# Australian Space Agency

OVERVIEW

MISSION SEGMENTS

OBJECTIVES

HUMAN LUNAR RETURN

FOUNDATIONAL EXPLORATION

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SUSTAINED LUNAR EVOLUTION

TEAM



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# What are the Artemis missions?

The NASA Artemis missions will enable humanity's return to the Moon for the first time in over 50 years.

The goal is to establish a sustained presence on the lunar surface. This prepares us to journey to Mars, the furthest from Earth that humans have ever been!

Global collaboration is key to the success of the Artemis missions. As a founding signatory of the Artemis Accords, Australia is well positioned to play a significant role in humanity's boldest adventure yet.

We are now living in the Artemis Generation, which presents Australia with an unprecedented opportunity. We can be part of redefining space exploration and pioneering technological innovation, with flow-on benefits to improve life here on Earth.

LEARN MORE about Australia's history in space



Centre for Appropriate Technology (CfAT), NT Image credit: Geoscience Australia

and planning.



# What is Team Artemis Australia?

Team Artemis Australia was created by the Australian Space Agency to support and strengthen our nation's technical and engagement activities on a global scale. It's a platform that places a global spotlight on Australia's world leading, unique and specialised capabilities that can contribute to NASA's Artemis and other Moon and Mars programs.

AUSTRALIA

The Agency has identified the capabilities that can best facilitate international collaboration based on NASA's Artemis Program design



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# Science

Artemis' scientific objectives cover many disciplines, allowing us to gain a better understanding of the universe. Australia continues to collaborate with international partners, such as NASA, utilising our scientific expertise and world leading researchers to help detect and discover exoplanets. Other areas of interest include studying the impact of radiation and microgravity on humans and plants, and exploring new ways to detect underground minerals to support life.



# Transport & Habitation

Transporting crew and cargo safely and efficiently to the Moon, as a stepping stone to Mars, is a core Artemis objective. Australia has become internationally acclaimed for inventing and utilising innovative propulsion technology to support sustainable space activities. Our country has unique geography and environments, with wide open ranges, remote locations and clear skies. It is well suited to launch and return crew and cargo into space and test habitation technology for living on the lunar surface.

There are four objectives that underpin the Artemis missions ►

Infrastructure

Cutting edge, interoperable and scalable infrastructure is essential to maintaining a continuous robotic and human presence on the Moon and Mars. This includes power generation, communication, positioning, navigation and timing, and other critical services. Australia has a long history operating ground station communication networks, having supported the Apollo missions. We are currently pioneering new and emerging technologies, such as optical and quantum communications.



# Operations

Artemis will return humans to the Moon, eventually establishing lunar operations that can be used in preparation for going to Mars. Australia is a global leader in remote operations. We have vast experience working in harsh and remote environments, for example in the mining and resources sector, as well as subsea robotics. The Australian outback and our proximity to Antarctica has also enabled us to become a world leader in delivering remote healthcare, and other related operational tasks, in extreme conditions.

# HUMAN LUNAR RETURN

### About **•**

The first Artemis mission segment involves preparing humanity to return to the Moon.

Australia can demonstrate its diverse expertise and advanced capabilities in a range of areas.

This includes communication infrastructure, positioning, navigation and timing technologies, operations, mission control support systems, launch activities and our breadth of knowledge in the scientific research sector.

### CASE | Fugro STUDY | SpAARC

The Space Automation, AI and Robotics Complex (SpAARC) was established in Western Australia to train and test remote operations in space and other harsh environments.

It is well positioned to support future space robotics projects, such as the Australian Space Agency's Trailblazer program. This program will play an important role in NASA's return to the Moon.

The facility will also support software simulation of space vehicles and robotic systems, as well as projects involving in-orbit servicing and manufacturing, and in-situ resource utilisation.

SpAARC Director Sam Forbes emphasises that "space is not just a highly challenging environment to work in, it is also the proving ground for robotics, automation, and harsh environment operations."



### Operations

Validating the readiness of systems, and facilitating training and interactions between team members on Earth, in orbit, or on the lunar surface, is critical for human lunar return. Infrastructure

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Technologies that support the manufacturing of infrastructure on and around the Moon will be used to facilitate and maintain a continuous human and robotic presence.







### About **•**

There will be increased activity around the lunar poles in the search for water, ice and other resources to support life.

This will require advanced autonomy in robotics, innovative techniques to identify and map the lunar terrain, and the deployment of robust communication systems to enable contact with mission support crews back on Earth.

Australia is an innovative world leader in mineral exploration, resource extraction and remote operational activities. We can lean on our extensive experience to support foundational exploration.

Transport

# CASE | Advanced STUDY | Navigation

Advanced Navigation has developed a ground-breaking solution called the Boreas X90. This uses an inertial navigation system powered by artificial intelligence.

The Boreas X90 provides accurate positioning over millions of kilometres, all by itself. It doesn't need maps, base station support, remote control by humans, or even traditional fixed references like stars. This kind of self-sufficiency is important when you're travelling huge distances into space.

It allows space exploration vehicles like lunar rovers to autonomously guide themselves across foreign landscapes, avoiding hazards along the way. It can also help space launch vehicles pinpoint their position through complex trajectories.

Additionally, the Boreas X90 accelerometers use quantum technology to boost performance and endurance on long missions.

# & Habitation

Systems are being developed that allow crew to autonomously explore the lunar surface.



Navigational systems are being developed to facilitate long term science, exploration, and industrial needs.



Australian



### About **v**

NASA describes Sustained Lunar Evolution as an 'open canvas' for pushing the boundaries in space technology and scientific exploration. It is Australia's chance to demonstrate our capacity for innovation, our expertise in resource utilisation, remote operations, and communications.

We are working in tandem with the latest in autonomous robotics and quantum enhanced navigation technology, and cultivating sustainable lunar agriculture. This allows us to combine cutting-edge technology and research to understand our origin in the universe.

# CASE | Plants STUDY | for Space

Plants for Space (P4S) is an Australian international collaborative research centre that aims to develop sustainable solutions for a long-term presence on the Moon. Some focus areas of the centre include habitation from sustainable materials, and growing plants in lunar soil for astronaut nutrition and space medicine.

P4S aims to train more than 400 researchers from a multitude of disciplines such as psychology, biology, engineering, and architecture. The research will have direct benefits for Earth, promoting sustainable agricultural practices and addressing food shortages.

"P4S research will create the flexible, plant-based solutions needed to support human physical and psychological well-being during deep space travel and settlement," Professor Matthew Gillham, Director of the ARC centre for Excellence in Plants for Space says.



Investigating how microgravity impacts biological systems will reveal how plants can provide sustainable and nutritious food sources, both in space and on Earth into the future. Transport & Habitation

> Investigating how habitation structures can be built from lunar soil will enable extended mission durations on the Moon, in preparation for Mars.



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### About **•**

Travelling to Mars presents many challenges. It will require advanced propulsion systems. Additionally, it will draw heavily on the experiences of operating new technlogies across previous lunar missions.

Our very own Aussie Outback provides a Martian-like landscape to study. It hosts the oldest known evidence of life on Earth.

Learning the geology of Mars, and its evolution in the solar system, will help us understand the formation of Earth and the emergence of life.

# CASE | Martian STUDY | Analogues

Our unique and diverse Australian landscape reflects the complex geological history of Earth and has attracted global attention.

The Pilbara Craton (WA) or 'cradle of life', contains the oldest geological record ever discovered. It is helpful in understanding how we may look for evidence of past life on Mars.

The Henbury Crater (NT), Undara Lava Tubes (QLD), Flinders Ranges (SA) and astrobiology research (University of NSW) have also been used to further our understanding of Mars.

Australia's proximity to Antarctica has given us the opportunity to become leading experts in operating in remote, challenging conditions, similar to what astronauts will experience on Mars. Examples of these projects include remote healthcare and specialist surgical training (Centre for Antarctic, Remote and Maritime Medicine and the University of TAS).

<u>A</u>Science

Martian-like terrain is used for testing robotics for surveying and retrieving samples, and providing in-depth missionspecific science training and health monitoring for crew.

#### Transport & Habitation

Martian-like terrain provides test beds to demonstrate systems that can transport crew and cargo.



Martian-like terrain provides test beds to demonstrate technologies related to in-situ resource utilisation techniques.



Henbury Crater, NT 🔻



#### Operations

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Martian-like terrain provides test beds to demonstrate command and control processes, and autonomously or remotely operate robotic systems on Mars from Earth or in-orbit.