WHAT HAPPENS TO THE BODY IN SPACE?

- BRAIN CHANGES
- OCULAR CHANGES
- RESPIRATORY ISSUES
- KIDNEY STONES
- CARDIOVASCULAR PROBLEMS
- MUSCLE ATROPHY
- BONE DEMINERALISATION
- • IMMUNE SYSTEM AFFECTED
- • SLEEP DISTURBANCES
- • RADIATION EXPOSURE
- • NUTRITION AND METABOLISM
- • ...

ON EARTH

IN SPACE
ESA's Human Research Programme
On Board the ISS

Ageing
Cardiovascular
Immunology
Muscle and bone
Neurophysiology
Nutrition
Respiratory system
Thermoregulation

...
SCIENCE WITH(out) GRAVITY

Parabolic flights

A refitted aircraft flies for three hours in repeated rollercoaster parabolas.

The climb can be changed to simulate lunar or martian gravity.

30 parabolas a day offer 20 seconds of microgravity each time.

Parabolic flights are often used to conduct research with humans and validate experiments before they fly to the International Space Station.

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SCIENCE WITH(OUT) GRAVITY

Bedrest

Bedrest volunteers spend two to 60 days in bed tilted towards the head end, usually at 6° below the horizontal.

By submitting themselves to this upside-down regime, the volunteers’ bodies start to adapt as though in space with blood and fluids rushing to the head and muscles and bones wasting away.

New bedrest studies, run in Cologne, Germany, now include a human centrifuge to recreate gravity towards the feet.

At least one shoulder must be touching the bed at all times including during showers and toilet visits.

In dry immersion, the body is supported evenly without pressure points. This is much like floating astronauts in space.

Results could help devise countermeasures for astronauts and bedridden people on Earth.

Volunteers spend 3 to 21 days immersed in bath tubs to simulate the changes the human body experiences in space.

Dry immersion

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ISOLATION STUDIES

Sirius

The Sirius programme simulates space missions on Earth to better understand human behaviour, health and performance in isolation and confinement.

Sensory and social deprivation
Six volunteers live and work without natural daylight, no fresh air and limited human interaction.

Challenges
The crew has to cope with limited communications, emergency scenarios and simulated spacecraft manoeuvres – all while being cut off from the world.

Why
To learn how to prevent conflicts, and keep optimal crew performance while avoiding social isolation and stress among space travelers.

Go green
The crew grows vegetables under artificial light in a greenhouse. This source of food will be crucial for future long-duration missions away from Earth.

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Human and robotic spaceflight contributes to a **circular economy**. Our research and technology developments improve energy efficiency, automation, robotics and artificial intelligence, as well as habitation, recycling, waste management and additive manufacturing processes and technology.