

proxima

→ THOMAS PESQUET: REACHING FOR THE STARS

European Space Agency

Thomas Pesquet

Thomas Pesquet was born in Rouen, France, on 27 February 1978. He has been dreaming of going to space ever since he was a child, playing with a Space Shuttle his father had made out of cardboard boxes and pillows.

By pursuing his passions and interests throughout his education and career, Thomas acquired the experience and skills to be an astronaut. He studied aerospace engineering, majoring in spacecraft design and control, and worked as a spacecraft-dynamics engineer and as a research engineer on space mission autonomy.

An avid private pilot in his spare time, he was selected in 2004 for Air France's flight-training programme and became a pilot for the airline in 2006. He has logged more than 2500 flight hours on commercial airliners.

Thomas sees many parallels between flying an airplane and a spacecraft: both require detailed technical knowledge, leadership, teamwork and good communication and analytical skills. Together with his love for learning, his motivation and positive attitude, these skills have served Thomas well in his new job and will help make the Proxima mission a success.

With flying colours

Thomas is the youngest member of the European astronaut corps. With his assignment, all six ESA astronauts from the class of 2009 will have flown to the Station within seven years of graduation.

When ESA called for candidates from its Member States to reinforce the European astronaut corps, more than 8000 people applied. Thomas and five others passed a demanding year-long selection process and became proud members of the European astronaut class in 2009.

After graduating as an astronaut, Thomas worked as a Eurocom, communicating with astronauts during spaceflights. He was also in charge of future projects at the European Astronaut Centre, including initiating cooperation with new partners such as China.

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ESA–Philippe Sebirot



Key data

Launch site	Baikonur, Kazakhstan
Launch	15 November 2016
Docking	15 November 2016
Landing	15 May 2017
Spacecraft	Soyuz MS-03
Launcher	Soyuz FG
Mission duration	6 months

(Status as of June 2016)

Proxima

ESA astronaut Thomas Pesquet is set to go into space on a long-duration mission packed with science and education activities. For six months, his home and workstation will be some 400 kilometres above Earth. He will serve as a flight engineer for Expeditions 50 and 51 to the International Space Station (ISS).

Thomas will be launched on a Russian Soyuz spacecraft from Baikonur Cosmodrome in Kazakhstan in November 2016, returning to Earth May 2017. He will share the ride with Russian cosmonaut Oleg Novitsky and NASA astronaut Peggy Whitson.

A former aerospace engineer turned airline pilot, Thomas will travel in the left-hand seat of the Soyuz capsule.

French astronauts

Thomas Pesquet will be the tenth French citizen to fly into space and the fourth French astronaut to visit the International Space Station. This will be the first six-month mission to the Station by a French astronaut.

Jean-Loup Chrétien was the first French person and the first west European to go into space when he visited the Soviet Salyut space station in June 1982. In 1988, while on the Russian Mir space station, he became the first non-American and non-Soviet to do a spacewalk.

Claudie Haigneré was the first French woman in space when she visited the Russian Mir space station for 16 days in 1996. In 1999, she became the first woman qualified to command a Soyuz capsule during reentry. In 2001, she became the first European woman to board the International Space Station. Claudie is ESA's first female astronaut.

European science in space

European science will be in full swing during the Proxima mission. Thomas will work on 62 experiments coordinated by ESA and France's space agency CNES. They cover human research, physical sciences and biology, as well as demonstrating new technology on the Space Station.

Biology

PLANTS

The Seedling Growth-3 experiment analyses how plants react to coloured light sources in microgravity. The research will help find alternatives to sunlight when growing crops.



Materials Science

METALS

Super-alloy metals are in high demand to optimise industrial casting processes. A set of experiments will investigate the effects of microgravity on metal microstructures, especially on liquid metals when forming alloys.

PLASMA

Plasma is an ionised gas. It is considered to be the fourth state of matter, distinct from gas, liquid and solid matter. The **PK-4 experiment**, operated by Russian crew within Columbus, investigates the creation of plasma-microparticles in weightlessness to simulate how molecules interact in three dimensions.

FLUIDS

Scientists are interested in understanding how quickly heat spreads in a fluid and how quickly liquids mix. The **SODI-DCMIX-3** experiment will exploit the fact that fluids in microgravity become less dynamic to measure diffusion in liquid mixtures. The **Fluid Dynamics in Space** experiment will look at the slosh of liquid propellants in reservoirs during satellite manoeuvres.

Monitoring the space environment

SUN

The **SOLAR** facility measures our star's electromagnetic radiation with unprecedented accuracy across a wide part of its spectral range. Its spectrometers make observations in the ultraviolet, visible and infrared wavelengths. One of the primary goals is to measure the solar constant to distinguish between solar impact and human influence on Earth's climate.

RADIATION

Radiation levels in space are higher than on Earth, usually as much as 30 to 50 times stronger. The **DOSIS-3D** experiment monitors radiation in the European Columbus module to prevent health problems on long-duration space missions.

MAGNETIC FIELD

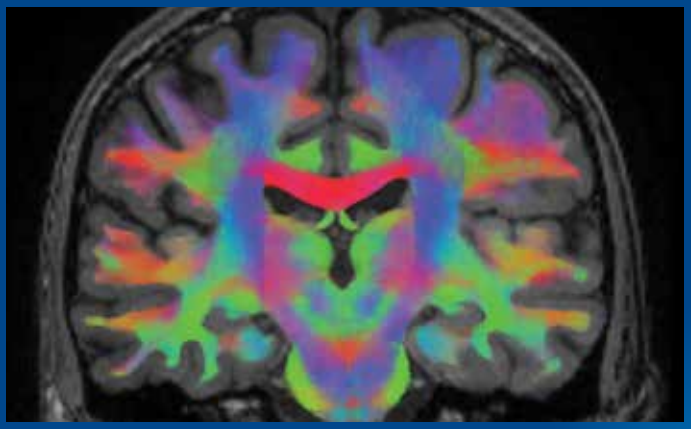
The **MagVector** experiment measures changes in the strength of the magnetic field that interacts with the Space Station to better understand the effects of Earth's magnetic field on electrical systems.



Human Research

HEAD

Thomas's brain will be examined in detail before and after his mission to understand how the neural processes of perception adapt to weightlessness. He will also record any headaches while in orbit.



IMMUNE SYSTEM

More than half of space travellers show significant signs of immune dysfunction after long missions. Using brain scans, monitoring breathing and looking at samples of hair from Russian cosmonauts, the **Immuno-2** experiment looks at how stress affects the immune system.

INNER CLOCK

The **Circadian Rhythms** experiment will look at how long-duration spaceflight affects Thomas's biological clock. The findings could help people who work irregular hours on Earth.

HANDS

The **GRIP** experiment will study the effects of long-duration spaceflight on Thomas's dexterity. The **GRASP** experiment will take advantage of the Perspectives equipment to immerse Thomas in a virtual-reality environment. The goal is to investigate how the central nervous system integrates sensory cues and information to coordinate hand movement and visual perception.

BONES

Astronauts lose up to 1% of their bone mass each month in space. The **Early Detection of Osteoporosis in Space** experiment will look at changes in cosmonaut's bone structure.

MUSCLES

Living in microgravity leads to the loss of muscle mass, function and motor control. The **SARCOLAB-3** experiment will study characteristics of muscles that are particularly affected in space, such as the muscles in the lower leg while. By taking samples of Thomas's soft tissue before and after spaceflight, the **Muscle Biopsy** experiment will help to work out how to counteract loss of muscle strength in space.

SKIN

Astronauts lose more skin cells and age faster during spaceflight. Samples of Thomas's tissue will give insights on skin physiology in space and, in particular, the skin-ageing process.

METABOLISM

Humans lose body mass in space. Thomas will measure changes in energy expenditure to derive an equation for an astronaut's needs on long-duration missions to the International Space Station and beyond.







Technology Demonstrations

WATER PURIFICATION

Thomas will test the filter capabilities of a membrane in microgravity and will analyse the microbial quality of Space Station water. The final goal of the **Aquamembrane** demonstration is to revolutionise water purification by means of industrial biotech techniques in space and on Earth. **Aquapad** will help simplify water quality analysis in the Space Station.

CLEANING UP

Thomas will evaluate the use of antimicrobial surfaces in space. The aim of the **MATISS** experiment is to reduce surface microbial contamination in astronaut spacecraft by testing agents that inhibit or reduce the ability of microorganisms to survive on surfaces.

FEEL THE FORCE

ESA is investigating the limits of human perception and ability to apply fine forces with their hands in space. Thomas will use a force-reflecting joystick in space, helping to improve the equipment to support robotic and human interaction in weightlessness.

REMOTE CONTROL

To help turn robotics and remote operations into a standard tool for space missions, ESA is linking the Space Station with Earth. Thomas will operate ESA's **Eurobot** in the Netherlands while orbiting Earth using a laptop and a joystick. The European astronaut will also test a medical imaging ultrasound scanner that will be operated remotely by a radiologist on Earth.

SUITED FOR SPACE

Astronauts can grow by up to seven centimetres as their spines lengthen in weightlessness. As a result, many suffer from backache during long-duration missions. Thomas will wear a suit designed to combat the lack of gravity effects by squeezing the body from shoulders to the feet with a familiar force to that felt on Earth.

SMART SENSORS

Thomas will also wear clothing that incorporates sensing devices. **EveryWear** will demonstrate how personal physiological data can be collected from astronauts and transmitted to Earth in real time for medical and scientific purposes. **EuCPAD** will test a new radiation dosimetry system for space that provides continuous, real-time instant information on radiation exposure and could become part of ESA's radiation protection strategy for astronauts.

WIRELESS SENSING TECHNOLOGY

How does a wireless sensor network function in space? The **Wise-Net** experiment is testing a set of sensors in the Columbus module.

MARITIME CONTROL

The **Vessel ID** system is the marine equivalent of air traffic control. Attached to Europe's Columbus laboratory, its satellite receiver can identify more than 22 000 ships a day. The data are contributing to develop global maritime surveillance.



Inspiring the next generation

One of Thomas's priorities during his stay on the International Space Station is to share his mission with people on Earth. The astronaut hopes that more people will be able to fly to space in the future. In the meantime, a whole set of educational activities will challenge students to join his spaceflight adventure and continue learning.

Computing – Astro Pi

At the end of his mission, ESA astronaut Tim Peake left behind two Raspberry Pi mini computers on the Space Station. Called Astro Pi, each of these credit card-sized computers is equipped with a host of sensors and gadgets. Students will devise their solutions to coding challenges proposed by ESA.



Chemistry – living with enzymes

Enzymes are biological molecules that help complex chemical reactions occur inside the cells of living organisms. Without enzymes, we wouldn't be able to digest food. With Thomas's help, students on Earth will investigate how the chemical reactions associated with digestion are influenced by microgravity conditions.

Biology – gardening in space

Thomas will be busy growing seeds while in space. A special cargo of mustard, lentil and radish seeds will be waiting for him on the Space Station. He will water them and take pictures at regular intervals to study how the seeds grow in space. To compare notes with Thomas, schoolchildren on Earth will use the same type of seeds and will follow the same procedures. The pupils will learn how space travel impacts growth and whether humans could one day produce their own food in space.

Space sciences – watch and learn

Astronaut Thomas Pesquet joins the efforts of teachers on Earth in the quest to explain space science to their pupils. The astronaut will record videos from the International Space Station demonstrating the phenomena that mentors find hard to show during their earthbound lessons.

Mission-X – train like an astronaut

Mission-X fever is spreading across the planet. Future space explorers will get on their marks and invade gyms to train like astronauts for the 2017 challenge. 'Mission-X: Train like an astronaut' is an educational programme in which thousands of schoolchildren aged 7 to 12 years old from more than 25 countries do science activities and learn how to get fit.

Earth Guardian

From the Space Station's Cupola, astronauts have a privileged vantage point to observe the beauty of our planet. However, its fragility, as well as global threats, are also more obvious when seen from space. Thomas will stimulate school children to think about environmental protection and sustainable strategies for the future.



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