
Zar’s eyes narrowed suspiciously. “400 kilometers away, how do they find out these things?”

“Astronauts take samples with dry swabs, like cotton buds, rubbing them on walls, railings, and tables,” Usha said. “(The picture shows NASA astronaut Scott Kelly collecting samples for Microbial Observatory-1). They freeze it all up at minus eighty degrees Celsius and send it back to Earth. Then scientists sequence the DNA, scanning genetic ‘barcodes’ to find out what each microorganism is.”

“But the best thing of all is...” Usha went on. “Some microbes are evolving in space. The ISS has microgravity, more radiation, and frequent disinfectants. Some bacteria are getting tougher, as we found more antimicrobial resistance genes. One species, *Pantoea piersonii*, was quite different genetically from its counterparts on Earth. Some are even making biofilms, which are slimy coatings that help bacteria stick to surfaces.”

Mari sat upright. “Isn’t that dangerous?”

“Not necessarily,” said Usha. “But it shows that living in space causes





Scott Kelly on ISS

changes. And by comparing the ISS to hospitals, residences, and even spaceship assembly buildings on Earth, scientists may discover which bacteria and chemicals support human health—and which ones don't."

Humans & Hitchhikers

Zar frowned. "So, knowing about these tiny organisms can help astronauts stay healthy on longer missions, like going to Mars?"

"Right," answered Usha. "As we prepare for human life on the Moon and Mars, we need to understand how our microbial companions will adapt with us. This work can help in designing safer spaceships and protect people on extended journeys."

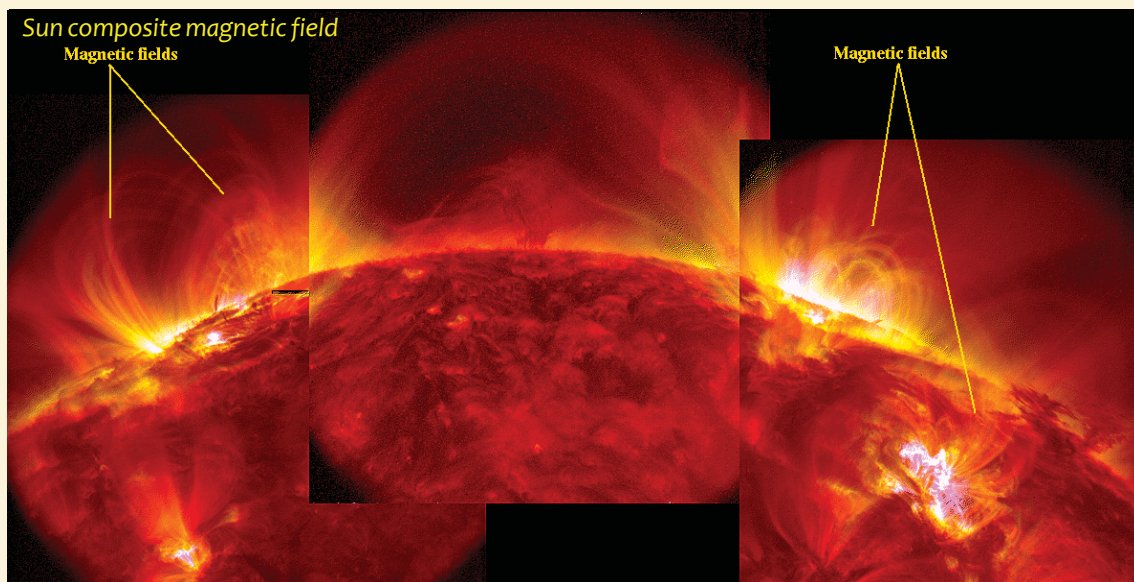
The three girls looked at each other. Suddenly the space station seemed even more astonishing, not simply a home for humans in space but an entire invisible ecology, forever changing.

"And to think," Mari whispered, looking up into the night sky, "we are never really alone, regardless of where we travel."

Usha smiled. "That's true. We take the microbes that are part of our existence with us. Always."

Further Reading:

International Space Station:
Everything you need to know about the orbital laboratory, <https://www.space.com/16748-international-space-station.html>



If heat destroys magnets, how does the Sun maintain a magnetic field?

TV Venkateswaran,

IISER Mohali

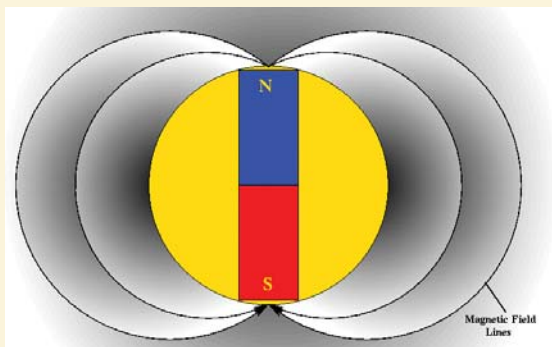
One day, while interacting with school students, a girl asked, “If heat destroys magnets, how can the Sun have a magnetic field?”

We are taught that heating a magnet weakens it. Cross a certain temperature, and the magnet loses all its strength. So it seems reasonable to expect that the Sun, which is far hotter than any furnace on Earth, should have no magnetism at all.

But here is the catch: the Sun is not a magnet like the ones we handle in school.

Think of a simple bar magnet, the kind you play with. Billions of tiny atomic magnets inside it are all lined up, like disciplined students standing in a row, all pointing in nearly the same direction. Heat spoils this order. As the temperature rises, atoms begin to vibrate strongly, and the neat alignment breaks down. Once this order is lost, magnetism disappears. That’s the fate of any permanent magnet.

The Sun, however, is a different beast. Its magnetism isn’t the “permanent” kind. The Sun is not solid like a magnet. It is not even



an ordinary gas. It exists in a state called **plasma**.

How to make plasma

Here's how you make plasma. Take a gas and keep heating it. Heat is a form of energy. Atoms can use this energy for various purposes: they can move faster and faster. Or they can vibrate more intensely (with higher frequency), etc. But there is one more interesting thing they can do:

You may have learned that electrons in an atom are bound to its nucleus by the mutual attraction between the negatively charged electrons and the positively charged protons in the nucleus. At some point, the heat is so intense that the electrons can use it to overcome this attraction and leave the atom; that is, the atom is **ionised**.

In lighter atoms like hydrogen and helium, all the electrons are stripped off, leaving only the central **nucleus**. In heavier atoms, only a few electrons are removed, leaving behind a positively charged ion (containing the nucleus and a few electrons). What you're left with is a wild soup of negatively charged electrons and positively charged ions all zooming around at incredible speeds. That's plasma. It's not solid, and

it's not even a normal gas. It's a fourth state of matter called plasma.

Remember plasma was made by heating neutral gas. But because the electrons and ions have separated, so the particles in a plasma are charged, they behave in a way that ordinary gas doesn't.

The Solar Dynamo

Hot plasma bubbles up from the depths of the Sun to the surface, cools, and sinks back down, like sambar boiling in a huge pot. The Sun is full of motion, rising, falling, swirling, almost like a pot of boiling sambar. This is called **convection**. But unlike sambar, every moving particle here carries an *electric charge*.

When charged particles move, they naturally create magnetic fields, which in turn have an additional effect on how the particles move. The plasma in the sun is set into complicated motion by the enormous heat produced due to the nuclear fusion in the centre of the Sun (where hydrogen gas burns into Helium). This movement of the plasma creates the sun's magnetic fields. This system is known as the solar dynamo.

Dynamos

You may have learned in school that moving charges create magnetic fields. This is the idea behind a *bicycle dynamo* that can be used to light up your path in the dark. You spin a magnet near a coil of wire, and the movement of charges creates electricity to power your headlight. But the reverse is also true. If you have a flow of charges—an electric current—it creates a magnetic field.

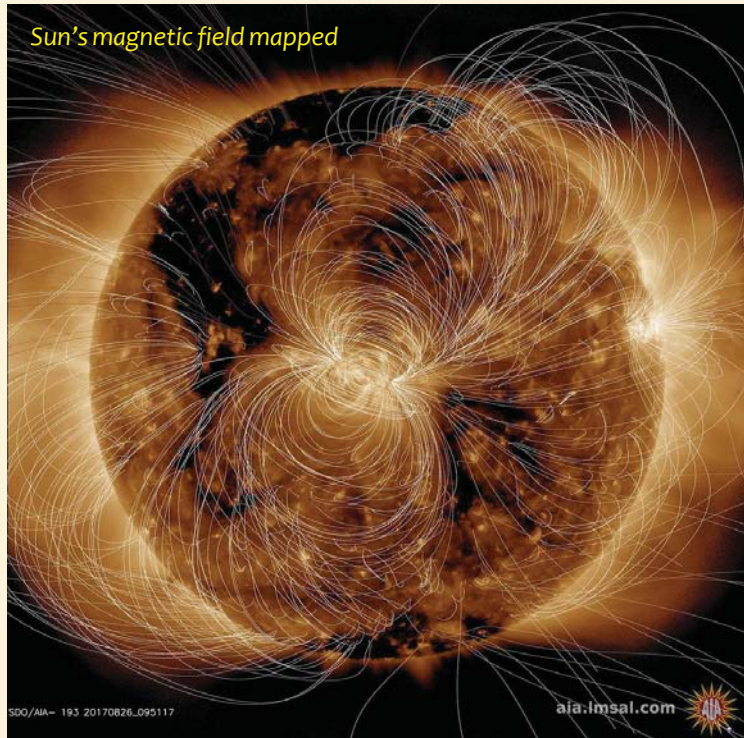
In the Sun, there are no wires, but the effect is the same. The movement of charged particles in the plasma acts like an electric current. That current produces magnetic fields.

So, the Sun, with its churning, swirling sea of charged plasma, is like a natural, massive dynamo. Now, this churning happens on a spinning sphere. And the Sun doesn't spin like a solid ball; its equator spins faster than its poles. This uneven spinning and the constant churning twist and stretch the magnetic field lines, generating electric currents. These new currents, in turn, create even stronger magnetic fields. It's a self-feeding loop.

The spinning disc experiment

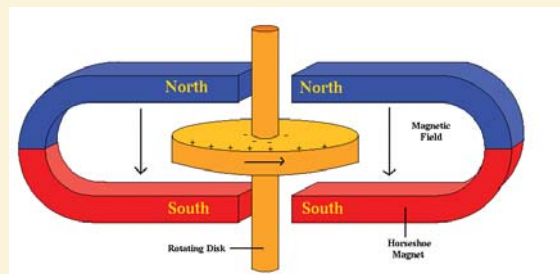
The simplest of all the dynamos is the disk dynamo developed by Michael Faraday nearly 200 years ago. It consists of a copper disk mounted so that part of the disk, from the center to the edge, is between the poles of a horseshoe magnet (see figure).

When the disk rotates, electrons start to move from the center of the disk to its edge and you obtain an electrical current. The flow of electrons is possible because in metals (as in a plasma) electrons are not bound to the atoms and can move around freely. This way of generating electric currents is based on a physical principle called *electromagnetic induction* (or

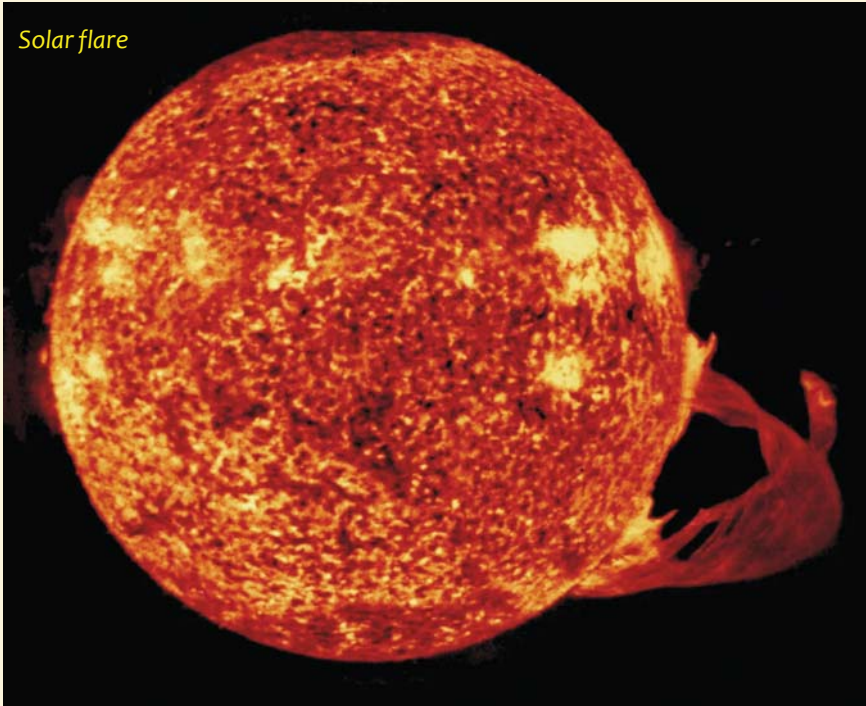


Faraday's law).

However, there exists another physical principle (*Ampere's law*), which says that moving electrons, i.e., electrical currents, generate magnetic fields. Therefore, the above disk dynamo, does not only generate electric currents but also some magnetic field. As we can see electric currents and magnetic fields are very closely related. Simply speaking we can say that electric currents generate magnetic fields and



Solar flare



peratures, there would be no plasma, no moving charges, and no magnetic field.

The exact mechanism, and how the magnetic field remains self-sustaining, is not yet fully understood. However, we can observe the *shape* of the magnetic fields above the sun's surface because they guide the motion of that

magnetic fields generate electrical currents.

Inside the Sun, a similar cycle runs continuously. Hot plasma moves and creates currents. These currents generate magnetic fields. The magnetic fields, in turn, affect how the plasma behaves. This ongoing loop is called the solar dynamo. So heat does not destroy the Sun's magnetism. It actually makes it possible. Without such high tem-

peratures, there would be no plasma – the loops of material in the corona glow brightly in images of the sun taken in extreme ultraviolet (EUV) light. They can also be precisely measured using a magnetograph.

However, this is a very simplified picture of the solar dynamo. The flow of the plasma has to fulfill certain properties for the dynamo to work. These properties are:

The maths and physics of the solar magnetic field

For those who have studied a bit more physics, here's the cycle in short: The Sun is made of plasma flowing with a certain velocity (V). This flow creates an electric field ($E = V \times B$) in a direction perpendicular to both V and B . This electric field drives electric currents (j) through the plasma. These currents, by the laws of electromagnetism, create the magnetic field (B). The interaction between the current and the magnetic field ($j \times B$) then acts back on the plasma. This looping sustains its flow. The whole system thus becomes a self-sustaining dynamo, feeding on the Sun's own heat and motion.

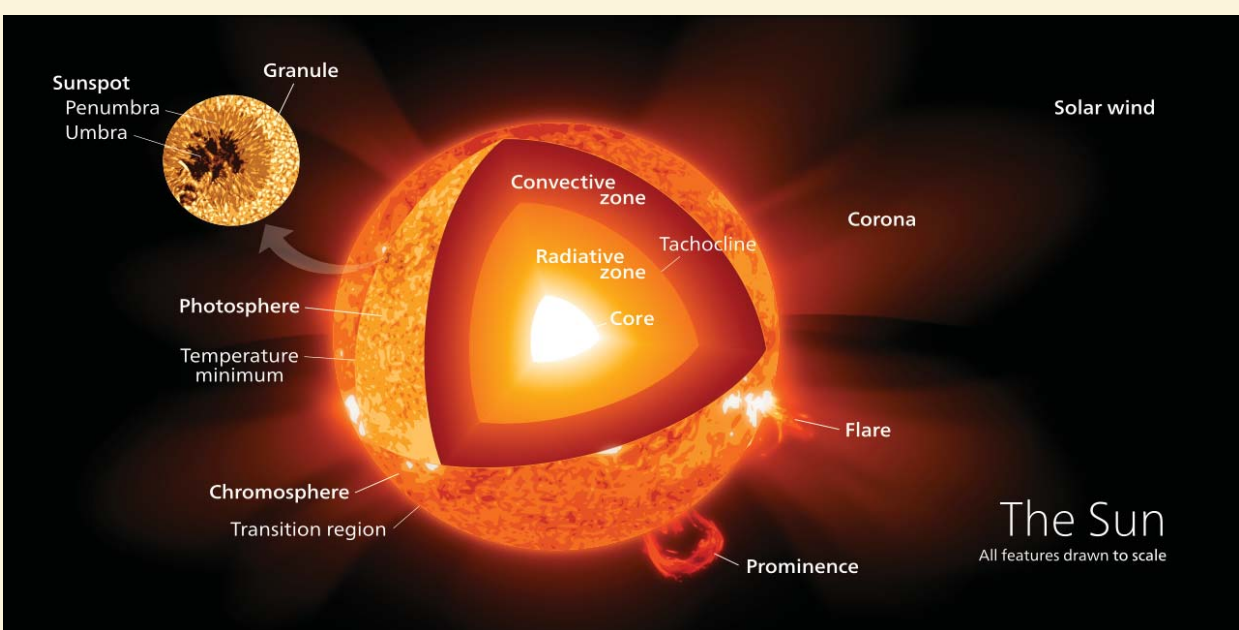
1. The flow has to be turbulent: the plasma must look more like boiling water than the smooth flow from a tap.

2. The flow has to be fully three-dimensional. The stream of water that emerges from a tap is only 1-dimensional, i.e., it flows in only one direction. Can you think of a 2-dimensional flow?

solar surface (sometimes they can be seen by the naked eye). The number of sunspots increases and decreases over a period of 11 years. This is called the solar cycle.

Where is the solar dynamo located?

Today, most solar physicists believe that the solar dynamo is located either at the bottom of the convection zone or in a thin



3. The path of the plasma cannot be in straight lines; it has to follow the path of a *helix*, in order to generate the correct magnetic fields.

The fact that the Sun has a magnetic field has only been known for about 100 years. This was discovered in 1908, by the American astronomer George Ellery Hale (1868-1938). He managed to show that sunspots are regions on the solar surface which have a very strong magnetic field. Sunspots are the most prominent magnetic feature on the

region called the overshoot zone. The overshoot zone is located between the convection zone and the radiative zone (see figure).

Sources:

<https://www.nasa.gov/science-research/heliophysics/nasa-understanding-the-magnetic-sun/>;
<https://www.cora.nwra.com/~werne/eos/text/dynamo.html>;
https://en.wikipedia.org/wiki/Solar_dynamo

The Art of Balance: Exploring Tensegrity Structures

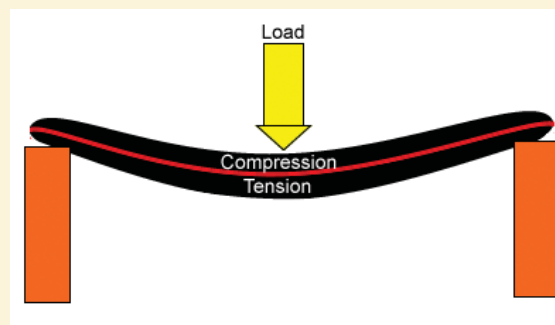
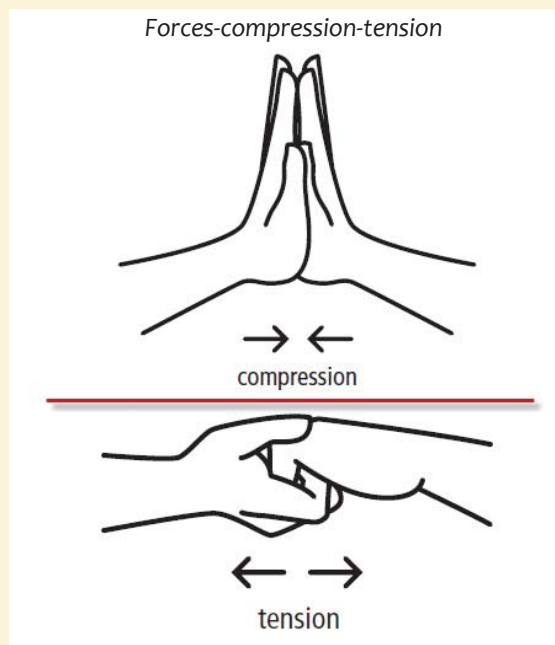
M. Divya

Have you ever visited a restaurant or café and noticed a table that seems to defy gravity? Or imagine walking into a science museum and noticing a strange structure. A heavy object appears to float in the air without any visible support beneath it. Curious, you move closer, expecting to find a hidden stand or support rod. Instead, you see only a few thin strings holding the structure together. How can something so delicate support so much weight?

This fascinating phenomenon is made possible by a principle known as **tensegrity**.

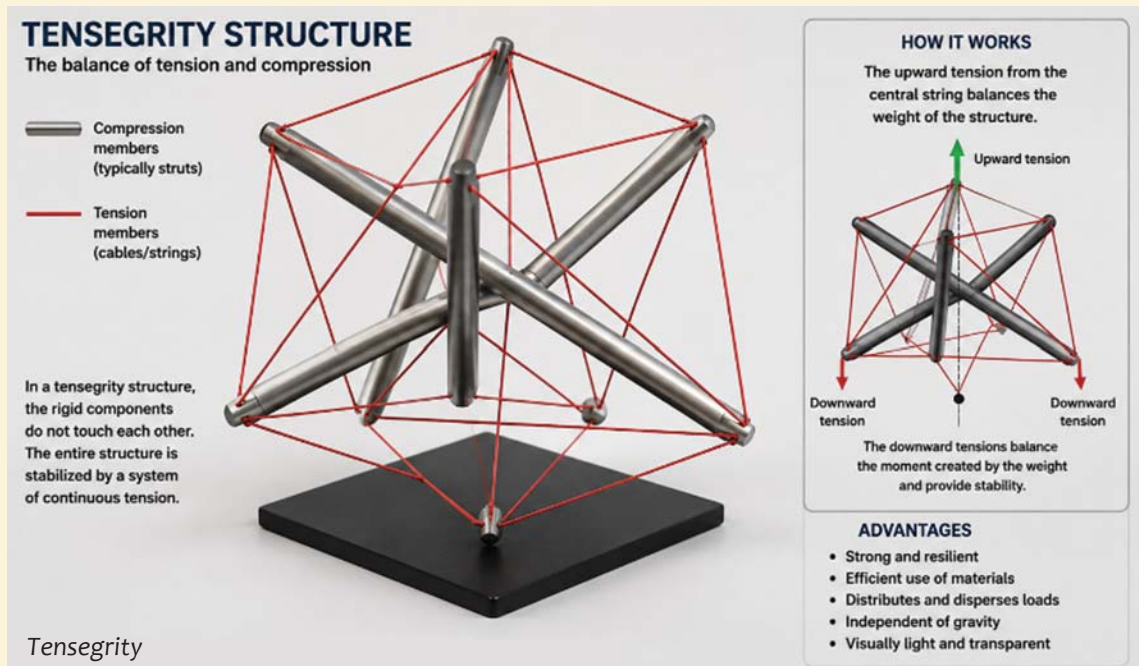
Strength does not always come from mass—it can also emerge from harmony and balance.

Derived from the words *tension* and *integrity*, tensegrity structures maintain their stability through a perfect balance of *tension* and *compression* forces. What appears impossible at first glance is actually a beautiful demonstration of physics and engineering working together. From artistic sculptures to modern architectural marvels, tensegrity structures showcase how



strength, stability, and elegance can emerge from the balance of forces.

The term “**tensegrity**” is a combination of the words *tension* and *integrity* (or *tensile integrity*) and was popularized by architect and inventor **Buckminster Fuller** in the 1960s. See the picture of the geodesic dome designed by him (located in the Montreal Biosphere Museum, Canada). The concept was further explored through the remarkable sculptures of artist **Kenneth Snelson**, whose creations appeared to challenge the



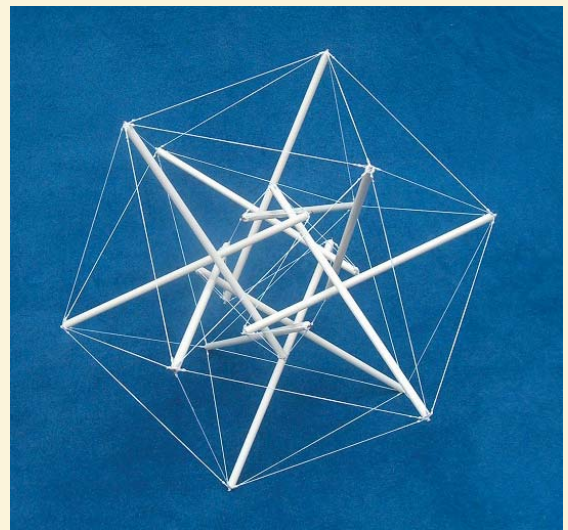
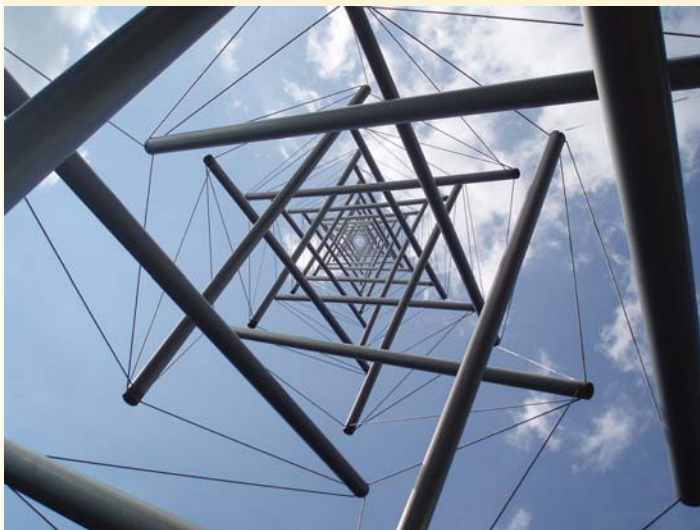
laws of gravity. See the picture of his Needle Tower in the Kröller-Müller Museum in the Netherlands.

How it works

In a pure tensegrity structure, the rigid components do not touch one another directly. Instead, they are connected by a network of cables or strings that remain under continuous tension, creating the illusion that parts of the structure are floating in space. What makes this possible is the careful balance of forces acting throughout the system.

The central string exerts an upward tension force that supports the weight of the suspended component. At the same time, other strings pull downward and sideways, balancing the turning effect (moment) produced by





Top: Olympiastadion, Munich

Above: Kenneth Snelson needle tower

Above right: Icosahedron

and visually striking.

Although tensegrity may seem like a concept confined to science museums and classroom demonstrations, its principles have inspired several remarkable structures around the world.



Some famous tensegrity structures

One of the most celebrated examples is the **Needle Tower** in Washington, created by American sculptor Kenneth Snelson. The sculpture consists of metal rods suspended within a network of tensioned cables, giving the impression that the rods are floating in space. It beautifully demonstrates how stability can be achieved through a balance of tension and compression. Another iconic example is the **Montreal Biosphere** in Canada. Designed by Buckminster Fuller, this geodesic dome serves as an environmental museum and showcases the elegance and efficiency of lightweight structural design. Its striking appearance reflects many of the principles associated with tensegrity and tensile architecture.

The **Olympiastadion** in Munich, Germany, is not a true tensegrity structure but uses

tensile membrane architecture. However, it also incorporates principles of tension and compression, in its massive roof made of acrylic glass held with steel cables.

In India, visitors to Science City, Kolkata, can observe a tensegrity structure that vividly demonstrates these principles. The exhibit shows an **icosahedron** and is a popular attraction because it appears to defy gravity, encouraging visitors to explore the science behind its stability.

These examples show that tensegrity is far more than a scientific curiosity. From sculptures and museums to large-scale architectural projects, the concept continues to inspire innovative designs that combine strength, efficiency, and visual appeal.

Sources:
Images from Wikipedia



Artemis II Astronauts Catch Moon Joy Syndrome

7. V. Venkateswaran

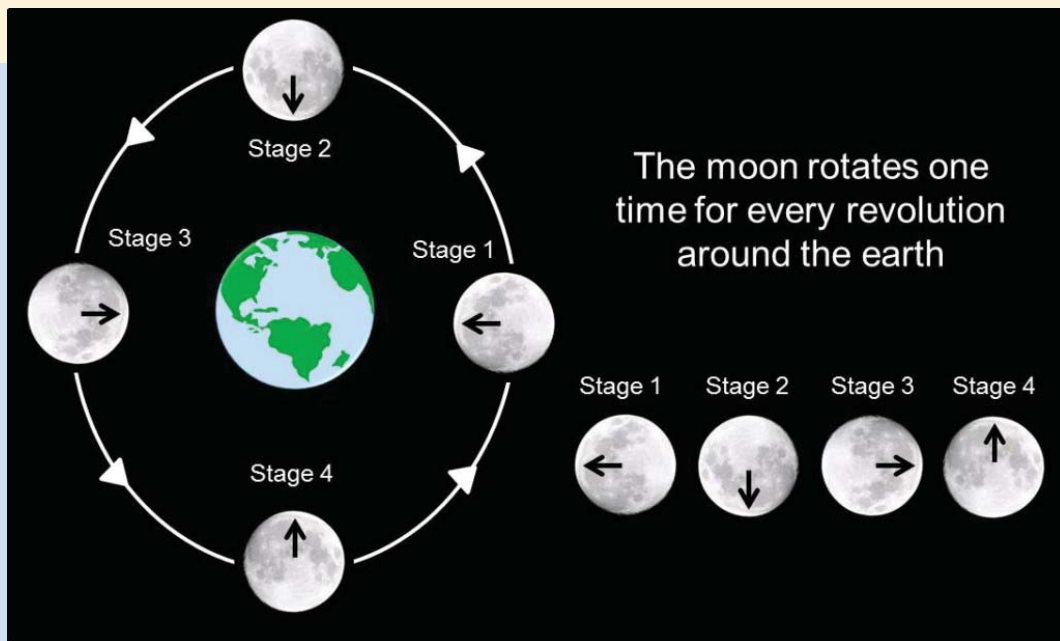
In the wee hours of April 7, 2026, IST, four astronauts looped around the **far side of the Moon**. It was a feat achieved nearly 53 years after the Apollo missions, way back in 1972. The **Artemis II mission** crew: Jeremy Hansen (mission specialist); Victor Glover (pilot); Reid Wiseman (commander); and Christina Hammock Koch (mission specialist) seen in the photo from left to right, completed their planned lunar fly-by (they flew

low over the Moon but did not land on it) and returned safely to Earth on April 11, 2026.

At 4:37 AM on April 6, the Orion spacecraft reached a distance of 406,771 kilometres from Earth. That is 6,600 kilometres farther than Apollo 13 had ever travelled. This created a new record—the farthest humans have travelled from Earth.

First Glimpse

Earth and Moon do not maintain a perfectly constant distance. Small variations (since the Moon is not a perfect sphere) cause a gentle wobble called “libration”. Thanks to libration, about 9 per cent of the far side becomes visible from Earth at times. That means we can actually see a little over 59 per cent of the Moon’s total surface. The remaining 41 per cent remained completely hidden until 1959. For centuries, that hidden hemisphere was the greatest mystery in our celestial neighbourhood.



What is the Far Side of the Moon?

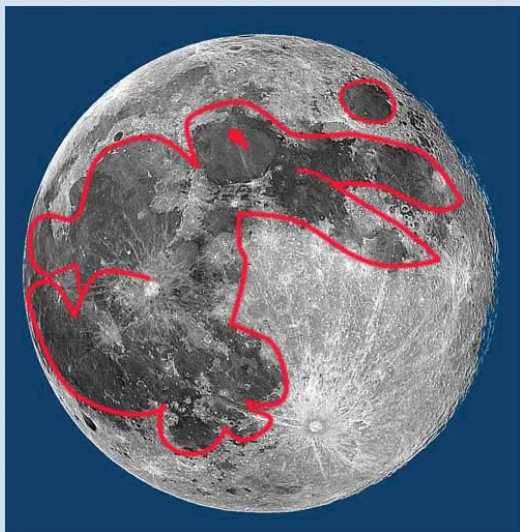
The far side was earlier also called the dark side of the moon. The far side of the moon is the side that we cannot see from the Earth. We don't see the far side because the moon is tidally locked to the Earth, This means that the moon does rotate, but it rotates at the same speed that it rotates around the Earth. The moon completes one full rotation on its axis in the time it takes to orbit the Earth. The result? One hemisphere always faces our planet. The other always faces away. That means the same side is always turned toward us. This will be clear if you look at the figure; a person on Earth always sees the side of the Moon containing the arrow.

Luna 3, a Soviet spacecraft, was the first mission to photograph the far side of the Moon, in 1959. The historic, never-before-seen views of the far side of the Moon caused excitement and interest when they were published around the world, and a tentative *Atlas of the Far Side of the Moon* was created from the pictures.

Here is another surprise: the far side is not dark at all. In fact, it receives slightly more sunlight over the course of a year than the near side does. How can that be? Consider lunar eclipses. During an eclipse, Earth's shadow falls on the near side of Earth. That never happens on the far side. Add up all the hours of illumination, and the near side loses some sunlight to those eclipses.

On the other hand, the near side does receive extra "earthshine", sunlight reflected off Earth. But when you do the full accounting, the far side still comes out ahead. It turns out that it is not the dark side. It is, truly, the brighter side.

Why was it called the dark side?



Is the far side of the Moon truly dark? When we say something is dark, we usually mean it receives no light. By that definition, the far side is not permanently dark. Both sides of the Moon get equal sunlight. In fact, a 'lunar day' is very long: each side of the Moon experiences two weeks of blazing day (with the Sun shining down on it), followed by two weeks of freezing night. As the Moon rotates on its axis and orbits Earth, sunlight falls equally on both hemispheres. Only a few spots deep inside craters where the sunlight is not able to penetrate due to geometry are truly dark.

But "dark" carries other meanings too. We often use it to describe things we do not understand, things hidden from our view, things obscured by some barrier. When we look up from Earth, we see only one face of the Moon, the one with the old lady frying vadas (or, in other cultures, a hare or rabbit always grinding herbs to make the elixir of life). The other face remains invisible. So, in the sense of "unseen" or "unknown", the far side earned the nickname "dark".

There is another meaning as well. When someone cannot be reached through normal communication channels, we say they have "gone dark". That fits the far side perfectly. Any spacecraft orbiting behind the Moon loses *radio contact* with Earth. Any craft that lands on the far side cannot be directly reached from the Earth. This is because the Moon's massive body blocks electromagnetic signals, radio waves, and all that. So in that sense, too, the far side is undeniably dark.

Still, to avoid confusion, astronomers prefer the term "far side".

That year, the Soviet Union's Luna 3 spacecraft photographed the far side for the first time. The world marvelled. No large dark plains there, it turned out. Just countless craters. Because the Soviets saw it first, they won the right to name its features. A large dark plain was named Mare

Moscoviense, the Sea of Moscow. The largest crater was named Tsiolkovskiy after the Russian rocket pioneer Konstantin Tsiolkovsky.

More recently, China has made historic landings on the far side. Chang'e 4 (2019) was the first space craft to touch down on

Artemis II versus Orion

Artemis II is a specific **lunar mission**, while Orion is the **spacecraft** that flies it. So, Artemis II is the *trip* (the first crewed flight around the Moon), and Orion is the *vehicle* (the capsule the astronauts travel in). The specific Orion capsule used for this flight was named *Integrity* by the astronaut crew.

the far side. Chang'e 6 followed in 2024, returning soil samples from that mysterious hemisphere to Earth. China is currently the only nation to have successfully landed a spacecraft on the far side of the Moon.

The Orion Spacecraft

The Orion Spacecraft is NASA's flagship deep-space exploration vehicle designed to carry astronauts to the Moon, Mars, and beyond. Built jointly by NASA and the European Space Agency (ESA), it supports a crew of four for up to 21 days in space. This means that it is complete with control room, living quarters, and lifeboat in deep space, including a kitchen, compact toilet and exercise equipment!

Mission Overview

Artemis II marked humanity's return to the vicinity of the Moon after more than 50 years, successfully testing the Orion spacecraft and Space Launch System (SLS) with humans on board.

The Artemis II flight was a vital test with human crew aboard. It was designed to validate deep-space life support systems,

navigation, and human health in deep space. The crew did not land on the Moon. Instead, they utilized a "free-return trajectory": here, the space craft is initially injected into space, but it needs no energy after that because it uses lunar gravity to *slingshot* the spacecraft back to Earth. This was similar to the older Apollo 8 and 13 missions. So it travelled about 7,400 kilometers beyond the far side of the Moon before Moon's gravity sent it back to Earth. This is a safety feature that guarantees that the crew will return even if the main propulsion systems fail.

The far side

The mission's most dramatic moment unfolded during the night of April 6 and the early hours of April 7, 2026. That was when the spacecraft looped around the Moon and began its journey back home.

At exactly 4:17 AM, Orion slipped behind the Moon and lost contact with Earth. Fifteen minutes later, at 4:32 AM, it made its closest approach, just 6,545 kilometres above the lunar surface. Then, at 4:54 AM, it emerged from behind the Moon and re-established communication with mission control.

Think of a mosquito buzzing around your head. It just doesn't see your face, but gets a good look at the back of your head too. Something similar happened here. As Artemis II swung around the Moon, the astronauts saw the hidden hemisphere of the Moon, the side not visible from Earth. They photographed it. They identified its geological features. And they marvelled at its beauty.



Near side of moon



Far side of moon

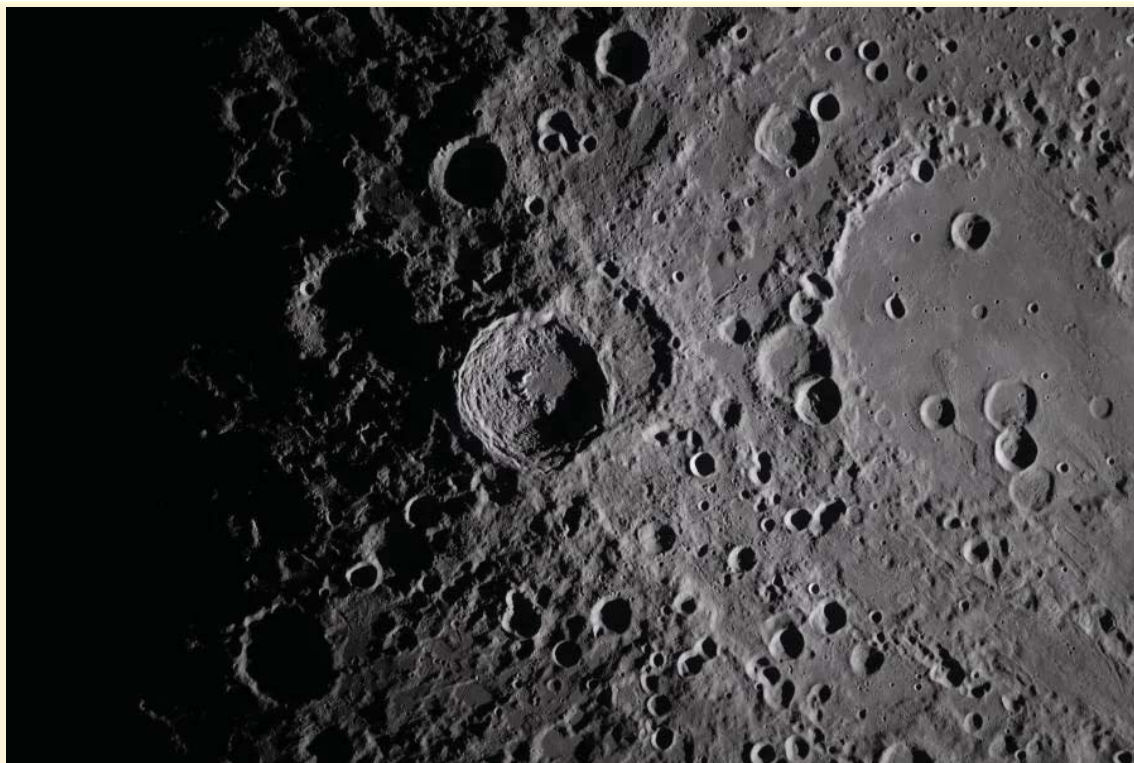
The far side glowed in the sunlight, with the deep dark sky around it. The crew was utterly mesmerised.

Christina Koch, the first woman to fly around the Moon, put it this way: “The moon we are looking at is not the moon you

see from Earth whatsoever.” She said she was particularly struck by the bright new craters that shone from the surface like pinpricks in a lampshade. “They are so bright compared to the rest of the moon.”

Earth set from Artemis II





Far side Artemis II

Victor Glover, the first Black American to travel beyond low Earth orbit, described the experience with quiet emotion: “It was very moving to look out the window.”

Their mission has expanded humanity’s understanding of the lunar far side like never before. The crew also took a photo of Earth setting behind the Moon!

‘Moon Joy’: The Contagious Wonder

Even during the Apollo missions, astronauts were awestruck by the Moon’s far side. Up close, the lunar surface filled them with astonishment and pure joy. They kept talking about its beauty endlessly. They raved, relentlessly, almost to the point where listeners might tire of it. Yet they could not stop. Mission controllers have a name for this: ‘Moon joy syndrome’.

During Artemis II, Commander Wiseman kept on and on about the Moon’s splendour

without pause. Finally, the Capcom at Houston’s mission control, with a wry smile and a touch of gentle teasing, radioed back: “Copy, Moon joy” (meaning, I’ve understood, you are affected by the Moon joy syndrome!).

What triggers this syndrome? The mystery of the far side is the key trigger; the sight is unexpected and new. It’s unexpected brilliance is another factor. Every astronaut who sees it agrees: this is not the Moon we know from our backyards. The bright fresh craters captivate them. On the near side, the one we see from Earth, dark volcanic patches called **maria** dominate the landscape. The far side is a lighter; those dark plains are few. Instead, countless craters, big and small, cover the terrain. With no atmosphere to soften the light, sunlit areas blaze white-hot, while shadows fall pitch-black. The boundary between light and dark is razor-sharp, like a knife’s edge. These stark



contrasts leave astronauts speechless with wonder.

The Bright Side of the Dark Side

China plans to build a radio telescope on the far side. Why there? On Earth, human-made radio signals constantly impede astronomical observations. Even space-based telescopes suffer interference from radio transmission from ground. But a telescope on the far side of the Moon would be permanently shielded by the Moon's body. No Earthly chatter would reach it. Such an instrument could listen to the faint whispers of the early universe, a revolutionary leap for astronomy.

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Do You Know?

Sloths have been made popular by Disney as the character **Flash** in the movie **Zootopia**. Here are some questions about them.

1. Are sloths just slow in moving or is everything about them slow?
2. Can sloths swim?
3. What is special about their fur?
4. They use their claws to climb, but where do they spend a large part of their lives?

Answers to these questions in the next issue of JM.

Answers to Mar-Apr issue's Do You Know?

Apologies for the delay in printing the answers.

—Editor

After the platypus, it is the turn of birds. Do you know the answers to these bird questions?

1. Woodpeckers (as their names suggest), hammer on tree barks. How come they don't injure themselves in the process?

Ans: Woodpeckers can slam their heads into trees up to 20 times per second with forces exceeding 1,000 times gravity without getting hurt because of many specialised features.

They have spongy, plate-like bones that act like an internal bicycle helmet. These absorb and distribute the kinetic energy of every blow before it reaches the brain tissue.

The hyoid bone of the woodpecker, which supports their extremely long tongue, winds around outside the entire back of the skull through a special cavity, thereby cushioning the brain. They have asymmetrical beaks: their lower beak is longer and stronger than their upper beak, helping to divert kinetic energy



away from the brain. Their brain is small and smooth, with less space inside and very little cerebrospinal fluid surrounding it. This limits brain movement that can cause *concussions*.

Woodpeckers align their necks and bodies perfectly in a straight line with the tree when pecking. This prevents dangerous twisting (angular) forces on their head and neck.

The pecking causes the woodpecker's skull to heat up. So they often peck in short bursts with brief breaks in between, giving the head some time to cool.

Their nostrils are often slit-like with special feathers to protect them. Finally, just before contact with wood, a thickened membrane closes, protecting the eye from flying debris!

2. Are any birds poisonous?

Ans: There are no known venomous birds that can actively inject toxins

through bites or stingers. However, several species are poisonous—meaning they are toxic to touch or eat because they extract poisons from their diet, much like poison dart frogs. For example, the skin and feathers of the *Hooded Pitohui* and the *Blue-capped Ifrita* (found in Papua New Guinea) contain **batrachotoxin** which is poisonous. The *Common Quail* migrates to southern India during the winter, during which it consumes large amounts of hemlock seeds. This causes a rare toxic syndrome known as **coturnism**. While the toxins do not harm the bird, eating the meat can lead to severe muscle degradation and kidney failure in humans.

3. Can crows really recognise and differentiate human beings?

Ans: Yes, crows are highly intelligent birds that can recognize specific human faces, voices, and gaits. Wildlife biologist **John Marzluff** and his students at the University of Washington in Seattle found that crows are highly adept at recognizing human faces. They conducted an experiment in which they netted and banded sets of crows at various sites on campus and around Seattle while wearing rubber human masks. A few days later the researchers walked through the same areas wearing assorted masks. At each site the crows ignored all but the particular mask that had been worn during the banding, which they greeted with loud scolding cries.

Research also shows that they can



differentiate between familiar and unfamiliar human voices. In fact, crows can categorize humans as “dangerous” or “friendly”. If a crow has a negative experience (like being trapped or harassed) with a specific person, it will remember that face. Conversely, if you regularly feed them, they may even bring you “gifts” like shiny trinkets or bottle cap.

What is even more amazing is their ability for social learning: crows communicate these threats to one

another. So if you’ve harassed a crow, be prepared to be harassed in turn by generations of crows!

4. Why are flamingoes pink in colour?

Ans: Flamingos are not born pink. When they hatch, their fluffy down feathers are dull gray or white. It takes about three years for them to transition into their iconic pink color as they continually filter-feed on pigment-rich aquatic life.

They consume tiny crustaceans and blue-green algae in their wetland habitats that are packed with

carotenoids—the same natural orange-red pigments that give carrots and pumpkins their bright colours.

Enzymes in the flamingo’s liver break down these pigments. The pigment-rich fats are then absorbed and deposited into their growing feathers and skin.

The shade of pink signals a flamingo’s health and readiness to breed. Brighter, deeper pink or orange birds are generally healthier, meaning they attract mates faster and begin breeding earlier.

Because color is entirely dependent on food intake, a flamingo deprived of carotenoid-rich foods will eventually lose its vibrant color and turn white or pale gray as it molts its feathers.

This is particularly true for captive flamingos: even if adequately nourished, they may turn a pale pink if they are not fed carotene at levels comparable to the wild.

Sources:

Wikipedia;
<https://birdsoftheworld.org/bow/home>



Presenting our budget

Kamal Lodaya.

Bengaluru

This is the second of a series of articles on the close correlation between the atmosphere, the ocean, and the weather ... and not just on Earth alone.

India's Budget

On February 1st of every year, the Finance Minister presents the Union government's budget in the Indian parliament. The budget gives an account of what the government has done for our economy, how many rupees it has raised in taxes from the people, how many rupees it has spent, and what it plans to do in the coming year. One thing the Finance Minister does not tell us

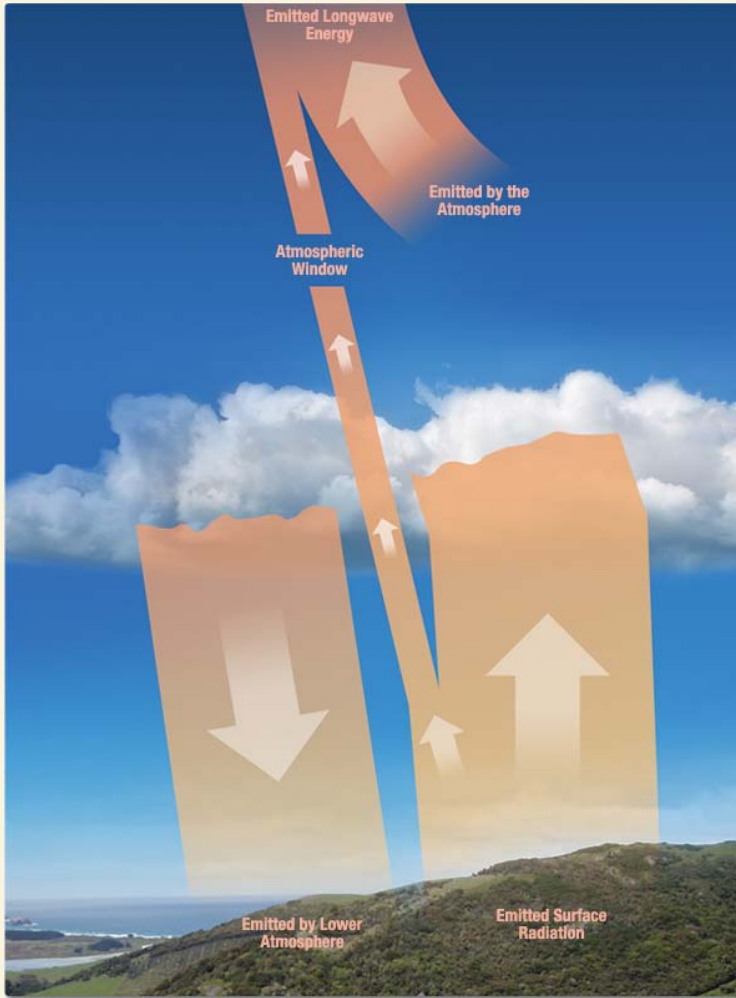
(because the budget is only concerned with India) is how the Indian rupee is faring compared to the basket of other nations' currencies in the world.

Earth's (Energy) Budget

To take account of what the Sun does to Earth every day, climate scientists present the Earth's budget. The unit of the Sun's intensity is watts per square meter, how much power is received or sent area-wise. Above the atmosphere, Earth receives solar power with intensity 1.38 kilowatts per square meter. Some solar radiation is reflected back into space by clouds and some is absorbed in the atmosphere. At the ground on a clear summer day we receive 1.36 kilowatts per square meter.

On the ground solar radiation is reflected back into space by snow, ice or other surfaces. Otherwise it is absorbed by Earth's surface. That makes the surface hot. This heat is released from Earth as *infrared* radiation. So outgoing power to space





is by sunlight reflection as well as by emitted radiation.

A tiny proportion of the atmosphere is **ozone**. Ozone high in the atmosphere reflects *ultraviolet* radiation coming in from the Sun's light back into space. This is good for life, because ultraviolet radiation damages crops and

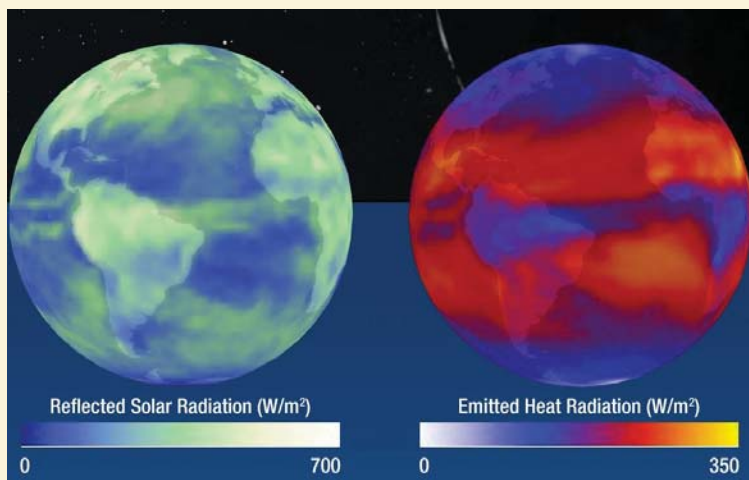
marine life, and causes cancer in animals. If we set up colonies of people who will live on the Moon, apart from having a supply of oxygen to breathe, they will have to figure out what to do with the threat of ultraviolet radiation, because there is no ozone on the Moon.

The Greenhouse Effect

Greenhouse gases in

the lower atmosphere (water, carbon dioxide and others) absorb this infrared radiation. It warms up the lower atmosphere. The warmed atmosphere releases more long-wave radiation. Some of it goes into space but some of it is in the direction of Earth. It warms up Earth's surface. This is called the *greenhouse effect*. So at night time, temperature does not drop to -180 degrees C like it does on the Moon's surface when it is not receiving sunlight. Our nights are colder, but even in winter in Antarctica, not colder than -50 C.

The picture shows averages of **solar radiation** that are reflected, and heat radiation that is emitted by Earth. You can see that more is reflected from the continents (up to 0.7 kilowatts per square meter) and less from the oceans, because the oceans absorb more heat. You can also see that more heat is emitted by the Tropics (up to 0.35 kilowatts per square meter) and less from

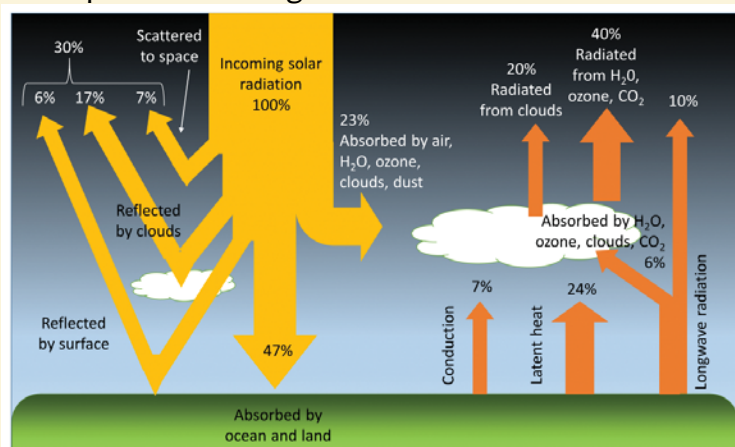


other regions where the Sun is not overhead.

Global Warming

Greenhouse gases like water (up to 1 per cent), carbon dioxide (0.04 per cent) and methane (even smaller) form a very tiny proportion of the atmosphere. Water molecules disassociate or fall to Earth within a few days, but carbon dioxide and methane stay in the atmosphere for a long

time. If their concentration increases, more of these gas molecules prevent the emitted heat from going out into space. This is called **global warming**. About 90 per cent of the atmosphere on Venus is made up of carbon dioxide. It does not let heat escape that easily, and the temperature there is over 400 C, day or night.



About 78 per cent of our atmosphere is nitrogen and 21 per cent is oxygen. They are not greenhouse gases, they do not trap heat emitted by Earth. This has allowed life to flourish on Earth. Compounds of nitrogen and oxygen (such as nitrous oxide) are greenhouse gases. It is important that their proportion remains tiny in the atmosphere.

If you know something about budgets and you have been keeping track of what has been happening, you would have noticed that our solar power budget isn't balanced. Here is a better picture to show this. You can see that almost half of incoming solar power is absorbed by the continents and oceans on Earth. A large part of what happens to this solar radiation goes into what we call *climate*.

Sources: <https://rwu.pressbooks.pub/webboceanography/chapter/8-1-earths-heat-budget/>;
https://science.nasa.gov/ems/13_radiationbudget/



BBC Quiz on David Attenborough

1. Select one: Which facial feature almost stopped Attenborough from appearing on our screens?

(a) Teeth (b) Nose (c) Eyebrows

Ans: (a). Attenborough's then boss believed he shouldn't be on TV because his "teeth are too big". Luckily, he was able to step in as the emergency host of the hit nature documentary series *Zoo Quest* in the 1950s, when the original presenter fell ill. This kick started Attenborough's long TV career.

2. Attenborough has encountered hundreds of animals, big and small, throughout his career. Usually, he finds

amazement and wonder in everything he sees. But there's one creature he doesn't like. Which animal is it? Pick one answer.

(a) Rats (b) Sting rays (c) Mamba snakes

Ans: Attenborough dislikes rats. He said they have no fear of humans and are loaded with foul diseases. However, despite his dislike of them, he went to a temple in India and filmed a documentary segment about rats for *The Life of Mammals*.

3. Attenborough has encountered several exotic plants over the years, including the world's largest flowering plant found in Sumatra, Indonesia. Known for releasing a foul smell and only flowering for one to three days every few years, do you know the common name given to the plant by Attenborough? Pick one answer.



Attenborough with Venomous Lizard

(a) *Helianthus Annuus* (b) *Nelumbo Nucifera* (c) *Titan Arum*

Ans: (c). Attenborough came across the world's largest flowering plant in his documentary series *The Private Life of Plants*. Rather than use its full name, *Amorphophallus Titanum*, he shortened the name to *Titan Arum*. The plant is also referred to as the corpse flower.

Helianthus Annuus is the name for a sunflower and *Nelumbo Nucifera* is a sacred lotus, often called a water lily.

4. Attenborough's career highlights weren't all nature documentaries. He also made a surprise appearance on the Glastonbury stage in 2019. What aspect of the festival did he praise while addressing the crowd? Pick one answer.

(a) Going plastic-free (b) The planned fallow year allowing nature to recover (c) Kylie Minogue's legend slot performance

Ans: (a). Attenborough took to the Pyramid Stage at Glastonbury and talked about his *Blue Planet II* series, which raised awareness about the impact of plastic in the ocean.

"[The documentary] had an extraordinary effect, and now, this great festival has gone plastic-free," he said, as the crowd erupted in cheers.

5. Released in January 2026, Attenborough presented a documentary about wildlife in London, called *Wild London*. Where in the capital did he





describe as a “refuge and source of inspiration”? Pick one answer.

(a) A meadow in Greenford, west London (b) Richmond Park (c) The grounds of the Natural History Museum

Ans: (b). Attenborough’s favourite local spot is Richmond Park. He said

“standing among these marvellous trees, it’s hard to believe that I’m in a capital city”.

Quiz collated by Rosemary McCabe and the Special Projects team.

<https://www.bbc.com/news/articles/c1e2pdw18o8o>

Photo Credits: BBC; www.riddle.com



What day is it?

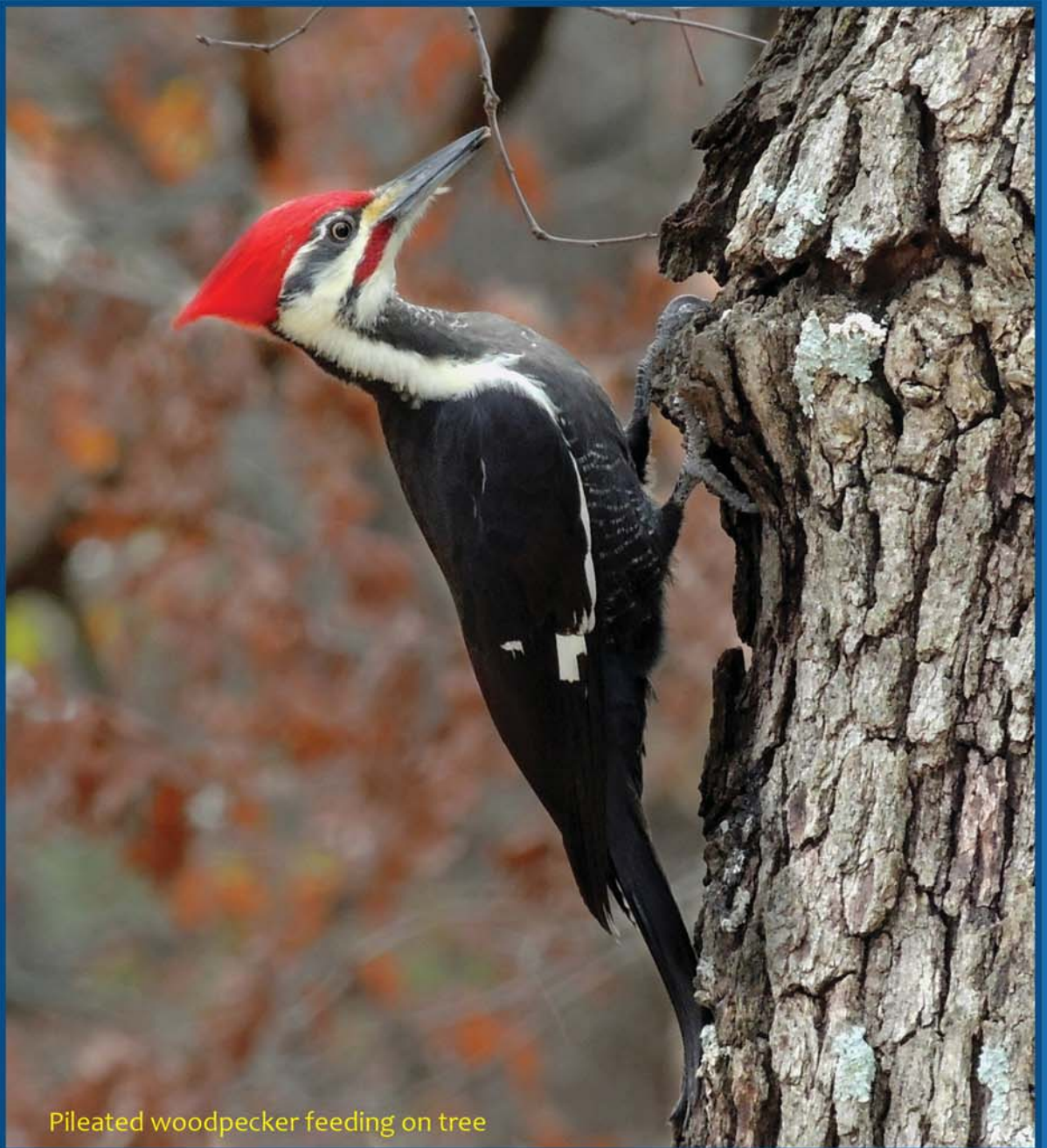
If I said that in three days’ time it would be a Thursday, I am sure that most of you would have no difficulty telling me that today was a Monday.

Try this one then. Three days ago, yesterday was the day before Sunday. What day will it be tomorrow?

From mathsisfun.com

Answer upside down

Ans: Thursday. Think about it. Let today be X. Three days ago is X-3. Yesterday on that day is X-4, which was the day before Sunday, which is Saturday. So today is 4 days after Saturday, which is Wednesday. So tomorrow will be Thursday.



Pileated woodpecker feeding on tree

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