# Back to the moon: the dream comes true

## Scuola Politecnica e delle Scienze di Base Federico II
## Napoli 19 giugno 2024

Source: NASA – ESA website

# Introduction

Aeropolis.it

***The race for space exploration is now an established reality that will accompany us permanently in the near future.***

***The engine that drives it is not only the noble "pleasure of knowledge" and the positive effects it brings on our daily lives, but also more "practical" material issues, such as the economic exploitation of the immense extraterrestrial resources (just think of the availability of rare-earth element, REE, and other noble minerals), the control of extra-atmospheric airspace and satellite telecommunications, the commodification of the knowledge acquired in the many ongoing or planned projects.***

***Considering what has been the recent history of humanity, the current global geopolitical situation of extreme conflict and the prospects for the use of new technologies, we believe it is necessary to make, now that the journey is still at the beginning, some reflections on which they must be the "boundary conditions", the constraints and rules to be respected in the development of the space economy.***

# Introduction

Aeropolis.it

***Fundamentally, today there is still no international legislation covering all areas of the economic use of space. Little has been done, beyond mere expressions of principle and some international agreements of limited scope. The ecosystem, therefore, presents itself as a sort of Wild West of the third millennium, where the richest and most unscrupulous could wage war with no holds barred, to grab (monopolistically) the most economically and strategically interesting planetary sites (starting with the Moon).***

***For this reason, we believe it is the task of the new generations who are about to enter the economic and social world to first define an "ethical" framework of the rules of the game to ensure the sustainability of the space economy development, the fair sharing of knowledge and the resulting fundamental benefits, the responsible conservation (or, better, improvement) of the ecosystem. This world and this universe are not our property. Man, after all, is only the main beneficiary; The utmost are, therefore, the responsibility to respect them and the duty to leave them to one's posterity in perfect conditions of conservation.***

Aeropolis.it

## Human life in space

Humans, by nature, have always been projected to explore the environment that surrounds them: migrations over the centuries have led them to settle extensively across the planet.

And so it will be for space; then, it is natural to delve into the risks of survival in an extraterrestrial environment and the strategies to ensure safe and comfortable living conditions in future space missions, which will be neither short nor close to the Earth.

The following slides, taking inspiration from a large amount of information available on the official ESA/ASI and NASA websites on current space medicine research, aim to give a first summary of the major "liveability" problems that men and women will encounter in future space missions and related mitigation/resolution strategies.

There is enough material for further study and discussion for a future workshop.

# Back to the moon: the dream comes true

Source: NASA – ESA website

## What Happens to the Human Body in Space?

Human body changes during spaceflights. Risks and strategies to ensure safe (healty and productive) missions for astronauts

Ref.:

- ESA - Body's defence in space
- https://www.nasa.gov/humans-in-space/the-human-body-in-space/

# Human body changes during spaceflights. Risks and strategies to ensure safe (healty and productive) mission for astronauts

*For more than 50 years, all the major Space Organizations (i.e. ESA, NASA, etc..) and Research Centers/Universities have studied what happens to the human body in space. Researchers, today, are using widely these studies to design procedures, devices, and strategies to keep astronauts safe and healthy throughout their missions.*

*Understanding the effects of spaceflight on humans is essential as astronauts move from the International Space Station in low-Earth orbit to deep space destinations on and around the Moon, and beyond (i.e. Mars exploration).*

*New accurate and extended information are expected from most of the health research projects currently underway and from next Artemis missions in service measured data.*

*What exactly happens to the body in space and what are the risks? Are these the same for astronauts who spend six months on the space station versus those who may be away on a Mars mission for years?*

# Human body changes during spaceflights. Risks and strategies to ensure safe (healty and productive) mission for astronauts

*The risks for long term missions are grouped into five human spaceflight hazards related to the stressors they place on the body. These can be summarized with the acronym "**RIDGE**" short for Space **R**adiation, **I**solation and Confinement, **D**istance from Earth, **G**ravity fields, and Hostile/Closed **E**nvironments*

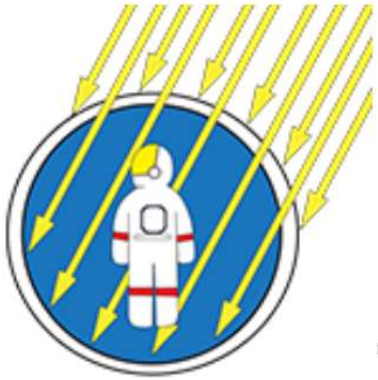
*The studies that researchers are carrying out are of fundamental importance in developing and assessing medical standards, physical fitness programs and standards, physiological and psychological adaptation training, "sensorimotor" training (ndr: addestramento "sensomotorio"),*
*and nutritional health protocols.*

*Ref.:*

- *ESA - Body's defence in space*
- *https://www.nasa.gov/humans-in-space/the-human-body-in-space/*
- *ESA - 20 years of human research on the International Space Station*

Aeropolis.it

# *Human body changes during spaceflights. Risks and strategies to ensure safe (healty and productive) mission for astronauts*



Risks and Mitigation/Countermeasures

## 1. Space Radiation

***Risk of Radiation exposure***

- ✓ Degenerative diseases
- ✓ Radiation sickness
- ✓ Cancer
- ✓ Changes in Central Nervous System

***Potential Countermeasures***

- ✓ Health Monitoring
- ✓ Medicines
- ✓ Healthy Diet
- ✓ Radiation Shelding

Aeropolis.it

***Human body changes during spaceflights. Risks and strategies to ensure safe (healty and productive) mission for astronauts***

Risks and Mitigation/Countermeasures

## 2. Isolation and Confinement

***Risk of Isolation***

- ✓ Behavioral Changes
- ✓ Sleep Problems
- ✓ Fatigue
- ✓ Decline in mood

***Potential Countermeasures***

- ✓ Gardening and journaling
- ✓ Light technologies
- ✓ Self assessment
- ✓ Virtual reality sessions

Aeropolis.it

# *Human body changes during spaceflights. Risks and strategies to ensure safe (healty and productive) mission for astronauts*

Risks and Mitigation/Countermeasures

## 3. Distance from Earth

***Risk of being far from Earth***

- ✓ Ineffective medications
- ✓ Food storage challenges
- ✓ Lack of medical care
- ✓ Equipment failure

***Potential Countermeasures***

- ✓ Food and medicine packaging for preservation
- ✓ Sustainable food systems
- ✓ Virtual assistants
- ✓ Clinical decision support tools

Aeropolis.it

# *Human body changes during spaceflights. Risks and strategies to ensure safe (healty and productive) mission for astronauts*

Risks and Mitigation/Countermeasures

## 4. Gravity Fields

***Risk of extended time in microgravity***

- ✓ Reduced muscle mass
- ✓ Bone loss
- ✓ Fluid shift
- ✓ Change in sensorimotor (*) skills

***Potential Countermeasures***

- ✓ Exercises
- ✓ Medications
- ✓ Pressure Devices
- ✓ Fine motor testing

(*) ndr: “sensomotorio”

Aeropolis.it

# *Human body changes during spaceflights. Risks and strategies to ensure safe (healty and productive) mission for astronauts*

Risks and Mitigation/Countermeasures

## 5. Hostile/Closed Environments

***Risk of Long Duration Closed Environment***

- ✓ Altered Immune system
- ✓ Celestial dust exposure
- ✓ Temperature Changes
- ✓ Exposure to contaminants

***Potential Countermeasures***

- ✓ Routine cleaning and air filter maintenance
- ✓ Air quality monitoring
- ✓ Immunizations
- ✓ Thermal control systems

Aeropolis.it

# *What Happens to the Human Body in Space?*

## *Thank You for the attention*

Source: NASA – ESA website