



भारत का नवाचार केन्द्र
The Innovation Engine of India

Science Reporter

A CSIR Publication

July 2025 | ₹ 75

SPACE & ASTRONOMY SPECIAL

YOGA IN SPACE

Bridging Ancient Wisdom with the Future of Space Exploration

Features

- Tribute to Dr MR Srinivasan and Jayant V Narlikar
- Space Biology
- Microgravity
- Cosmic Handshake
- EUROPA: An Ocean World of Liquid Water
- Q & A, Fiction & much more

COVER
STORY

Yoga in Space

Bridging Ancient Wisdom with the Future of Space Exploration

Neha Tripathi



Image credit: Freepik

In the 21st century, as we stand at the threshold of becoming an interplanetary species, one of the most important questions that we must ask is not just "how we will travel through space", but rather "how we will live in it". As rockets pierce through the stratosphere and astronauts orbit Earth for months, it is when their bodies slowly forget gravity and show changes. Muscles shrink, bones get thin, and blood redistributes. Even digestion falters, and the mind, suspended in silence, grapples with isolation and disorientation. These are not only the physical challenges faced by astronauts but rather are existential ones. Although modern science has offered strength

training and pharmacological interventions, but it is the ancient Indian science of Yoga that may provide the most sustainable answer. For centuries, yoga has helped human beings build resilience, clarity, and physiological balance, not through force, but through awareness. Now, as private space missions become more frequent and human presence in space grows longer, yoga is being reconsidered as a wellness practice as well as a vital tool of survival, one that brings alignment to body and mind, even when there is no "up" or "down." In the vacuum of space, perhaps it is not thrust and technology alone that will sustain us, but breath, posture, and stillness.

Why Consider Yoga in Space?

Space travel is not just about travelling from one planet to another; rather, it is much more about surviving, adapting, and thriving in an environment which is fundamentally different from our own Earth. Keeping in view the health of astronauts, yoga is unique because it integrates physical movement, controlled breathing, and mental focus, unlike traditional exercise routines.

Though astronauts already follow a strict fitness regimen to tackle the negative effects of microgravity, these exercises mainly focus on strength training and cardiovascular endurance. However, they do not fully address neuromuscular coordination, flexibility, breathing efficiency, or mental well-being, which are equally important for long-duration space missions.

But yoga, on the other hand, is a holistic practice that requires:

- No external equipment, which makes yoga highly adaptable to the confined spaces of a spacecraft.
- Breath control (Pranayama) can help regulate oxygen intake, lung efficiency, and stress management.
- Core stability and flexibility are essential for astronauts who experience spinal elongation and muscle deconditioning in space.
- Mental resilience and focus help astronauts cope with isolation, sensory deprivation, and decision-making under pressure.

Space agencies plan for long-duration missions to the Moon, Mars, and beyond. Then the need sustainable health approaches becomes even more urgent. Unlike the International Space Station (ISS), where astronauts can return to Earth every six months, future Mars missions will keep astronauts in space for two to three years at a time with no possibility of a quick return. In such extreme conditions,

Yoga-Inspired Practices in Global Space Programmes

Soviet Cosmonauts (1980s)

- Used breath control techniques resembling Pranayama to manage stress and isolation.
- These practices supported calmness during high-pressure, confined missions.

NASA Initiatives

- Studied mindfulness and breath-focused meditation to support sleep, focus, and emotional balance — practices rooted in yogic traditions.
- Astronauts have voluntarily adopted these techniques during missions.

ESA Research

- Explored body awareness and breathwork to boost astronaut resilience, drawing on core yogic principles.
- Such methods aid in handling long-duration spaceflight challenges.

maintaining muscle strength, mental clarity, emotional stability, and a strong immune system becomes as important as technical expertise.

Key Challenges of Practicing Yoga in Space

- **No Gravity for Grounding:** yoga postures rely on gravity on earth for balance, stability, and engagement of muscles. However, in space, there is no "up" or "down," therefore, the standing poses like Tadasana (Mountain Pose) or Vrikshasana (Tree Pose) become impractical unless astronauts find a way to anchor themselves.
- **Muscle Engagement Works Differently:** muscles get weakened in microgravity because they are not naturally engaged in movement. On Earth, even standing still activates the core and leg muscles. But in space, astronauts float freely and do not feel the same resistance. Yoga needs to be adapted, ensuring active muscle engagement without relying on weight-bearing movements.
- **Altered Breathing Patterns:** microgravity affects the distribution of fluids in the body, which leads to nasal congestion and changes in lung function. The absence of gravity also means diaphragmatic breathing may feel different, requiring astronauts to focus more on controlled breathwork (Pranayama) to ensure efficient oxygen exchange.
- **Limited Space in Spacecraft:** astronauts live and work in confined spaces, often smaller than a single room. Traditional yoga flows that need movement across a mat, such as Sun Salutations (Surya Namaskar), may not be practical. Instead, yoga must be adapted for small, controlled movements in tight spaces.

Yoga in Space: A Cardiovascular Countermeasure

One of the well-known and critical challenges astronauts face is orthostatic intolerance, which is the inability of the body to maintain an upright posture when returning from a weightless environment. A recent study published by the Institute of Aerospace Medicine examined this issue using Head-down Bed Rest (HDBR) to simulate microgravity and compared the cardiovascular responses of endurance-trained and resistance-trained athletes.

The study found that endurance-trained individuals showed a greater susceptibility to orthostatic stress than those trained in resistance exercises. In other words, those who focused on cardiovascular conditioning were more likely to experience faintness, dizziness, or blood pressure instability after six hours of simulated weightlessness. This reinforces the importance of training approaches that support vascular resistance and muscle tone, key for maintaining postural stability.

A lead researcher in space physiology and co-author of several studies on human adaptation to microgravity, believes the answer lies in bridging ancient wisdom with modern challenges. "The effects of microgravity are systemic. You need a tool that engages both body and mind. Yoga does that. It supports muscular engagement, respiratory control, and autonomic balance, three systems that undergo adaptation in space".

Yoga's value becomes even more apparent when aligned with the study's findings. Poses that involve isometric holds,

Stretching Beyond Gravity — The Science behind Yoga in Space

Expert Views by Dr KK Deepak, Professor of Physiology at AIIMS

When we imagine astronauts floating in the serene silence of space, yoga might not be the first thing that comes to mind. But in the laboratories of AIIMS and in collaboration with global space agencies, a silent revolution is taking shape, one that connects ancient Indian wisdom with the cutting edge of space science. At the centre of this innovation is Dr KK Deepak, Professor of Physiology at AIIMS, whose research on yoga and gravity-simulating body gear could redefine astronaut health. He remembers, "Our journey into space yoga began around 2015-16 when we collaborated on experiments involving yogic postures in microgravity. We studied Russian cosmonauts and even examined how Rakesh Sharma practised yoga aboard a Soviet mission in 1982. Those early insights laid the foundation for everything that followed."

These foundational studies revealed that certain yoga postures, especially those involving head-down positions or spinal stretches, could be particularly beneficial in preparing the body for space travel. In microgravity, the human body undergoes dramatic physiological changes, for example, muscles weaken, bones lose density, and fluids shift toward the head. Traditional resistance-based exercises help, but they do not always address the subtler aspects of neuromuscular control and balance.

He further adds "Yoga postures involving inversions and gravitational shifts, like Surya Namaskar and Halasana, showed promise in helping astronauts adapt to microgravity. We realised that to make them truly effective in space, we needed a way to simulate gravity, this realisation led to our next breakthrough."

That breakthrough came in the form of the Countermeasure Gravitational Load Modulating Body Gear, a suit designed to recreate the feel of gravity in a zero-gravity environment. Unlike bulky gym machines or complicated harnesses, this suit applies gentle, calibrated pressure to various muscle groups, keeping them active even when the wearer is at rest. He proudly explains, "We designed the Countermeasure Gravitational Load Modulating Body Gear to simulate Earth-like gravitational pressure on the astronaut's body. It helps engage muscles and bones, even when the person is lying down in zero gravity. This could be revolutionary for both space missions and medical rehabilitation on Earth."

Engineered to be lightweight and comfortable, the gear can be worn during yoga sessions, while sleeping, or even during routine space tasks. It helps maintain muscle tone, bone health, and postural alignment, key for astronauts who often return to Earth needing weeks of rehabilitation. "Our gear creates controlled resistance at specific points on the body, mimicking gravitational load. It's lightweight, wearable, and can be used during sleep, exercise, or rest. The idea is simple, don't let the body forget gravity, even when gravity is not there," Dr KK Deepak added.

The implications of this research go beyond space. For bedridden patients, the elderly, or individuals with muscle-degenerative conditions, this body gear could offer a safe, low-impact way to retain physical function. It's a futuristic concept rooted in ancient practice, proving that sometimes, to go forward in science, we must also look inward.



Space-Friendly Yoga Asanas Adapted for Microgravity Conditions

Asana	Target Area	Space-Friendly Modification
Dandasana (Staff Pose)	Spine, legs, posture alignment	Performed seated with legs strapped and spine supported
Padmasana (Lotus Pose)	Hips, knees, mental centering	One-leg version on a wide seat to maintain hip mobility
Paschimottanasana (Seated Forward Bend)	Hamstrings, spine, organs	Use a strap or belt around feet; practice on a secured mat or seat
Baddha Konasana (Bound Angle Pose)	Inner thighs, pelvic region	Sit on a wide base; use support under thighs for floating control
Virasana (Hero Pose)	Knee joint lubrication, thighs	Modified on seat or with ankle support in strapped position
Navasana (Boat Pose)	Core muscles, abdominal tone	Legs rested on support; engage abs with minimal lift
Gomukhasana Arms (Cow Face Arms)	Shoulders, upper back, circulation	Arm-only movement for microcirculation, seated upright
Seated Forward Fold with Head Rested	Nervous system, mental calm	Head supported on a table or cushion for stress relief
<p>Tip from Abhijata Iyengar: "These poses are not just for the body; they support respiration, digestion, emotional balance, and recovery. Even minimal movement, if done with sensitivity, can be transformative in space."</p>		

like Utkatasana (Chair Pose) or Virabhadrasana (Warrior Pose), can replicate the benefits of resistance training, crucial for maintaining venous return and muscular pump action in space. These can be modified using resistance bands or anchoring systems to suit the zero-gravity environment.

Beyond physical poses, Pranayama (breath regulation) may hold particular promise. "Breath is one of the few physiological rhythms astronauts can consciously control," "In space, breathing is altered due to fluid shifts. Controlled breathwork like Bhramari and Ujjayi can help restore the autonomic balance, improve heart rate variability, and enhance baroreflex response."

And it is not just the body, space can also challenge mental equilibrium. Prolonged isolation and sensory monotony can induce stress, anxiety, and even depression. This is where yoga's mindfulness and meditative practices can offer immense benefits. "Cardiovascular function is not just mechanical. It is deeply tied to your stress levels, your focus, and your emotional state. Yoga provides that internal anchor astronauts need."

Yoga for Astronauts after Space Travel: Healing Back to Earth

The best part is yoga's relevance does not end in orbit. In fact, its most healing role may begin when astronauts return to Earth, where their bodies must re-learn the laws of gravity.

Muscle atrophy, joint stiffness, and a confused nervous system are common. This is where yoga, thoughtfully adapted, can play a transformative role in recovery.

In the post-mission phase, the goal of yoga shifts dramatically. Unlike pre-mission training, which is about preparing the body to resist loss, post-space yoga is about rehabilitation. Movements must be simplified, gradual, and supported. The idea is not to stretch or strain, but to reacquaint the body with itself, to remind the muscles of their function, to gently nudge joints into motion, and to stabilise breathing rhythms that may have been disrupted in orbit.

One of the most powerful tools in this process is the use of yoga props like bolsters, belts, chairs, and supports. Originally designed by BKS Iyengar to make yoga accessible for people with physical limitations, these props are uniquely suited to

"After space travel, the body has lost many of its natural responses, muscle tone, joint strength, even the ability to handle its own weight. The yoga we do post-mission must be different. The principle remains, but the approach has to change completely," Abhijata Iyengar.

Postures Beyond Earth — How Yoga Asanas are being Reimagined for Space? Expert Views by Abhijata Iyengar, Managing Partner at Ramamani Iyengar Memorial Yoga Institute

While physiology gives us the 'why,' tradition shows us the 'how'. Practitioners like Abhijata Iyengar offer crucial insights into adapting yogic methods for the space-bound body. Abhijata Iyengar, one of the foremost torchbearers of Iyengar Yoga, has been exploring that very question. Her reflections offer a profound new lens on yoga in space, not as a set of rigid postures, but as a living, breathing system that adapts with context. "Yoga, as practised on Earth, relies heavily on gravity for balance, grounding, and physiological responses. In space, gravity vanishes, so the approach to asanas has to shift. We need to reimagine postures not as static shapes but as fluid movements supported by straps, seats, or even machinery."

Unlike Earth, where simple tasks activate muscles naturally, astronauts in microgravity experience muscle atrophy and joint underuse. Yoga's wide movement vocabulary can help counter this if tailored correctly. "In space, they'll be strapped to seats or using belts. So asanas like Dandasana can be adapted, legs strapped, feet engaged, and spine aligned. Even small actions like moving the toes, extending the arms, or rotating the torso have deep physiological benefits when done with attention," explains Abhijata.

Asanas involving hip mobility (Padmasana), spinal extension (Paschimottanasana), or mindful twists can keep the musculoskeletal and circulatory systems engaged. But it's not about replicating yoga as we know it. It is about reinventing the essence of movement for a gravity-less world. As simplified by Abhijata, "The body is not doing the usual set of movements in space. There is no bending down to pick something up or walking across a room. Yoga brings in movements the body is no longer required to do in microgravity, like forward bends or inversions, which are crucial for maintaining neuromuscular health."

These are not just physical benefits. The brain, too, suffers in microgravity. Spatial disorientation, disturbed sleep, and increased stress levels are common among astronauts. Abhijata emphasises the importance of gentle, supported postures to calm the nervous system and reassure the brain. "Instead of just Shavasana or static rest, positions where the head is supported, like a gentle forward fold on a table, help calm the nervous system. These are crucial when the brain is in a heightened state due to lack of gravity and spatial disorientation."

Breathwork, too, transforms. Deep breathing might feel natural on Earth, but with limited oxygen in space, pranayama must be approached with restraint. "With limited oxygen, pranayama must shift from ambition to adaptability. Exhalation-focused practices like Bhramari calm the brain and conserve oxygen. The goal in space is harmony, not expansion — yoga becomes a tool for sensitivity and internal efficiency." In short, space yoga is not about bending the body — it is about bending the practice itself to meet a new world.



Ramamani Iyengar Memorial Yoga Institute (RIMIYI) Archives

astronauts. For instance, a pose like Supta Padangusthasana (reclining leg stretch), which traditionally involves holding the leg up straight, is reimaged with the leg supported at a low angle, using a belt and bolster. As mobility returns, the angle is slowly increased. The point is not performance, it is progression.

Breathing, too, plays an important role. In yoga, breath is not just air, it is awareness in motion. When coordinated with movement, it enhances circulation, calms the nervous system, and reconnects the internal rhythm of the body. This holistic engagement, body, breathing, and mind working together, distinguishes yogic recovery from physiotherapy. It's not just mechanical; it's mindful.

Abhijata Iyengar shares her experience, "In yoga, even a small motion engages awareness, transforms the internal system, and brings holistic benefit. That's the gift yoga offers to astronauts."

Crucially, post-space yoga must be customised. No two astronauts return with the same vulnerabilities; some may feel it in their back, others in their legs or neck. The duration of the mission, the individual's physical history, and the intensity of space-related tasks all influence how the body reacts. Therefore, recovery sequences must be flexible, responding to each astronaut's unique needs and adapting over time.

India's Perspective: ISRO and the Role of Yoga in Space
India's space agency, ISRO (Indian Space Research Organisation), has long acknowledged the potential benefits of yoga for astronaut training. Given that yoga has deep roots in Indian tradition and has been promoted for health, longevity, and mental clarity, there is growing interest in exploring how it can be adapted for space travel.

During the 2015 International Day of Yoga, ISRO officials discussed the importance of yoga for physical and mental endurance, a quality that is essential for astronauts. However, ISRO has yet to formally incorporate yoga into astronaut training. With India's plans for its first human spaceflight programme, Gaganyaan, there is an opportunity to integrate yoga into astronaut well-being programmes.

In the past, Rakesh Sharma, the first Indian in space (1984, aboard Soyuz T-11), credited meditative techniques for his ability to stay calm and focused during his mission. He practised mental discipline, visualisation, and breathing control, which closely resemble yogic practices. His famous response to then-Prime Minister Indira Gandhi "Saare Jahan Se Achha" highlighted his mental clarity and positive outlook, possibly influenced by his pre-mission training, which included techniques similar to yogic concentration.

Moreover, Indian scientists in aerospace medicine have explored the role of yoga in improving astronaut endurance and psychological resilience. The Defence Institute of Physiology and Allied Sciences (DIPAS) has researched yoga's impact on stress, cardiovascular health, and high-

altitude adaptation, which has implications for space travel and extreme environments.

Yoga in Space: Awakening the Inner Gravity

In the microgravity of space, where the body is untethered and Earth's evolutionary blueprint no longer applies, ancient disciplines like Yoga are revealing new relevance. One of the most pressing physiological challenges astronauts face is digestive disturbance, which is a silent disruptor that affects nutrient absorption and overall mission performance as well. A landmark Indian study conducted at the Institute of Aerospace Medicine, Indian Air Force, offers critical insight into this.

Using Dry Supine Immersion (DSI), a validated Earth-based method to simulate the effects of microgravity, researchers studied how different food types influenced the Gastric Myoelectrical Activity (GEA) of healthy male volunteers. The findings were striking: mean gastric frequencies dropped significantly, and irregular waveforms (bradygastria and arrhythmia) increased during DSI, especially after consuming fat-rich foods.

"Our study showed that a fat-rich diet causes maximum slowing down of gastric electrical response, both at normal gravity and in simulated microgravity. This could potentially impair nutrient delivery and affect astronaut performance," said a researcher in the field of space physiology from Bengaluru.

The implications are profound. When digestion slows, it compromises everything from metabolism to mood, which ultimately increases the risk of nausea, gastric discomfort, and impaired drug absorption. Space missions can no longer afford to treat the gut as a passive organ, it must be actively regulated. And that is where Yoga offers a unique countermeasure.

Unlike exercise regimens that rely on external movement, Yogic kriyas, such as Agnisar (rhythmic abdominal pumping) and Nauli (abdominal churning), stimulate internal peristalsis. These practices bring a kind of 'internal gravity' by massaging the viscera and activating parasympathetic pathways that support digestion. When performed mindfully, even in microgravity-modified positions, these kriyas can help counter gastric inertia.

Just as yoga restores gut function in space, it restores holistic equilibrium, physical, mental, and emotional. This makes it not just an add-on, but a core strategy for space health. As research from institutions like the Institute of Aerospace Medicine India begins to validate the physiological wisdom of yoga in microgravity, we are witnessing a convergence of ancient insight and modern innovation. In a spacecraft orbiting 400 kilometres above the Earth, or on a mission that stretches for years toward Mars, astronauts will need more than muscles and machines. They will need methods to regulate their nervous systems, maintain internal harmony, and connect with something deeper than the machinery around them. Yoga may be the quiet, potent force that carries the human spirit through the cold, infinite silence of space.

Ms Neha Tripathi is a science journalist, anchor and filmmaker. Email: mail_neha@icloud.com