

Latest Advances in Space Medicine Research



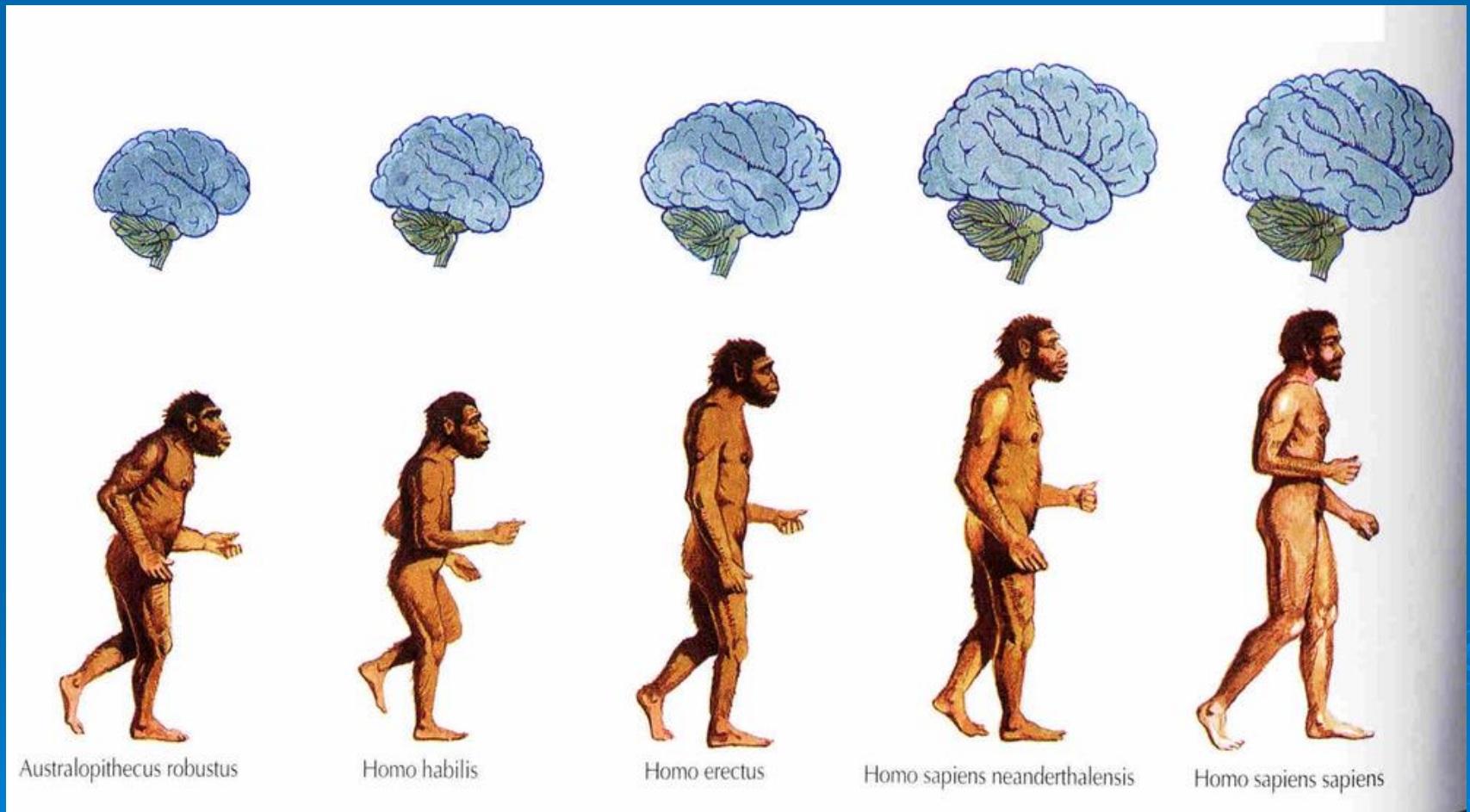
Latest Advances in Space Medical Research



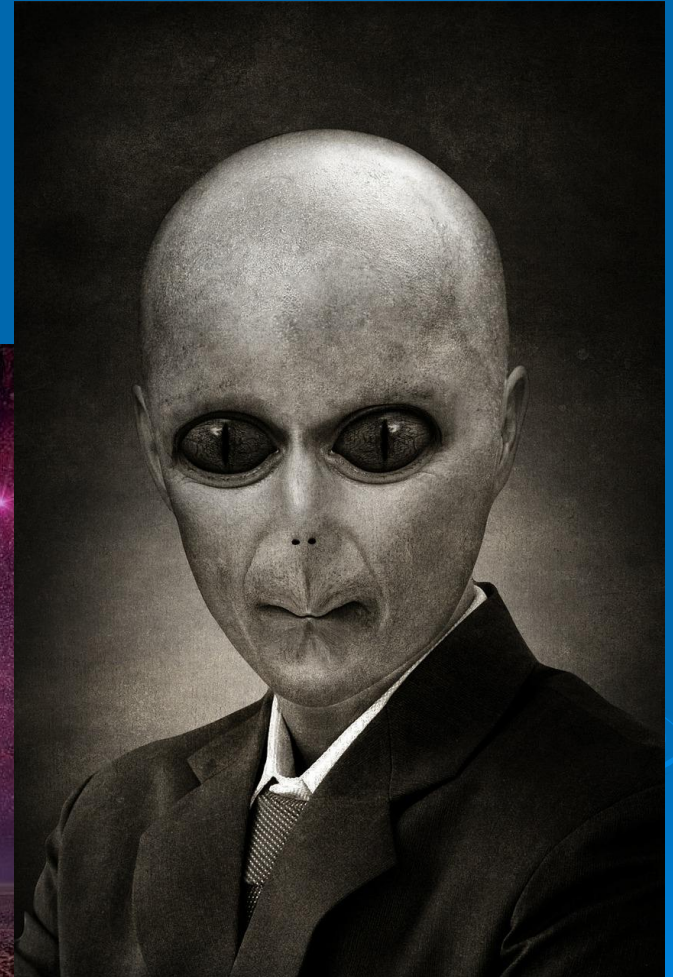
Prof. Thais Russomano, MD, MSc, PhD, FRSA
Co-Founder & CEO, InnovaSpace UK
Board Member of ACESWorldwide USA
www.innovaspace.org



Homo sapiens sapiens



Homo sapiens spatium

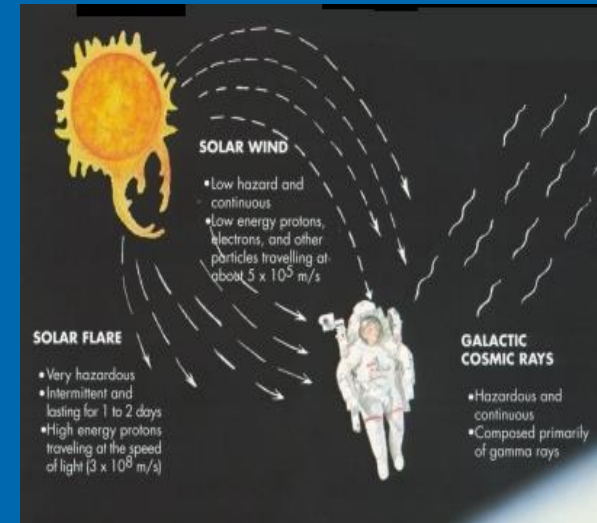


Space Environment – Space Missions (LEO)

Microgravity



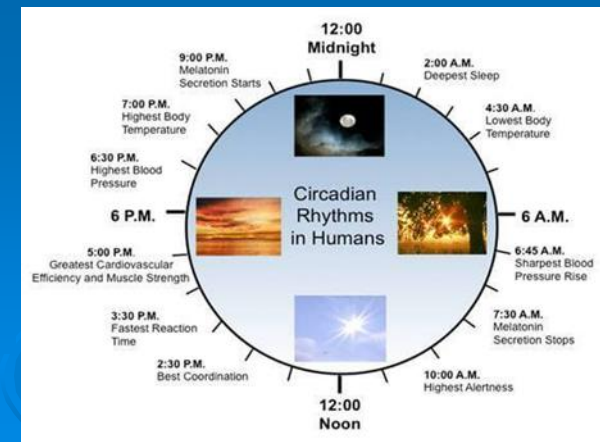
Radiation



The Human Mind in Space



Circadian Rhythm



Humans on The Moon



There is a **very, very thin** layer of gases on the lunar surface = **atmosphere**.

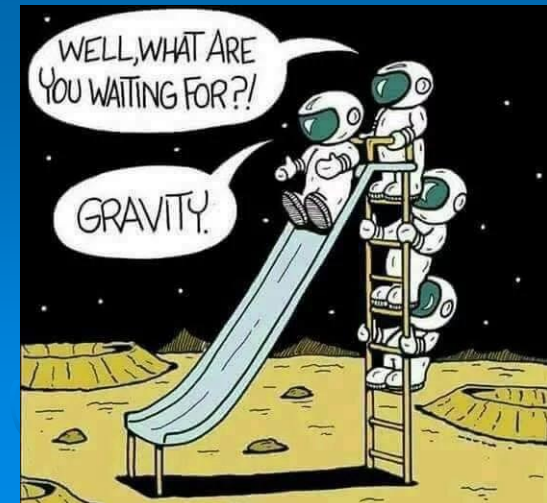
There is **neither oxygen nor water** on the surface of the Moon.

There is **no protection** against radiation and meteorites and asteroids.

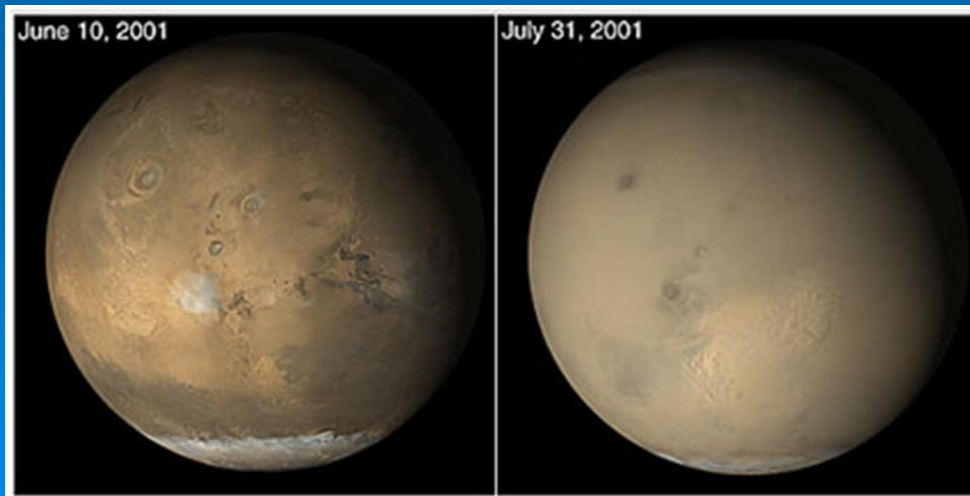
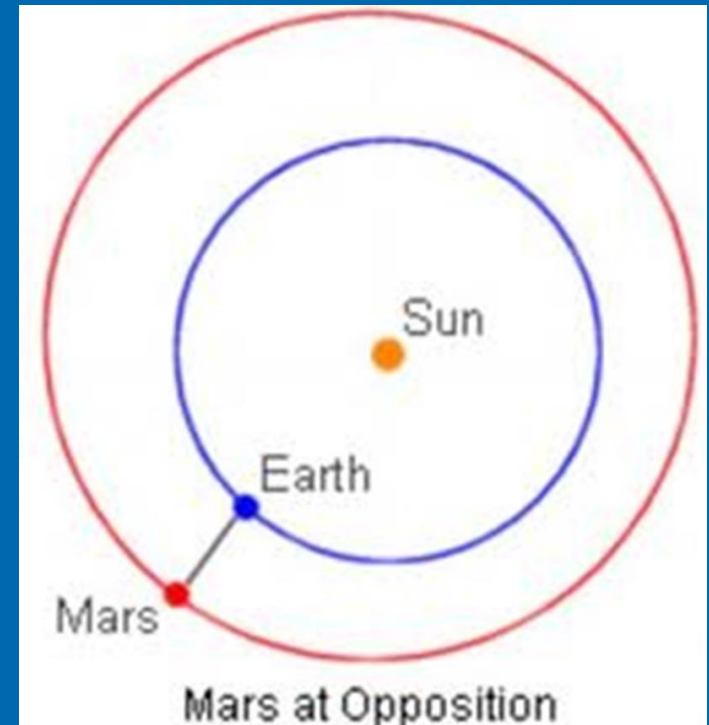
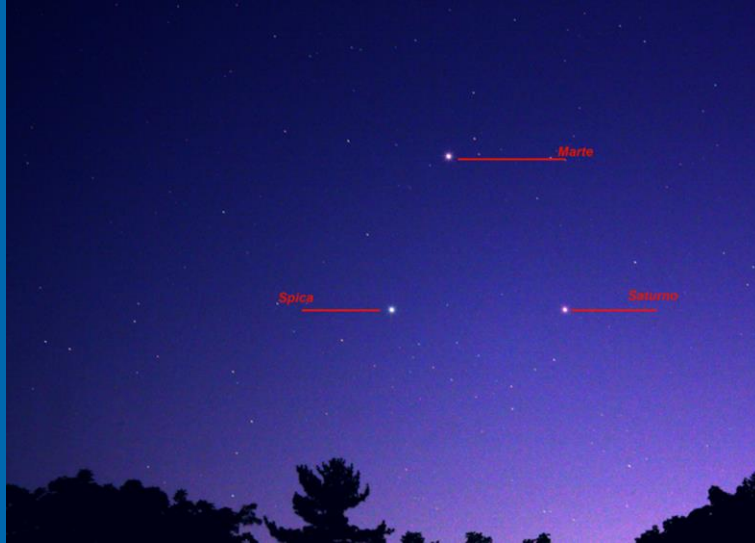
Moon **dust**

Distance – allows good **communication**

The Moon's gravitational pull is **one-sixth** to that of the Earth's - **hypogravity**



Humans on Mars



Very **low barometric pressure**

Atmosphere – 96% **CO₂**

Max temp 20°C Min temp -140°C

Average temp **-63 °C**

Hypogravity – 38% of 1G

Distance – 55 to 401 million Km

How space affects men and women differently

● EFFECTS OBSERVED IN SPACE ● EFFECTS OBSERVED ON EARTH ● EFFECTS OBSERVED ON EARTH & IN SPACE

MEN

WOMEN

- Men show a bias towards speed over accuracy during an alertness test
- Less potent immune responses
- Some males have significant vision impairment
- More hearing loss from aging, especially in the left ear
- Muscle and bone loss varies for each individual person
- Kidney stones are more common
- Urinary tract infections are less common
- Less susceptible dizziness and light-headedness when standing

- Women show a bias towards accuracy over speed during an alertness test
- More potent immune responses
- No evidence of significant vision impairment
- Less hearing loss from aging, in both ears
- Muscle and bone loss varies for each individual person
- More susceptible to radiation-induced cancer
- Urinary tract infections are more common
- More susceptible dizziness and light-headedness when standing

SOURCE: NASA

TECH INSIDER

Short-term physiological alterations

Long-term physiological alterations

Central fluid shift (nasal and sinus congestion, headache)

Neurovestibular changes associated with motion sickness

Back pain

Anxiety

SANS

Transient orthostatic symptoms on reexposure to gravity

Bone density loss

Nephrolithiasis

Radiation-induced changes

Muscle deconditioning



Space Medicine



Space
Physiology
&
Psychology



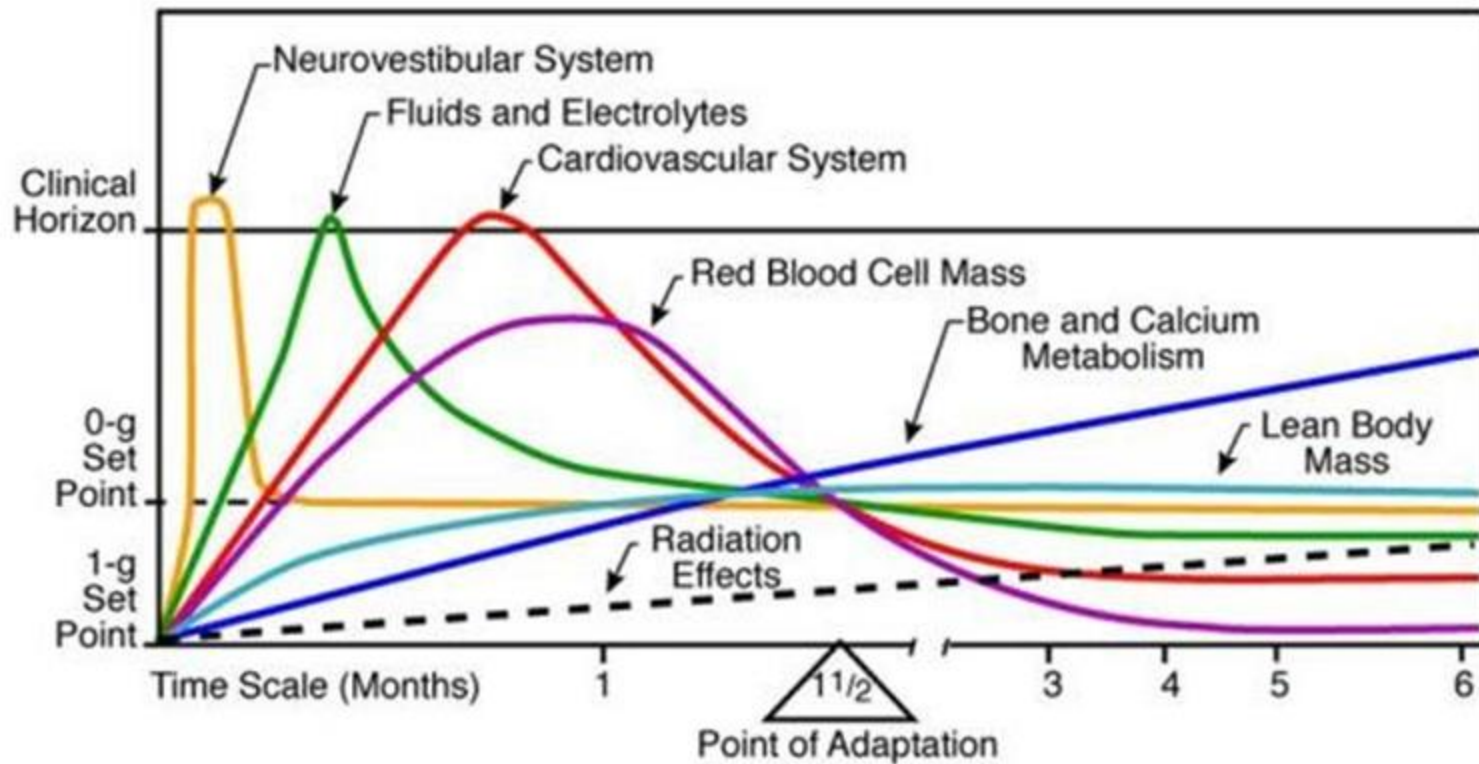
Operational
Medicine



Clinical
Medicine



Space Physiology – What we know!



*Each physiological system
acclimates to microgravity at
a different rate*

Exercise - ISS

Strength



Advanced Resistive Exercise Device

ARED

Locomotion



Treadmil Exercise Device

T2

Resistance



Cycle Ergometer with Vibration Isolations and Stabilization Syst.

CEVIS

The Human Mind in Space

Isolation – lack of references

Monotony vs Overloaded by work

Depression

Light/dark cycles - Insomnia

Communication issues/crew diversity

Habitat design - Spacecraft and Spacesuits/Risks and Confinement

Radiation – brain effects (study in mice)

Hostile places (ambient noise & vibration, hypothermia, hypoxia, microG, hypoG...)

Life-threatening dangerous



Entertainment and Socialisation





Absence of familiar
proprioceptive cues



Space Meals



In-flight medical events for U.S. astronauts during the Space Shuttle Program (STS-1 through STS-89, Apr 1981 to Jan 1998)

Medical Event or System by ICD-9 ^a Category	Number of Events	Percent	Incidence/ 14 days	Incidence/ year
Space adaptation syndrome	788	42.2	2.48	64.66
Nervous system and sense organs	318	17.0	1.00	26.07
Digestive system	163	8.7	0.52	13.56
Skin and subcutaneous tissue	151	8.1	0.48	12.51
Injuries or trauma	141	7.6	0.44	11.47
Musculoskeletal system and connective tissue	132	7.1	0.42	10.95
Respiratory system	83	4.4	0.26	6.78
Behavioral signs and symptoms	34	1.8	0.11	2.87
Infectious disease	26	1.4	0.08	2.09
Genitourinary system	23	1.2	0.07	1.83
Circulatory system	6	0.3	0.02	0.52
Endocrine, nutritional, metabolic, and immunity disorders	2	0.1	0.01	0.26

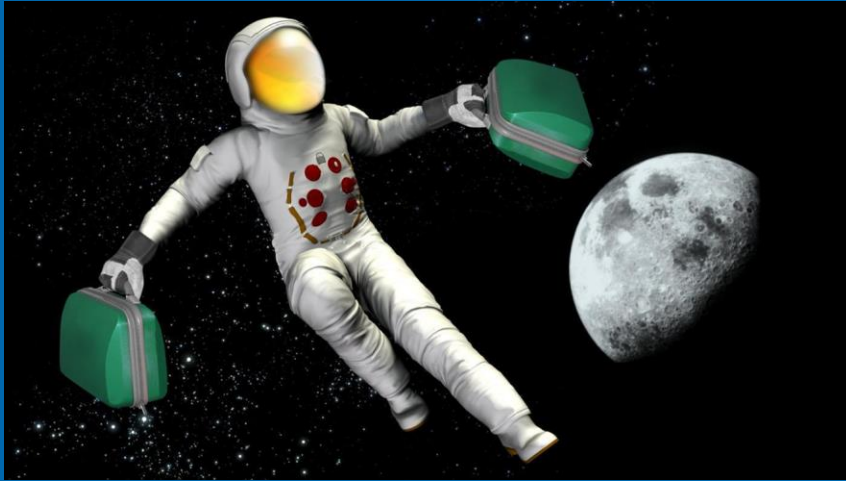
^aInternational Statistical Classification of Diseases and Related Health Problems, 9th edition.

Source: Billica (2000)

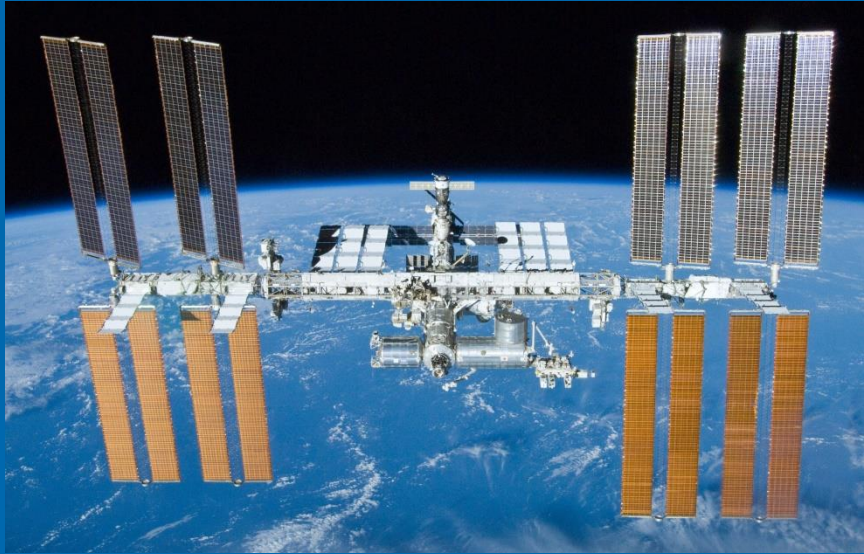
<https://humanresearchroadmap.nasa.gov/Evidence/reports/BMed.pdf>

Space Tourism

Space mission for recreational, leisure or business purposes
It will increase the need for medical monitoring during space flights – less fit candidates, sick people (?), older travelers....



Space Missions - Medical Evaluation of Astronauts



400km / 27000 km/h /
1 orbit = 90 min



Real-time communication
LEO – low Earth orbit
160km – 2000km

Medical monitoring on board the ISS involves **the collection of medical data** at regular intervals, **support to medical emergencies** and **physiological evaluation of crewmembers** during microgravity adaptation.

The Challenges of Medical Care during a Trip to Mars

Microgravity/Hypogravity

Space Radiation

Social, emotional, psychiatric aspects



1G

0.38G



Distance in million kilometers

The minimum distance = 54.6

The average distance = 225

The furthest distance = 401



Communication Issue (speed of light 300.000 km/s)

Delay each way: 3 min (minimum), 12.5 min (average), 22 min (furthest)

Solutions!

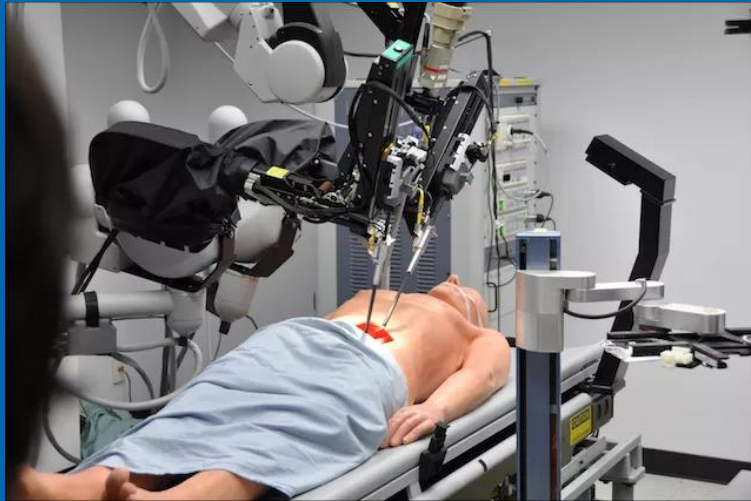
Astronaut training



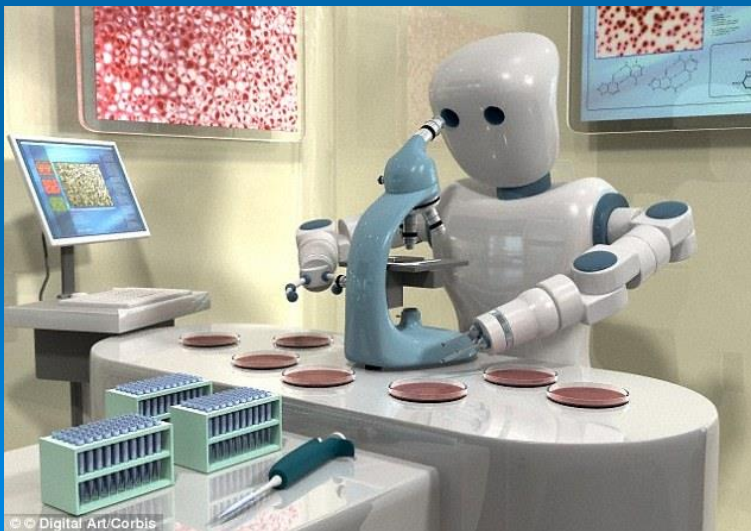
Medical tools



Robonauts



Robots as doctors



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