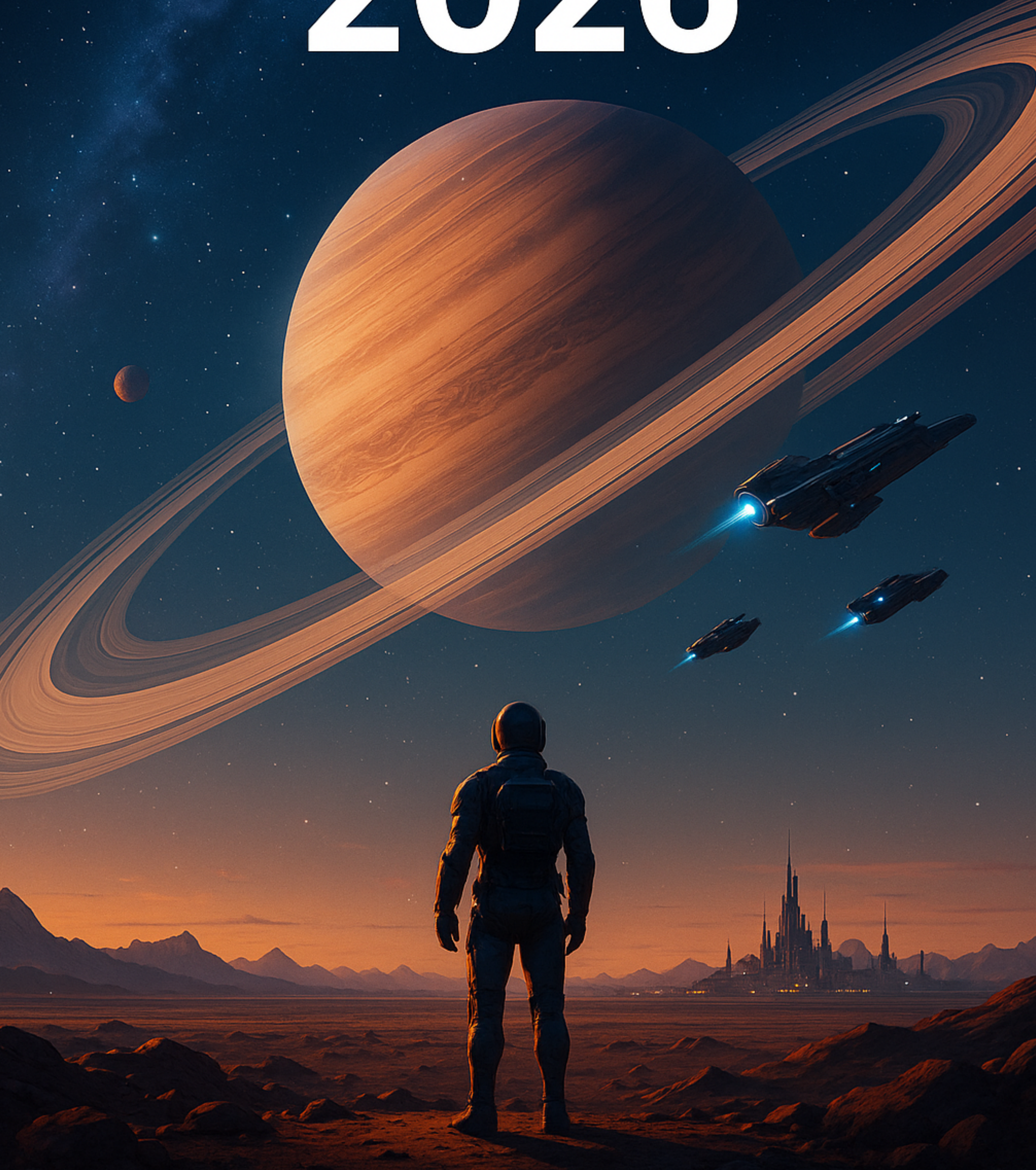
OBSERVING 2026



Observing 2026

Frontiers in Space Exploration and Health Breakthrough

By Dr. Gianpaolo Marcucci – Human Advisor Project

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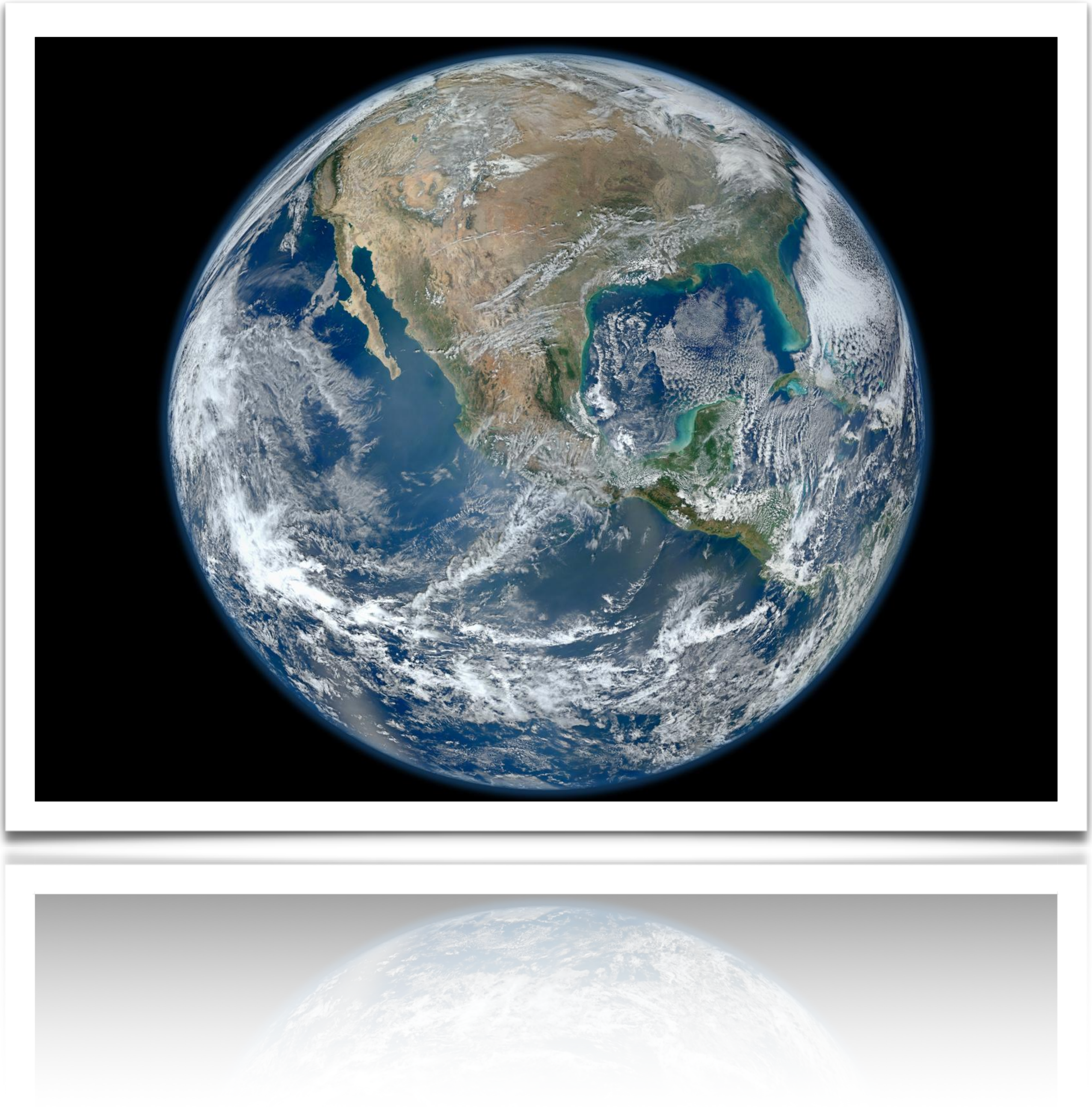
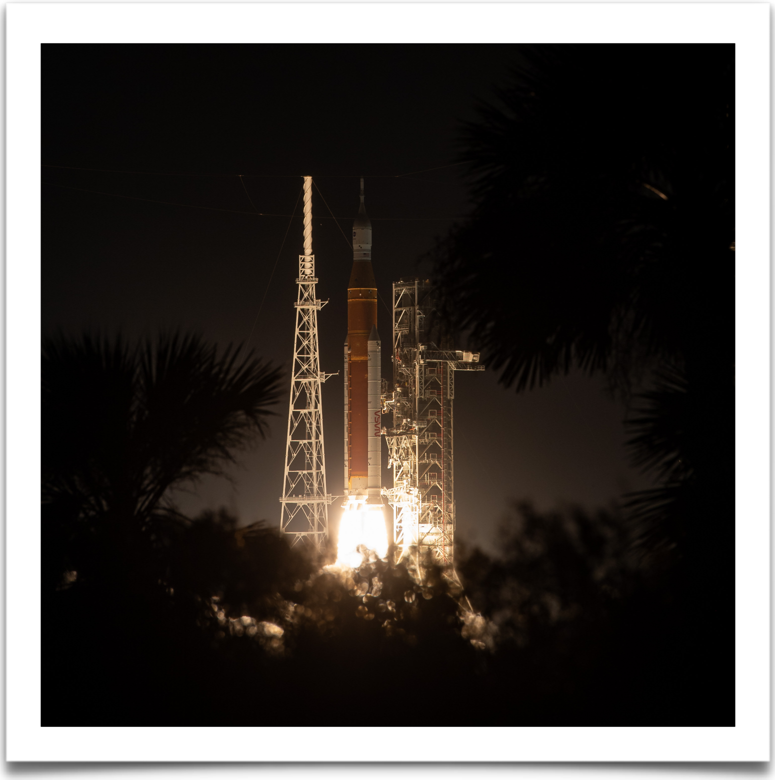
Part I: Space Exploration – Reaching for New Horizons

Humanity's quest beyond Earth continued to accelerate in 2025, marked by renewed lunar ambitions, unprecedented privatesector activity, and cuttingedge astronomical discoveries. Space exploration today is a truly global endeavor, with the United States, Europe, China, India and others all achieving milestones. In this part, we review the state of space exploration in 2025 – from Moon missions and Mars plans to rocket innovations and space science – and see how these achievements lay the groundwork for 2026.



1. Return to the Moon: Artemis and Global Lunar Missions



Over half a century after Apollo, returning humans to the Moon is firmly on the international agenda. NASA's Artemis program leads the way for the United States and partners, aiming to land astronauts on the lunar surface again. In 2025, NASA focused on preparing *Artemis II* (the first crewed Artemis flight, planned for early 2026) and started assembling the hardware for *Artemis III*. Artemis II will send four astronauts on a tenday journey around the Moon, testing the Orion spacecraft in deep space and laying the groundwork for a crewed landing. Following that, *Artemis III* – now expected in 2027 – will attempt the first human lunar landing since 1972, targeting the Moon's south polar region. This mission plans to land a woman and a person of color on the Moon for the first time and will rely on a SpaceX Starshipderived lander to ferry crew from Orion down to the surface. Delays in both the Orion spacecraft and Starship led NASA to schedule Artemis III no earlier than 2027, but critical testing is slated for 2025–2026, including inorbit propellant transfer between Starships.

Meanwhile, other nations advanced their lunar agendas. China returned samples from the Moon's far side in 2024 and plans its *Chang'e7* mission for 2026 to search for water ice at the south pole. India built on the success of Chandrayaan3 by evaluating followon missions and testing its Gaganyaan spacecraft for a future crewed orbital flight. In Japan, commercial and government lunar efforts continued; startup ispace attempted its second landing in 2025 (the lander unfortunately crashed), and NASA's CLPS program sent multiple robotic landers. A Firefly Aerospace lander touched down on Mare Crisium, transmitting highdefinition images and over 110 GB of data, while another from Intuitive Machines landed intact but tipped on its side. These commercial missions are paving the way for frequent, lowcost deliveries to the Moon. Blue Origin is developing a *Blue Moon* lander for future Artemis missions and launched a pathfinder prototype in late 2025.

Together, these activities lay the foundation for a new era of lunar exploration. Infrastructure for sustainable Moon exploration – such as NASA's planned Lunar Gateway station and Artemis base camps – is in development. International collaborations are growing: Europe supplies the Orion service module and is considering a large lander logistics vehicle, while agencies from Japan, Canada and others contribute technologies and join the U.S.-led Artemis Accords. As we move into 2026, we can expect more frequent robotic landings, continued testing of crew systems, and increasing global partnerships to ensure that humanity's return to the Moon is lasting and inclusive.

> *"Return to the Moon with Artemis will mark the dawn of a new lunar era."*

2. Mars and Beyond: Robots on the Red Planet and Future Plans

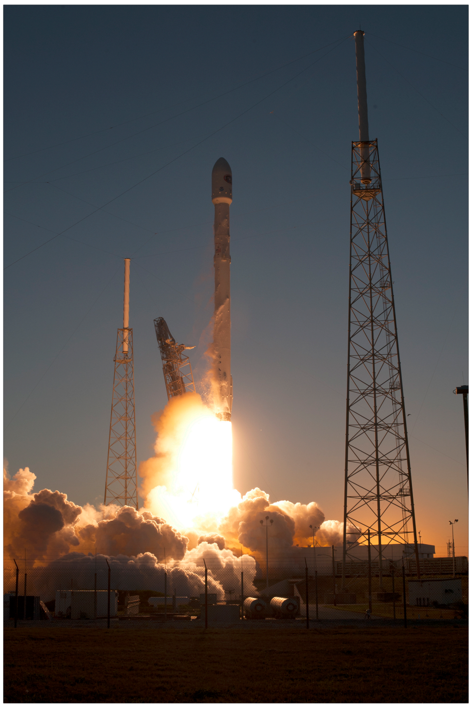
With the Moon as a steppingstone, the ultimate horizon is Mars. In 2025, robotic missions on Mars continued their work even as plans for sample return and crewed missions evolved. NASA's Perseverance rover has spent the past few years exploring Jezero Crater and collecting samples of Martian rock intended for return to Earth. NASA and ESA are developing the Mars Sample Return campaign to retrieve these samples in the late 2020s – an ambitious endeavor involving a fetch rover, a small rocket to launch samples off Mars and an orbiter to bring them home. Engineers reassessed the mission design in 2025 to simplify it; the current concept foresees a single lander (with a rocket and helicopters for sample pickup) launching around 2028 and an Earth Return Orbiter launching in 2027 to capture the sample canister in orbit. If all goes well, Mars samples could arrive on Earth by 2033.

On Mars itself, NASA's Ingenuity helicopter (originally a tech demo) surpassed expectations – by 2025 it had flown over 50 sorties, scouting terrain for Perseverance. The veteran Curiosity rover continued to climb Mt. Sharp and study ancient habitable environments. Europe and Russia had planned the ExoMars Rosalind Franklin rover, but after delays the launch is now pushed to the latter half of the decade. Meanwhile, China is formulating its own Mars sample mission for the early 2030s and even a crewed mission in the 2040s. SpaceX remains passionate about Mars; while Starship development focuses on the Moon and Earth orbit for now, the vision of using Starships for Mars journeys keeps interest high.

Beyond Mars, the solar system saw other notable missions in 2025. China launched *Tianwen2* – a mission to collect samples from a nearEarth asteroid and then visit a comet. NASA's OSIRISREx delivered pieces of asteroid Bennu to Earth in late 2023; by 2025 scientists worldwide studied those pristine samples for clues to the early solar system. NASA's Psyche probe launched in late 2023 and is en route to a metalrich asteroid, due to arrive in 2029. ESA's JUICE probe is heading to Jupiter's moons (arrival 2031) and NASA's Europa Clipper will launch soon to investigate Europa. Concepts for exploring Uranus and Neptune gained traction though actual missions await 2030s funding. Meanwhile, Voyager 2 – launched in 1977 – is still communicating from interstellar space over 20 billion kilometers away, reminding us of humanity's enduring presence in the cosmos.

> *"Robotic explorers on Mars today pave the way for sample return and eventual human footprints."*

3. Rocket Revolution: New Launchers and Private Spaceflight



The year 2025 confirmed that we are in a rocket renaissance. A record number of orbital launches took place – over 300 globally – with much of the growth coming from the commercial sector and new national players. Reusable rockets have become routine for some: SpaceX's Falcon 9 conducted dozens of flights with booster landings, and multiple new rockets debuted. Blue Origin's *New Glenn* heavylift rocket made its maiden flight in January 2025. New Glenn successfully reached orbit on that test, though its first stage missed a drone ship landing; with its massive 7meter diameter and partially reusable design, New Glenn aims to compete in the heavy launch market and support deepspace missions. In Europe, after years of delay, the Ariane 6 finally entered service – its first successful commercial launch on 6 March 2025 delivered a French satellite to orbit. By August 2025, Ariane 6 flew again to launch a weather satellite, proving Europe's independent access to space though it faces cost pressure from reusable competitors.

The most anticipated rocket, SpaceX's *Starship*, continued development in 2025. Starship is the largest ever built, designed for full reusability and unprecedented payload capacity. After a dramatic first orbital test flight in April 2023, SpaceX upgraded the design and launch infrastructure. By May 2025, SpaceX had flown Starship prototypes nine times in tests, steadily improving performance. The goal is to demonstrate inspace refueling by docking two Starships in 2025, then attempt an uncrewed Moon landing in 2026 to validate the spacecraft for Artemis. If achieved, this would be a gamechanger for deepspace travel, enabling transport of large cargos and crews to the Moon and Mars at relatively low cost. The world will watch Starship closely in 2026, as its success could transform space travel.

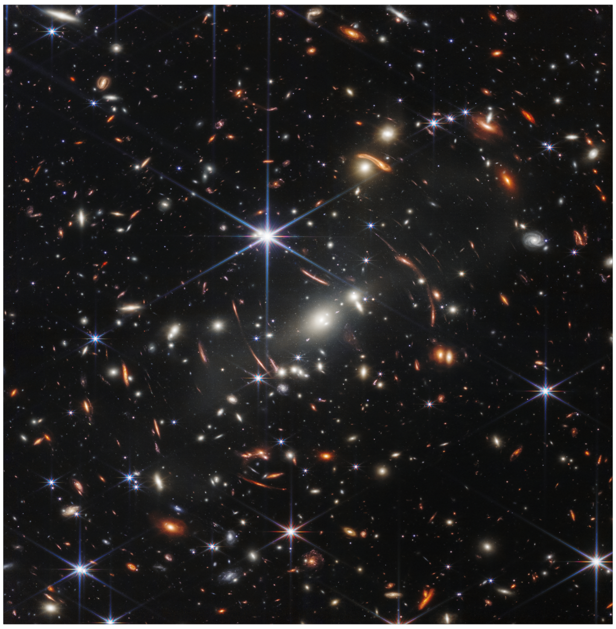
Smaller launch vehicles proliferated in 2025. India demonstrated inorbit docking for the first time – two small Indian satellites autonomously docked in January, making India only the fifth entity to achieve orbital docking. This capability is crucial for future space station aspirations and onorbit assembly. India's workhorse PSLV rocket performed reliably, while the newer LVM3 took on more missions, including launching part of OneWeb's internet constellation. Satellite megaconstellations expanded rapidly: SpaceX's Starlink surpassed 5,000 satellites, providing global broadband, and Amazon's Project Kuiper began deployments in 2025 with the first test satellites and plans for thousands more. To launch Kuiper, Amazon is buying rides on various rockets including Ariane 6, Vulcan and New Glenn – a sign of healthy competition.

This boom in satellite numbers raised concerns about space traffic management and orbital debris. In 2025, U.S. and international bodies discussed new regulations (like requiring satellites to deorbit within five years of mission end) and funded technologies for active debris removal. Europe's ClearSpace1 mission, contracted to launch by 2026, will demonstrate capturing and deorbiting a defunct satellite. On the human spaceflight front, space tourism and private astronauts made headlines. Axiom Space sent its second private crew to the ISS in 2023 and more missions followed. By 2025, multiple commercial astronauts (paying or sponsored) had visited ISS via SpaceX Dragon capsules. In April 2025, a novel mission called *Fram2* flew – a crewed Dragon that entered a polar orbit, becoming the first crewed spacecraft to fly over Earth's poles. Space tourism on suborbital flights also resumed: Virgin Galactic flew several batches of civilian customers and Blue Origin's New Shepard was expected to return to service in late 2025. For those who can afford it, the dream of experiencing weightlessness and Earth's curvature is increasingly within reach.

Looking ahead to 2026, the ISS remains an invaluable microgravity lab but plans for its transition are accelerating. NASA and partners intend to operate ISS until 2030, then shift to commercial stations. Companies like Axiom, Northrop Grumman and Sierra Space are developing private station modules – Axiom's first module is set to attach to ISS by 2026. Internationally, China completed its Tiangong station in 2022 and has kept it permanently crewed; by 2025 China opened opportunity for foreign astronauts to visit. India announced plans for a small station in the coming decade. Clearly, Low Earth Orbit is set to become a more diverse and bustling arena.

"Reusable rockets and private spaceflight are transforming access to orbit."

4. Space Science and Astronomy: New Eyes on the Universe



In addition to voyages outward, 2025 was an exciting year for space science and astronomy. NASA's James Webb Space Telescope (JWST), operational since 2022, continued to wow scientists and the public. By 2025, JWST had detected some of the earliest galaxies ever seen, revealed surprisingly mature galaxies that challenge models of early cosmic evolution, and probed exoplanet atmospheres in unprecedented detail. One headline in late 2023 was JWST's observation of K218b, where it found hints of organic molecules and possibly even a marker of life – a tantalizing preview of what JWST might uncover about habitable worlds.

Closer to home, 2025 marked the 50th anniversary of the original "Blue Marble" photograph of Earth (taken by Apollo 17 in 1972). To commemorate this, NASA's EPIC camera on the DSCOVR satellite captured a series of Blue Marble images from its position about one million miles away, showing Earth fully illuminated on the winter solstice. These stunning images remind us of Earth's fragility and the value of the global perspective that space exploration affords.

Several space observatories were launched or prepared in 2025. In February, NASA launched a telescope named SPHEREx (SpectroPhotometer for the History of the Universe, Epoch of Reionization and Ices Explorer) on a Falcon 9. SPHEREx is a small astrophysics mission with a big goal: it will survey the entire sky in 102 nearinfrared colors, mapping the cosmos' largescale structure and searching for clues about the very moment of the Big Bang. During its twoyear mission, SPHEREx will collect data on about 450 million galaxies and 100 million Milky Way stars, creating a 3D map of the universe's galaxies. One aim is to investigate cosmic inflation – the mysterious exponential expansion thought to have occurred a fraction of a second after the Big Bang. By mapping how galaxies are distributed, scientists hope to discern patterns imprinted by inflation and explain what drove that momentous event. SPHEREx will also hunt for water ice and organic molecules in our galaxy's interstellar clouds – the raw materials for stars and planets. As one project scientist put it, "Every time we look at the sky in a new way, we discover something new." Expectations are high that SPHEREx's novel allsky spectroscopic maps will yield surprises about galaxy evolution and maybe uncover unknown cosmic phenomena.

Another mission launching with SPHEREx was PUNCH (Polarimeter to Unify the Corona and Heliosphere), a set of small satellites to observe the Sun's outer atmosphere and solar wind in 3D. As climate change and solar activity make space weather monitoring important, understanding the solar wind helps protect satellites and power grids. In Earth orbit, satellite technology reached new heights: Europe and the U.S. jointly launched NISAR in July 2025 – a dualfrequency radar imaging satellite for environmental monitoring. NISAR, a partnership between NASA and India's ISRO, uses Lband and Sband radars to measure Earth's crust movements (earthquakes, glaciers) and ecosystem changes with unparalleled precision. This exemplifies how space exploration isn't just about leaving Earth, but also about observing Earth to benefit life below.

In fundamental physics and astronomy, 2025 saw breakthroughs. In 2023, astronomers using pulsar timing arrays announced the first evidence of a cosmic gravitational wave background – a lowfrequency "hum" likely caused by orbiting supermassive black holes over billions of years. By 2025, additional data strengthened this finding, opening a new window on the universe using pulsars as detectors. Groundbased gravitational wave observatories (LIGO, Virgo, KAGRA) continued detecting dozens of black hole and neutron star mergers annually after upgrades. Plans are afoot for nextgeneration observatories in the 2030s (like a spacebased LISA and improved ground detectors) that will vastly expand the gravitationalwave sky.

In planetary science, 2025 delivered fascinating firsts: astronomers observed a large asteroid that had been struck by NASA's DART mission in 2022 and found that the impact changed the asteroid's orbit and even its surface geology – demonstrating humanity's ability to alter celestial bodies as a technique for planetary defence. International collaboration and competition intensified: the United States and Europe deepened cooperation on projects like Artemis and Earth science missions; China and Russia had announced plans for a joint lunar base, though Russia's program struggled. Global forums like the UN discussed norms for responsible behaviour in space, including managing space debris and preventing antisatellite weapon tests. The concept of space sustainability gained traction – aiming to preserve the space environment for future generations, analogous to environmentalism on Earth. Europe led some of these discussions, leveraging its regulatory experience and emphasis on longterm safety in orbit.

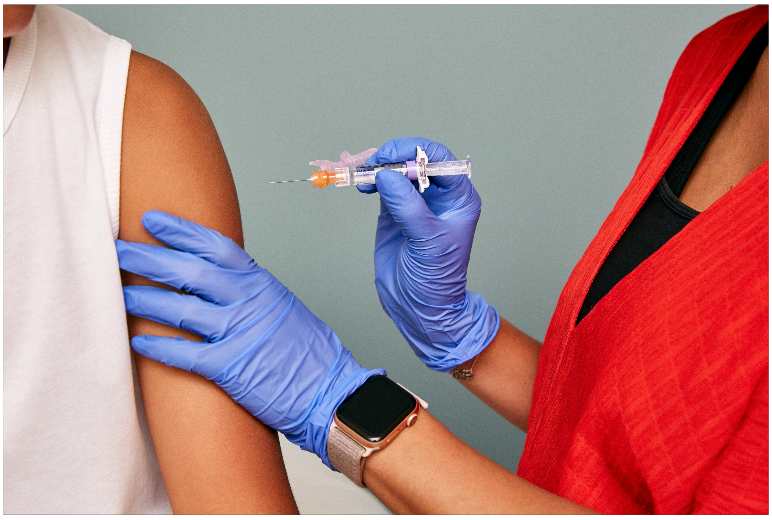
As 2026 dawns, the cosmos beckons with both challenges and wonders. New missions like NASA's Nancy Grace Roman Space Telescope (scheduled for 2027) are being built to search for exoplanets and study dark energy. Cuttingedge telescopes on Earth (such as the Extremely Large Telescope in Chile, nearing completion) will join JWST in probing the universe's origins. Humanity's cosmic horizon is expanding – and with it, our understanding of where we come from and where we might go.

"New telescopes like JWST and missions like SPHEREx show that every time we look at the sky in a new way, we discover something new."

Part II: Health and Vaccines – Advancing Global WellBeing

The year 2025 was pivotal for global health. In the wake of the COVID19 pandemic, nations redoubled efforts to strengthen health systems, develop new vaccines and tackle longstanding diseases. This part examines breakthroughs in vaccines, public health and biomedical research that emerged in 2025, and looks ahead to innovations likely in 2026. From the continued rollout of lifesaving vaccines (for COVID19, malaria, RSV and more) to cuttingedge therapies like gene editing and AIdriven drug discovery, we explore how science is improving health outcomes. We also consider the policy and global cooperation aspect – including Europe's contributions – because safeguarding health is a worldwide mission.

5. The Vaccine Revolution: COVID19 and Beyond



Vaccines remained our most powerful public health tool in 2025, with ongoing campaigns against COVID19 and major strides against other infectious diseases. COVID19 by 2025 had transitioned to an endemic state in most regions, but vaccination (especially of highrisk groups) continued to be crucial. Vaccine makers updated their formulas to target newer variants of SARSCoV2, releasing annual booster shots much like seasonal flu vaccines. The mRNA vaccine technology, which rose to prominence during the pandemic, has proven its versatility: clinical trials were underway for mRNA vaccines against influenza, RSV and even HIV. While an HIV vaccine remains elusive, mRNA candidates offer a fresh approach. Researchers also began early trials of mRNA cancer vaccines, personalized to teach the immune system to attack a patient's tumours – a promising frontier in oncology. The success of mRNA COVID vaccines spurred massive investment in vaccine R&D; however, it also faced political headwinds in some places. Notably, in the United States debates about research funding led to concerns that cutting support for mRNA vaccine studies would jeopardize future breakthroughs – a reminder of how essential sustained support is for vaccine innovation.

Beyond COVID19, 2025 was historic for vaccination against other diseases. In October 2023, the World Health Organization recommended a second malaria vaccine – the R21/MatrixM vaccine developed by Oxford University – for use in children. This came after the first malaria vaccine (RTS,S) had been introduced in a few African countries starting in 2021. With R21 now joining RTS,S, the world finally has multiple tools to combat malaria, which kills over half a million (mostly children) each year. Demand for malaria vaccines was described as unprecedented in 2025, and having two approved vaccines is expected to boost supply to meet all atrisk children's needs. WHO's DirectorGeneral Dr. Tedros Ghebreyesus celebrated the moment, stating "now we have two" safe and effective malaria vaccines, which can be deployed to save hundreds of thousands of young lives. By 2026, at least 28 African countries plan to include a malaria vaccine in their routine immunization programmes – a triumph of science and global cooperation. Similarly, dengue fever saw progress: a new dengue vaccine (Takeda's Qdenga) gained wider approval after WHO's recommendation in late 2022, offering protection for children in endemic regions regardless of infection history.

Perhaps the most dramatic vaccine news of 2023–2025 came in the fight against Respiratory Syncytial Virus (RSV), a common respiratory virus that can be deadly for infants and the elderly. After a 60year quest, in May 2023 the first RSV vaccines were approved – a momentous achievement. The U.S. FDA approved GSK's Arexvy vaccine for adults over 60, making it the firstever vaccine against RSV. Soon after, Pfizer's Abrysvo vaccine was also approved for older adults, and later for pregnant women in the late second trimester – with the remarkable aim of protecting newborns via antibodies passed from mother to baby. These approvals mark a turning point in preventing RSV, which each year hospitalizes and kills thousands of seniors and infants. Public health authorities recommended that adults 60+ consider getting an RSV shot before winter, and by the winter of 2024–25 many countries had rolled out RSV vaccines to seniors for the first time. Additionally, a longacting antibody injection (nirsevimab) was approved to protect infants in their first RSV season. Europe moved quickly as well – the European Medicines Agency authorized the RSV vaccines, and national immunization programmes in the EU began adopting them for the elderly. If these measures are widely implemented by 2026, we may see far fewer hospitalizations among babies and grandparents during RSV season – a clear win for vaccine science.

The impacts of COVID19 also pushed broader vaccine initiatives. Governments invested in manufacturing capacity ("vaccines for all") and in pandemic preparedness. In the European Union, the new Health Emergency Preparedness and Response Authority (HERA), established in 2021, became fully operational by 2025. HERA coordinates EUwide efforts to stockpile medical countermeasures, fund R&D for emerging pathogens and ensure rapid vaccine development when new threats emerge. In 2025, the EU doubled HERA's budget to bolster readiness for future pandemics. This reflects lessons learned from COVID19 – that early investment in vaccine platforms and manufacturing can pay off massively when a crisis hits. On the global stage, organizations like CEPI promoted the idea of a "100day vaccine" – aiming by later this decade to be able to develop and deploy a new vaccine within 100 days of an epidemic's start. Efforts in 2025 toward a universal coronavirus vaccine and a universal influenza vaccine were under intense research, as such broadprotection vaccines would help preempt future outbreaks.

In summary, the vaccine landscape in 2025 was one of rapid progress and optimism. Humans now have more vaccines in their arsenal than ever before – from COVID and flu to RSV, dengue, malaria, HPV, polio and beyond. The challenge moving into 2026 will be ensuring equitable distribution and strong public confidence. Misinformation and unequal access can hinder the lifesaving potential of these innovations. The global health community, including European agencies and WHO, is working to address these via education campaigns and initiatives like COVAX for equitable distribution. If successful, the vaccine revolution of the mid2020s will translate into millions of lives saved and a healthier world populace.

"Vaccines remain our most powerful tool against disease, from COVID19 to malaria and RSV."

6. Tackling Global Health Challenges: Policy and Preparedness

While scientific advances are crucial, 2025 underscored the importance of health policy, infrastructure and international solidarity in securing global wellbeing. The tail end of the COVID19 pandemic revealed weaknesses in health systems that policymakers are intent on fixing. One major focus has been rebuilding routine healthcare and immunization that were disrupted. Childhood vaccination rates fell in many countries during 2020–2021; by 2025, campaigns were underway to catch up on missed measles, polio and DTP vaccinations, especially in lowincome regions. Encouragingly, by 2025 global immunization levels started recovering, though not evenly everywhere. The WHO's Immunization Agenda 2030 provides a roadmap for countries to strengthen vaccine delivery and surveillance systems, aiming to avert future outbreaks of vaccinepreventable diseases. A stark reminder came in 2022–23, when poliovirus resurfaced in a few places (including a vaccinederived outbreak in Africa and detection of wild polio in Pakistan). In response, 2025 saw renewed commitment to the End Polio Initiative, with the goal of interrupting all transmission by 2026. New tools like the novel oral polio vaccine type 2 (nOPV2) – engineered to be more genetically stable – were deployed in outbreak areas to combat vaccinederived strains. If these efforts hold, polio could truly be relegated to history in the next couple of years.

Pandemic preparedness and response were also major focuses. As mentioned, institutions like HERA and similar entities in other countries invested in horizon scanning for threats, stockpiling PPE and antivirals, and strengthening laboratory networks. In 2025, the World Health Assembly discussed a potential Pandemic Treaty – an international agreement to ensure timely sharing of data and equitable access to countermeasures during global emergencies. Though negotiations are ongoing, the hope is that by 2026 countries will adopt measures that prevent the fragmented response seen early in COVID19. Europe's health security framework got a reboot in 2025, with an expanded mandate for the European CDC and more powers for HERA to coordinate across member states. For example, the EU worked on joint procurement of vaccines and critical medicines so that smaller countries aren't left behind. These policy moves, while less visible than new vaccines, are vital to ensure scientific advances reach everyone who needs them.

Global health equity was a prominent theme throughout 2025. The pandemic highlighted disparities not only between countries but within them. Programmes addressing social determinants of health – such as housing, education and environment – gained urgency to build resilience. Climate change also became clearly linked to health, as 2025 saw severe heatwaves and floods leading to hospitalizations and disease outbreaks. Governments in Europe and beyond started developing ClimateHealth action plans, recognizing climate change as a health emergency multiplier. For instance, more funding went into early warning systems for heatwaves and into researching the spread of vectorborne diseases like malaria, dengue and Zika into new regions as temperatures rise. By 2026, we can expect integrated strategies that address climate adaptation in healthcare (e.g. cooling centres during heatwaves, mosquito control programmes, wildfire smoke response) to protect populations in a warming world.

Europe's role in global health remained significant. In 2025, the EU continued being a major funder of initiatives like Gavi (the Vaccine Alliance) and the Global Fund (against AIDS, TB and Malaria). European research institutions led cuttingedge studies, such as trials for an HIV prophylactic vaccine and new therapies for tuberculosis. Europe also championed One Health approaches – tackling human, animal and environmental health together (for example, combating antibiotic resistance by monitoring antibiotic use in livestock as well as hospitals). Indeed, antibiotic resistance remained a looming crisis: by 2025, an estimated 1.3 million people per year were dying from resistant infections. EU policymakers in 2025 incentivized antibiotic development and tightened regulations on antibiotic use in agriculture. A promising development was the discovery of new antibiotic candidates using AI – in 2023, researchers used artificial intelligence to identify a potent compound effective against a superbug Acinetobacter. This showcased how modern technology can help solve ageold problems. By 2026, we might see one or two novel antibiotics enter clinical trials, giving hope in the fight against AMR.

In summary, recent years have taught that technology alone is not enough – robust health systems and cooperation are essential. The world in 2025 took concrete steps on that front. If a new pathogen emerges in 2026, we are arguably better prepared: surveillance networks (for influenza, coronaviruses, etc.) are enhanced; scientific collaboration is faster, thanks to platforms for sharing pathogen genomes; and there is a playbook of sorts ready to deploy. Persistent challenges such as misinformation and vaccine hesitancy require continued engagement with communities. Health is as much a social endeavour as a scientific one.

"Strong health systems and global solidarity are as vital as scientific advances."

7. Medical Breakthroughs: From Obesity Drugs to Gene Editing

On the biomedical science front, 2025 will be remembered for remarkable breakthroughs in treatments and therapies. One of the most impactful developments has been the advent of highly effective weightloss medications, which some call a game changer for obesity and metabolic disease. Drugs originally developed for diabetes – GLP1 receptor agonists like semaglutide (Wegovy/Ozempic) and tirzepatide (Mounjaro/Zepbound) – proved capable of inducing significant weight loss (15–20 percent of body weight on average) in people with obesity. By 2025, these injectable drugs were in high demand globally, heralding a new era in obesity management beyond just diet and exercise. Pharmaceutical innovation didn't stop there: nextgeneration therapies like retatrutide, a triple hormone agonist targeting GLP1, GIP and glucagon receptors, showed even greater potential. A Phase 2 trial of retatrutide reported staggering results – patients on the highest dose lost over 24 percent of their body weight in 48 weeks on average. These are weight loss levels approaching what bariatric surgery achieves, but with a weekly injection. While retatrutide is still in trials, experts predict it (and similar multiagonist drugs) could become available by 2026–27 if all goes well. Meanwhile, an oral pill version of semaglutide was being refined (seeking to match the efficacy of injections) and Eli Lilly even hinted at work on a onceyearly obesity shot that could slowly release medication over 12 months. Such a treatment could make longterm weight management much easier for patients, potentially administered alongside an annual flu shot. The arrival of these pharmacological tools is poised to dramatically reduce obesityrelated complications like type 2 diabetes, heart disease and certain cancers. Indeed, in 2025 guidelines in some countries were updated to include antiobesity medications as a standard option for appropriate patients, reflecting a shift in viewing obesity as a treatable chronic condition.

Another breakthrough field is gene therapy and gene editing. After decades of research, the promise of gene therapy is finally being realized. In late 2023, the FDA approved the firstever therapy based on CRISPR gene editing – a treatment for sickle cell disease called Casgevy (exacel). This was historic: it meant a CRISPRedited cell therapy is now commercially available, offering a functional cure for patients with sickle cell disease who receive it. Casgevy works by editing the patient's own bone marrow stem cells to produce fetal haemoglobin, thus overcoming the defective adult haemoglobin that causes sickle cell problems. The FDA approval and similar approval in Europe opened the door for CRISPR therapies targeting other diseases. By 2025, clinical trials were ongoing for CRISPRbased treatments of conditions like beta thalassemia, certain forms of inherited blindness and even high cholesterol (via a gene edit to permanently lower LDL levels). The rapid progression from CRISPR's invention in 2012 to the first approved medicine in 2023 – just eleven years – was hailed as truly remarkable by pioneering scientists. Jennifer Doudna, coinventor of CRISPR, noted that with CRISPR we have moved from "potentially" curing diseases to actually doing it. Challenges remain, notably the high cost of such therapies and the difficulty of delivering gene editors into certain tissues. But the gene editing revolution is accelerating. In 2025, new delivery methods (like lipid nanoparticles and viral vectors) were refined, and base editing (a variant of CRISPR that makes single DNA letter changes) advanced to human trials for diseases like progeria. The coming year 2026 is likely to see approval of another gene therapy for severe betathalassemia, and perhaps interim results from CRISPR trials tackling muscular dystrophy and HIV.

Parallel to gene editing, more conventional gene therapies (using viral vectors to add correct genes) also scored successes. In 2023, hemophilia A saw its first gene therapy approved (Roctavian in Europe), following an earlier gene therapy for hemophilia B (Hemgenix). Patients treated showed greatly reduced bleeding episodes, freeing them from regular infusions. Neurological disorders also saw hope: 2023's approval of Leqembi (lecanemab), an antibody drug that slows Alzheimer's progression by targeting amyloid plaques, was a milestone as one of the first diseasemodifying Alzheimer's drugs. In 2025, another similar antibody (donanemab) was expected to receive approval, indicating that for earlystage Alzheimer's, medicine can at last alter the disease course (albeit modestly). Researchers are now combining these with diagnostics – since early detection of Alzheimer's via spinal fluid or blood tests is crucial to treat in time. By 2026, routine screening for early cognitive impairment may become more common if treatments are available.

Cancer therapy continued to evolve. Immunotherapies like CART cell treatments expanded to more cancer types, including trials for autoimmune diseases using regulatory Tcells. Targeted therapies based on genetic tumour profiling meant that a patient's cancer DNA is sequenced to find driver mutations and match to specific drugs. This approach has greatly improved outcomes in diseases like lung cancer and melanoma. Furthermore, mRNA vaccine technology is being applied to cancer – in 2023, promising trial results of a personalized mRNA vaccine for pancreatic cancer (combined with immunotherapy) were reported, pointing to a potential new modality for hardtotreat cancers.

Artificial intelligence (AI) in healthcare made notable strides in 2025. AI systems trained on vast datasets assisted in drug discovery by predicting which molecules might target, say, a viral enzyme or a cancer protein. One concrete outcome was the AIdesigned antibiotic mentioned earlier, but AI also accelerated the identification of new drug targets and helped design protein structures (e.g. DeepMind's AlphaFold providing structures for nearly all human proteins has been a boon). In clinical settings, AI diagnostics became more prevalent: algorithms reading medical images (Xrays, MRIs) or analysing ECGs and pathology slides achieved expertlevel accuracy. In 2025, some hospitals in Europe started pilot programmes where AI reads mammograms alongside radiologists to improve breast cancer screening. Telemedicine and digital health tools that grew during the pandemic remained widely used in 2025, increasing access to care for remote patients – though ensuring quality and data privacy is an ongoing effort.

The field of regenerative medicine and organ transplantation saw both triumphs and tragedies. In 2024, a second patient received a genetically modified pig heart transplant after the first attempt in 2022; while these pioneer patients did not survive longterm, each case provided invaluable insights for xenotransplantation (using animal organs to alleviate human organ shortages). By 2025, biotech companies had created pigs with multiple gene edits to reduce rejection, and clinical trials for pig kidney transplants into braindead human recipients showed kidneys functioning for weeks. It's conceivable that by 2026–27, regulated trials of pig kidneys or hearts in living patients could commence if safety data is strong – a development that would be revolutionary for those on transplant waitlists. Additionally, researchers are pushing the envelope with labgrown organs (like organoids and bioprinted tissues) and even an artificial womb prototype that successfully gestated lamb fetuses – with regulatory discussions about potential trials for extremely premature human infants. These earlystage yet profound areas raise ethical as well as scientific questions which society is beginning to grapple with.

In summary, 2025 has brought us to an era where formerly sciencefictional therapies are becoming reality. A person with previously incurable disease now has multiple avenues of hope: medicines that reprogramme hormones, edit genes, harness the immune system, or replace faulty organs. The task ahead in 2026 and beyond is to make these innovations affordable and widely available, so that the benefits of scientific progress are shared by all members of humanity – not just a privileged few. Achieving that will require continued advocacy, smart policy (such as funding public–private partnerships and regulating pricing) and international collaboration.

"From gene editing cures to AIdesigned drugs, medicine is entering a sciencefiction era."

8. Outlook for 2026: Integrating Science and Humanity

As we look toward 2026, the overarching theme from both space exploration and health breakthroughs is integration – of international efforts, of cuttingedge science with onthe-ground implementation, and of knowledge across disciplines. The challenges we aim to solve – be it landing humans on Mars or eradicating a deadly virus – are complex and interconnected. The successes of 2025 give reason for optimism. In space, humanity is returning to the Moon together and peering deeper into the universe than ever before. On Earth, we are harnessing our most advanced technologies to save lives and improve quality of life. Europe and the world are more aligned in recognizing that global problems demand global solutions – whether designing planetary missions or stopping pandemics.

2026 is poised to build on this momentum. In space, we anticipate *Artemis II's* voyage around the Moon carrying human explorers farther than any have gone in 50 years. We might witness the first private spacewalk and the inauguration of new commercial space stations. Mars will get closer in our sights as sample return hardware takes shape. In health, by 2026 the fruits of 2025's labours should become evident: hopefully, child deaths from malaria decline thanks to new vaccines; seasonal RSV becomes much less fearsome for grandparents and babies; those suffering chronic diseases may find relief in novel drugs and possibly onetime genetic cures. We also expect ongoing surprises – science always has a way of revealing the unexpected. Perhaps Webb will find a strong biosignature on an exoplanet, or a new "Disease X" will emerge (which we must be ready to confront swiftly). Through it all, humanity's capacity for innovation and compassion will be our guiding light.

In conclusion, *Observing 2026* finds that the state of human advancement is strong. The endeavours in space remind us of our innate curiosity and drive to explore, while the advances in health science reflect our deep commitment to preserving life and alleviating suffering. Both domains benefit immensely from shared knowledge and solidarity across borders – a lesson as important as any technical discovery. As Dr. Gianpaolo Marcucci of the Human Advisor Project emphasizes, the ultimate purpose of these innovations is to improve the human condition. By continuing to invest in research, crafting enlightened policies and inspiring the next generation of scientists and explorers, we can ensure that 2026 and the years beyond usher in a new era of prosperity, wellness and perhaps even cosmic transcendence for all.

"Integration across science and humanity will ensure that the innovations of 2026 serve all people."

Sources

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