


“El ser humano en el espacio. Un pequeño paso para el hombre, un salto gigantesco para la medicina”

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Centro de Instrucción de Medicina Aeroespacial (CIMA)

CURSO COMPLUTENSE DE INTRODUCCIÓN A LA EXPLORACIÓN ESPACIAL Y SU UTILIZACIÓN
Madrid, 20 de noviembre de 2024

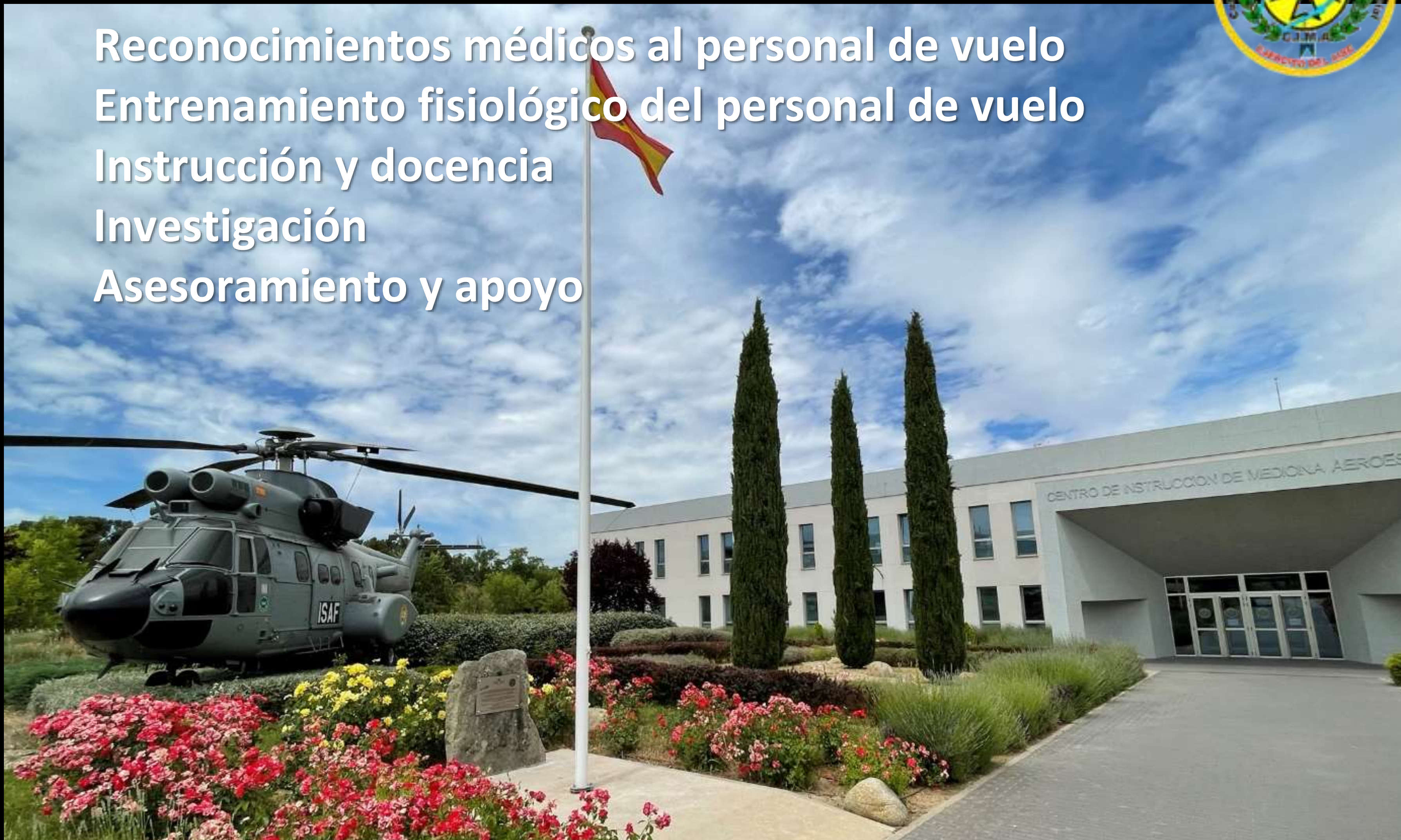
Ejército del Aire y del Espacio

Y quién soy yo…

- Facultad de Medicina, UCM, Madrid.
- Cuerpo Militar de Sanidad.
- Médico de Vuelo.
- Diploma Medicina Aeroespacial.
- Diploma Seguridad de Vuelo.
- CENTRO DE INSTRUCCIÓN DE MEDICINA AEROESPACIAL
- Vocal Permanente Médico de la Comisión para la Investigación Técnica de Accidentes de Aeronaves Militares (CITAAM)
- Candidata Astronauta ESA 2021

CIMA

Reconocimientos médicos al personal de vuelo
Entrenamiento fisiológico del personal de vuelo
Instrucción y docencia
Investigación
Asesoramiento y apoyo



Agenda

Recuerdo Histórico

Fisiología Humana en el Espacio

Requisitos Médicos para viajar al Espacio

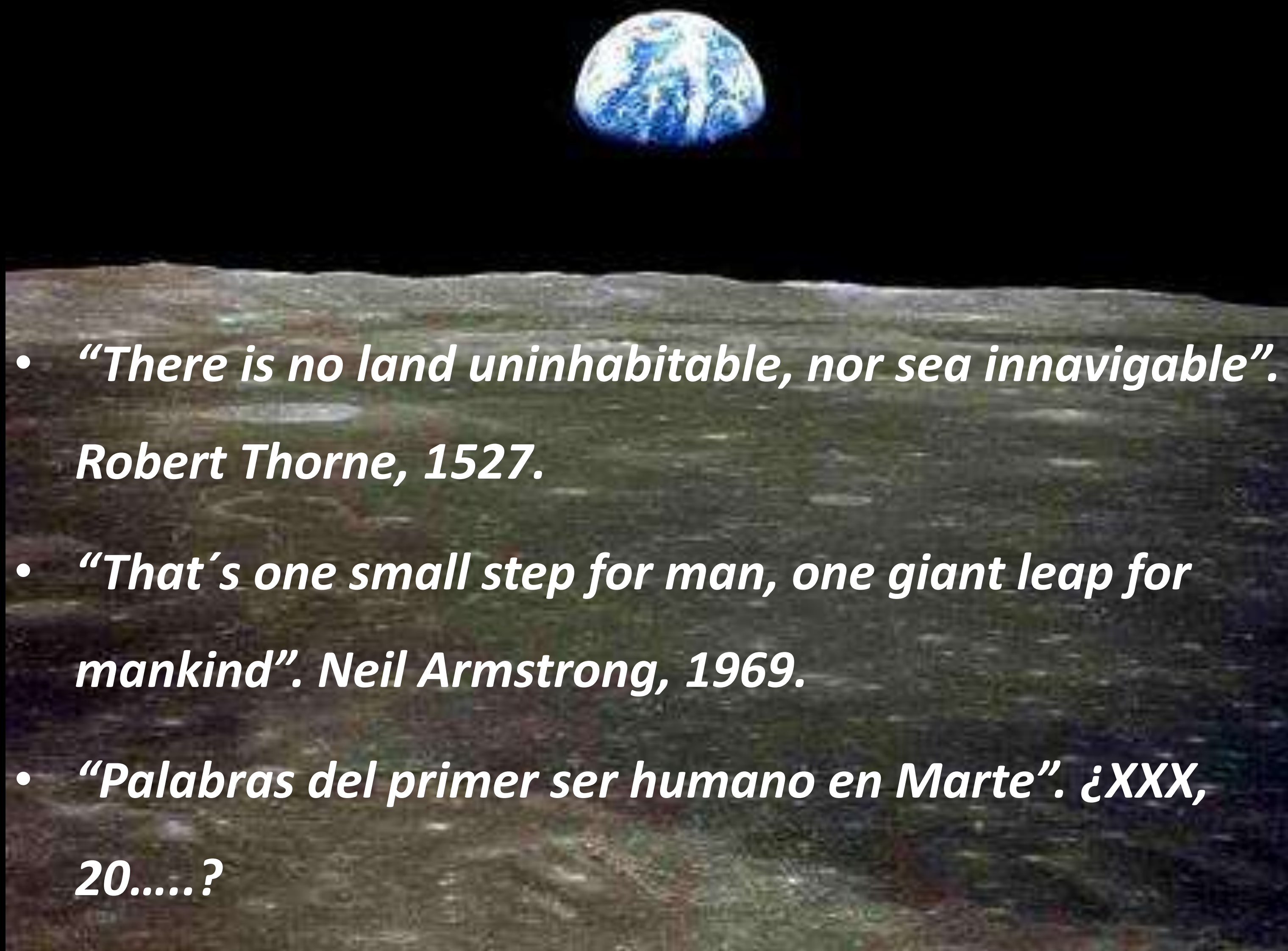
Agenda

Recuerdo Histórico

Fisiología Humana en el espacio

Requisitos médicos para viajar al espacio

Frases para el recuerdo



- ***"There is no land uninhabitable, nor sea innavigable". Robert Thorne, 1527.***
- ***"That´s one small step for man, one giant leap for mankind". Neil Armstrong, 1969.***
- ***"Palabras del primer ser humano en Marte". ¿XXX, 20…..?***

Carrera Espacial: Recuerdo Histórico

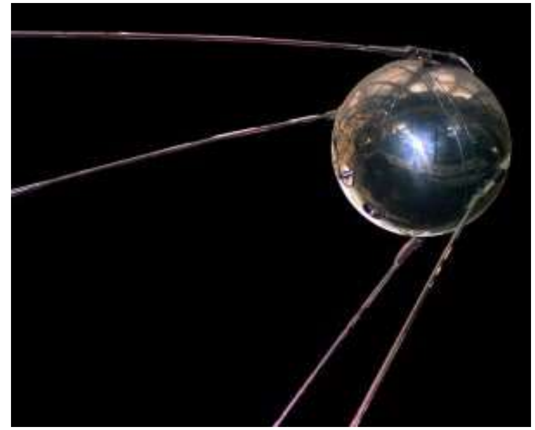







HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Sputnik 1** (4 Octubre 1957): El **primer satélite artificial.**
  - *No tripulado*
- **Sputnik 2** (3 Noviembre 1957): El **primer animal en el espacio**: *Laika*
  - *En el año 2002 se reveló que Laika había aguantado poco tiempo con vida, ya que murió a causa del sobrecalentamiento de la nave y el estrés.*
- **Korabl-Sputnik 2** (Agosto 1960) *"Arca de Noé":*
  - *Dos perros Belka y Strelka, 40 ratones, 2 ratas y una variedad de plantas.*
  - *La nave regresó a la Tierra al día siguiente y todos los animales fueron **recuperados sanos.***

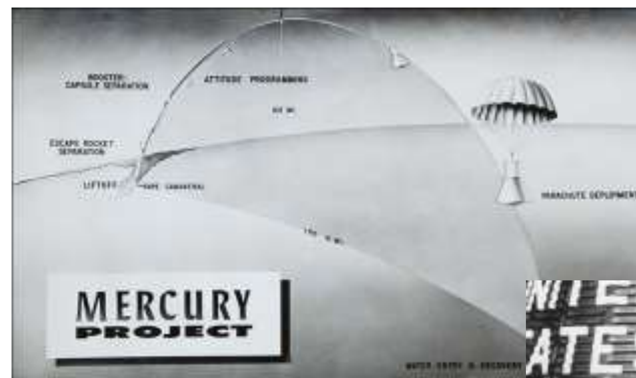


HITOS (“Médicos”) DE LA CARRERA ESPACIAL

- **Vostok 1**: 12 Abril 1961 Yuri Gagarin (108 min):
  - **Primer ser humano en alcanzar la órbita terrestre**
- **Mercury** :
  - 5 mayo 1961: Vuelo suborbital del **Mercury MR-3** (Freedom-7) de Alan Shepard:
    - Primer estadounidense en el espacio
  - 20 Febrero 1962. Vuelo orbital del **Friendship 7** de John Glenn:
    - tercer estadounidense en volar al espacio tras Alan Shepard y Gus Grissom, y el **primero en orbitar sobre la Tierra**

Yuri Gagarin (12 abril 1961)

Alan Shepard (5 mayo 1961)

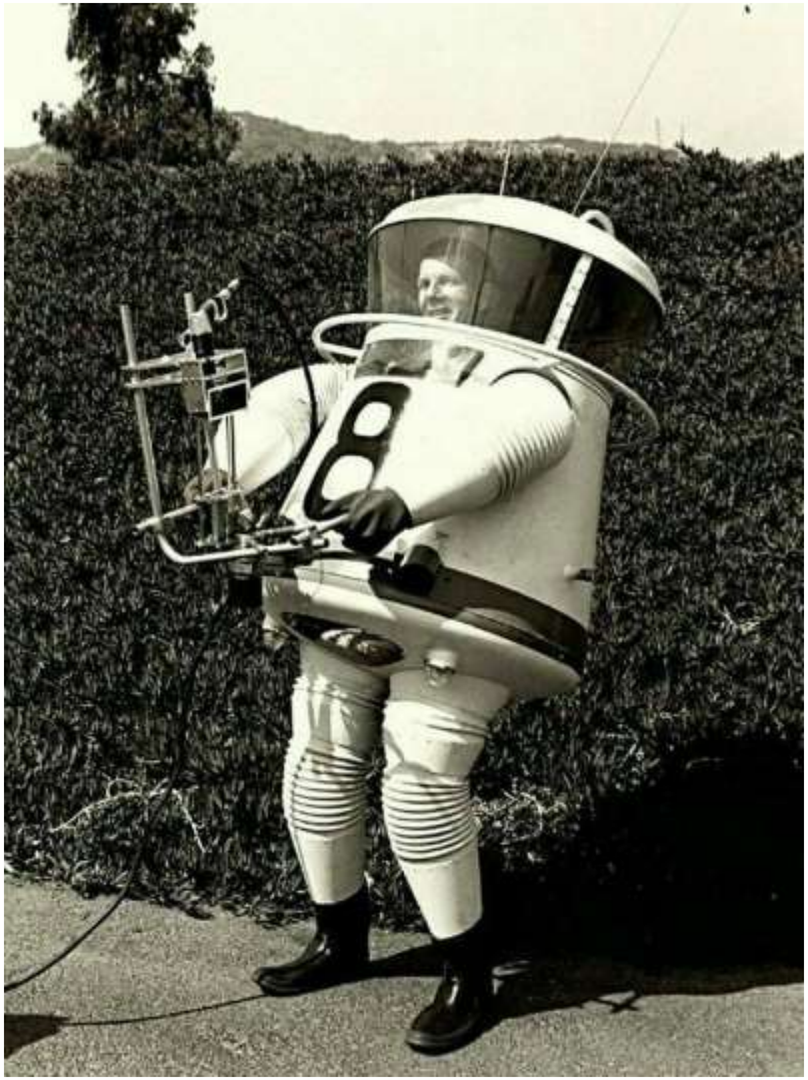


John Glenn (20 Febrero 1962)

HITOS ("Médicos") DE LA CARRERA ESPACIAL

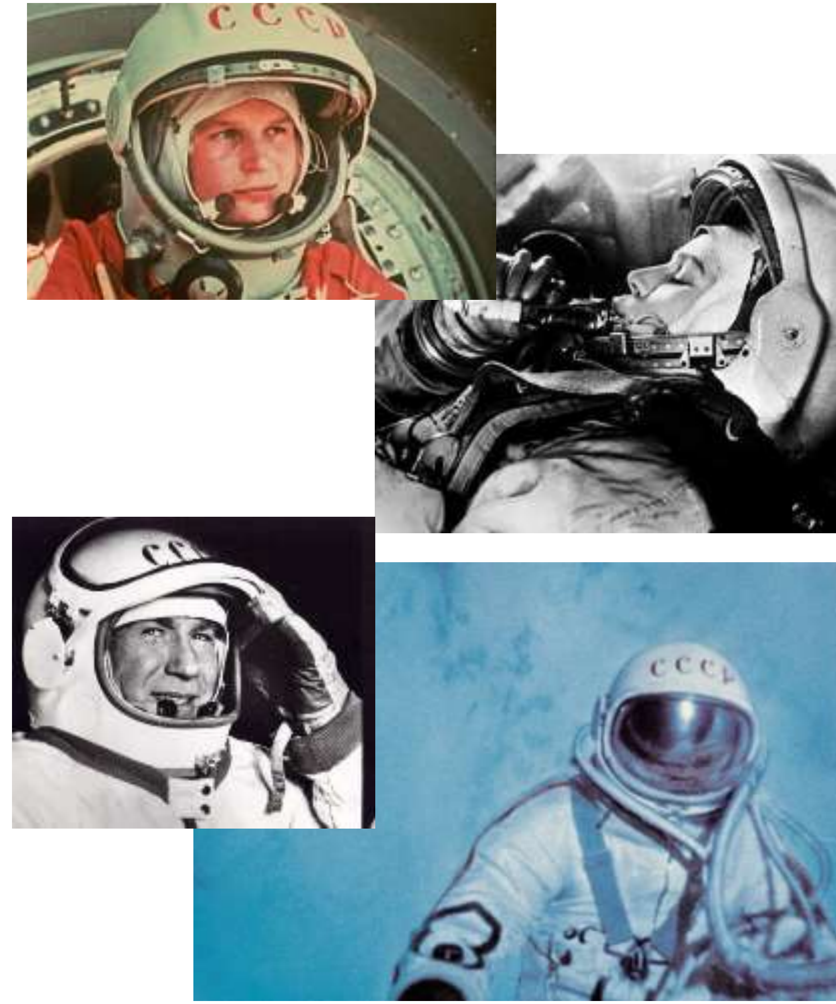
Emilio Herrera Linares, 1935

El ingeniero de la NASA Allyn B. Hazard, 1959



HITOS (“Médicos”) DE LA CARRERA ESPACIAL

- **Vostok 6**: 19 de junio de 1963:
  - Valentina Tereshkova, la **primera mujer en el espacio** (3 días).
  - Los trajes típicos de los cosmonautas soviéticos tuvieron que ser modificados para adaptarse a la fisionomía femenina.
  - El objetivo de la misión, además de encontrar posibles diferencias entre el comportamiento de los organismos de hombres y mujeres, fue el refinar el problema de la alimentación de la tripulación de las misiones espaciales.
- **Vosjod 2:** 18 de marzo de 1965:
  - Alekséi Leónov realiza el **primer paseo espacial** de la historia de la humanidad (12 minutos)
  - La misión estuvo plagada de problemas relacionados con el sellado de la nave después del paseo espacial y con el tren de aterrizaje.
  - Ambos tripulantes tuvieron que pasar dos días sobreviviendo en medio de los Urales



El primer paseo espacial EEUU fue realizado el 3 de junio de 1965 por Edward White

HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Soyuz 1**:
  - Primer vuelo tripulado de una nueva serie de naves espaciales de la Unión Soviética.
  - Lanzada el 23 de abril de 1967 con un único tripulante, el coronel Vladímir Mijáilovich Komarov, que murió cuando la nave se estrelló en su regreso a la Tierra.
  - **Primer accidente mortal en vuelo de la historia de los vuelos espaciales**.

HITOS (“Médicos”) DE LA CARRERA ESPACIAL

- **Programa APOLO: Apolo 1:**
  - Un incendio en la cápsula espacial durante una simulación de lanzamiento costó la vida a los astronautas Gus Grissom, Ed White y Roger Chaffee el 27 de enero de 1967.
  - Debido a la atmósfera presurizada de oxígeno puro, el fuego se extendió muy rápidamente, casi de forma explosiva, y mató a los astronautas en solo 17 segundos.
  - La falta de un sistema de escape de emergencia en la escotilla de la cápsula contribuyó en parte al desastre.
  - Tras este suceso, la NASA tuvo que rediseñar casi por completo la nave Apolo antes de poder garantizar su uso para misiones tripuladas.


HARD HAT
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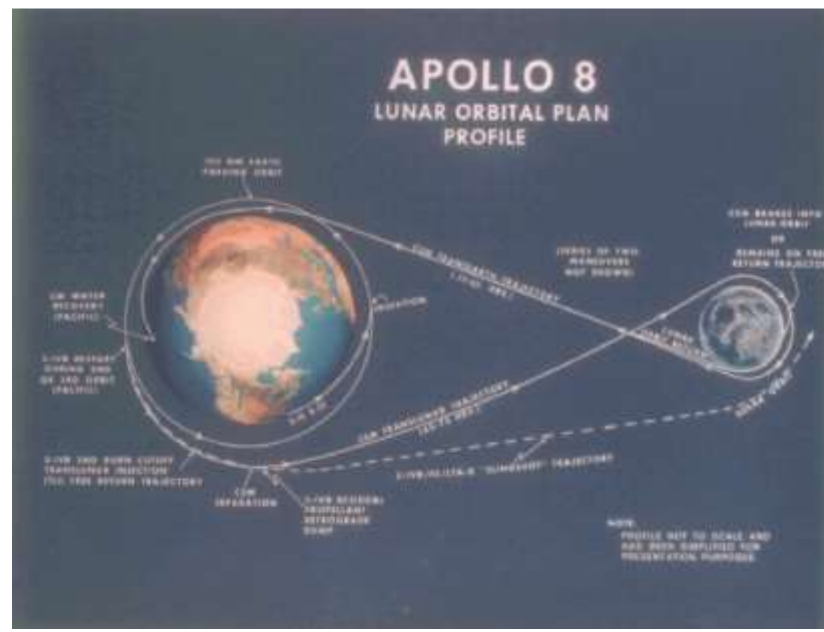
UNITED STATES

HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Apolo 8:** El 21 de diciembre de 1968. EEUU pone en órbita a los astronautas Bill Anders, Jim Lovell y Frank Borman:
  - Primera tripulada en alcanzar la velocidad necesaria para escapar de la gravedad terrestre, consiguiendo ser los **primeros humanos en orbitar alrededor de la Luna**, el 24 de diciembre de 1968
  - Fueron los primeros hombres que vieron la cara oculta de la Luna, así como los primeros en ver la Tierra mientras orbitaban alrededor de otro cuerpo celestre.



HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Apolo 11:** El 16 de julio de 1969, EEUU lanza la misión con el objetivo de poner al hombre en la Luna por primera vez en la historia de la humanidad.
  - La tripulación de la misión estaba compuesta por Neil Armstrong, Ewing Aldrin y Michael Collins.
  - Cuatro días más tarde, el módulo lunar Eagle alunizaba en el Mar de la Tranquilidad
  - El **21 de julio de 1969**, seis horas y media después de haber alunizado, **Neil Armstrong se convirtió en el primer ser humano en pisar la superficie lunar.**
  - Poco después Ewing Aldrin se convertiría en el segundo hombre en pisar la Luna, siendo Michael Collins el único que se mantuvo en órbita.


NAVY
60


UNITED
STATES

HITOS (“Médicos”) DE LA CARRERA ESPACIAL

- **Apolo 13:**
  - Séptima misión tripulada del Programa Apolo y la tercera con el objetivo de alunizar.
  - Lanzada el 11 de abril de 1970.
  - El alunizaje fue abortado debido a la explosión de un tanque de oxígeno dos días después del despegue, inhabilitando el módulo de servicio, del cual dependía el módulo de mando, usando el módulo lunar como bote salvavidas.
  - A pesar de los apuros causados por la energía limitada, la pérdida de calor en la cabina, falta de agua potable (por congelación) y la crítica necesidad de reparar el sistema de depuración de dióxido de carbono, la tripulación pudo regresar a salvo a la Tierra el 17 de abril.


LA VANGUARDIA
ESPAÑOLA

"Apolo XIII": FELIZ FIN DE LA AVENTURA

HITOS ("Médicos") DE LA CARRERA ESPACIAL

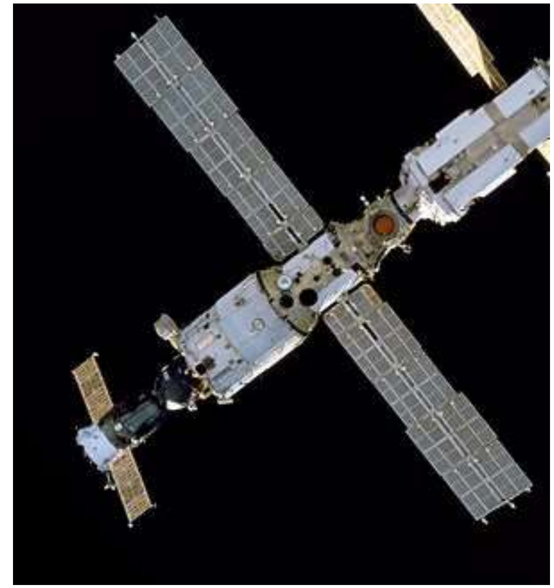
- **19 abril 1971– Salyut 1: Primera estación espacial soviética**
  - A 200 km
  - 175 días en órbita: el 11 de octubre fue destruida por una reentrada controlada en la atmósfera al tener casi agotado el combustible para poder mantener la altura.
  - Visitada por las misiones tripuladas:
    - Soyuz 10: el acoplamiento falló lo que hizo abortar la misión a la tripulación que no pudo acceder al interior.
    - Soyuz 11: fue la primera misión espacial tripulada en habitar una estación espacial. Estableció un nuevo récord de permanencia en el espacio. Sin embargo, los miembros de la tripulación murieron al regresar a la Tierra. El accidente causó un retraso de dos años en el programa espacial tripulado soviético, obligó a rediseñar la nave Soyuz y a abandonar prematuramente la Salyut 1.

HITOS ("Médicos") DE LA CARRERA ESPACIAL

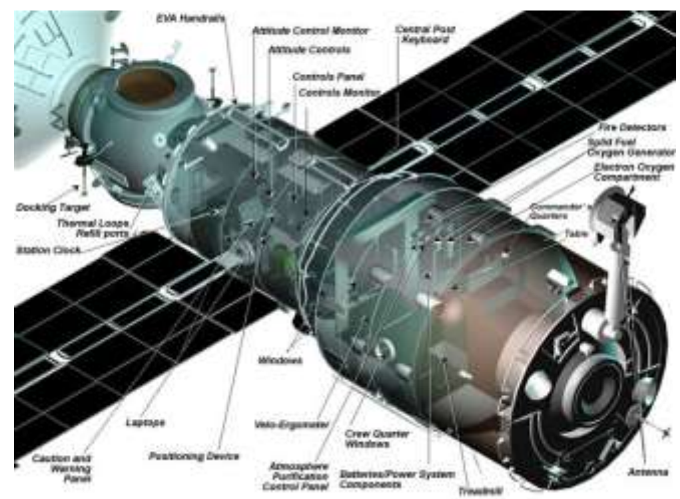
- **Soyuz 11**
  - La tripulación de la Soyuz 11 -formada por Viktor Patsáyev, Vladislav Vólkov y Gueorgui Dobrovolski- realizaron experimentos durante 23 días (crecimiento de las plantas en el espacio o pruebas médicas sobre sí mismos).
  - La estancia se vio salpicada por diversos incidentes (avería del telescopio principal, un incendio que estuvo a punto de provocar una evacuación de emergencia y fuertes fricciones entre dos de los tripulantes) que motivaron el regreso anticipado de la tripulación.
  - El 30 de julio, justo antes de la reentrada de la Soyuz 11 con la tripulación de vuelta a Tierra, una válvula falló accidentalmente provocando la despresurización de la nave. Los tripulantes fallecieron.
    - Después del accidente la necesidad de rediseñar las naves Soyuz con el fin de incorporar los trajes espaciales durante su uso para aumentar la seguridad impidió que nuevas misiones tripuladas pudieran llegar a la estación Salyut 1.

HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Salyut 1:**
- Fue la primera misión del programa Salyut que continuó con cinco lanzamientos exitosos y dos fracasos de un total de siete estaciones construidas y lanzadas al espacio.
- El módulo final del programa, Zvezda (DOS-8) se convirtió en el núcleo del segmento ruso de la Estación Espacial Internacional instalado desde el año 2000.
  - proporciona algunos de los sistemas de soporte vital de la estación, así como alojamiento para dos tripulantes

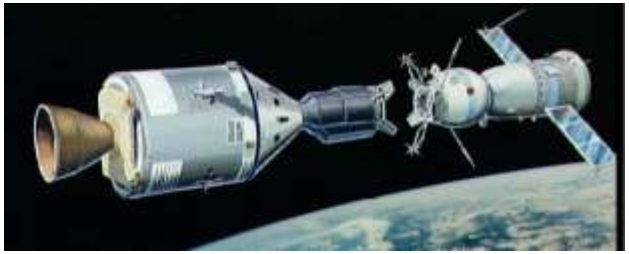


La tripulación de la Expedición 43 celebra un cumpleaños en el módulo Zvezda, 2015



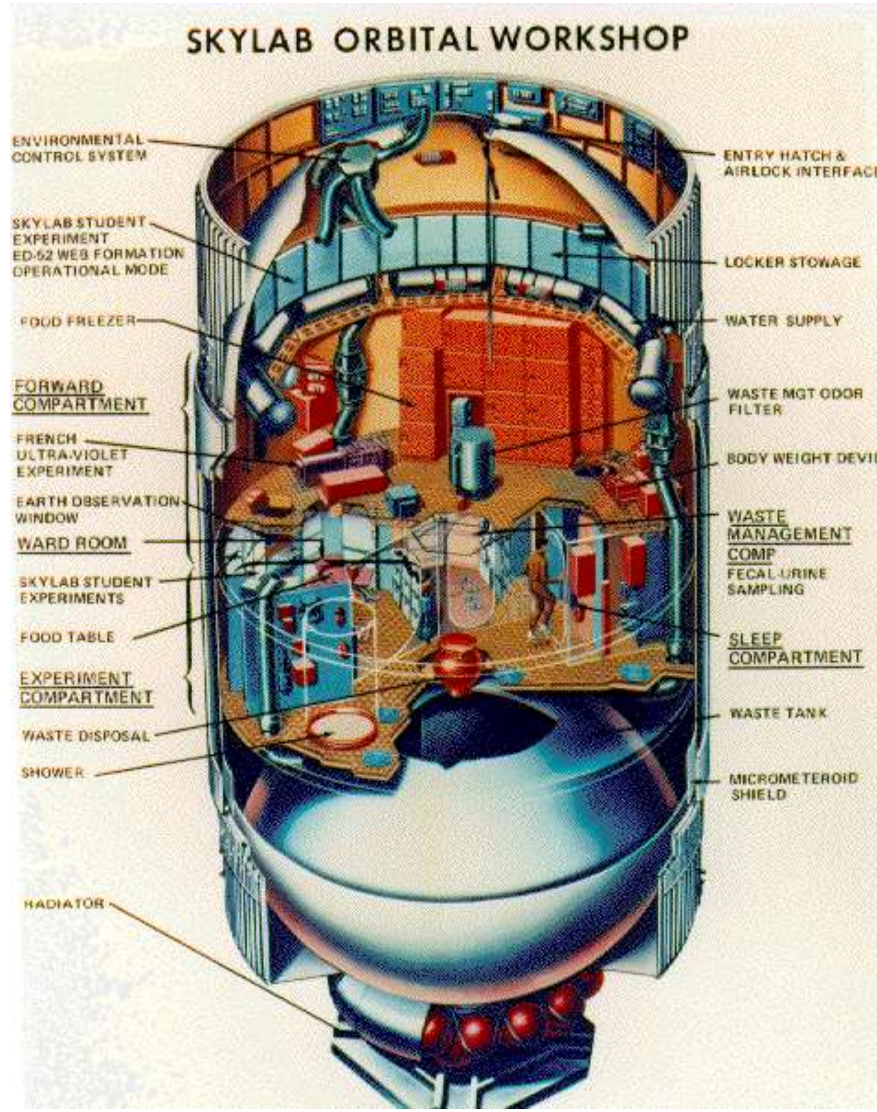
HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Apolo-Soyuz:** el primer proyecto conjunto entre EE.UU. y U.R.S.S.
  - Primera misión conjunta de las dos grandes potencias enfrentadas en la Guerra Fría: consistió en el acoplamiento en el espacio de una nave soviética, la Soyuz 19, y una nave USA, la Apolo 18
  - La tripulación estadounidense estuvo formada por Thomas Stafford, Vance Brand y Deke Slayton, mientras que la tripulación soviética estuvo formada por Alekséi Leónov y Valeri Kubasov.
  - Ambas naves fueron lanzadas con tan sólo 7 horas de diferencia el **14 de julio de 1975**, teniendo el acoplamiento lugar dos días más tarde.



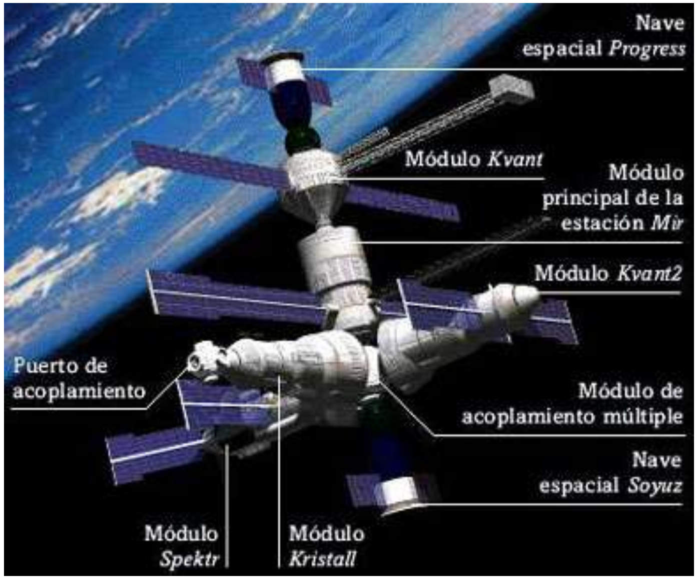
HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Skylab: primera estación espacial estadounidense**.
  - Orbitó alrededor de la Tierra de **1973 a 1979** y fue visitada por astronautas en tres ocasiones durante sus dos primeros años de servicio.
  - La primera tripulación realizó tareas de reparación profundas en un paseo espacial y permaneció **28 días** en la estación.
  - Las siguientes misiones comenzaron el 28 de julio de 1973 y el 16 de noviembre de 1973 y duraron **59 y 84 días** respectivamente.



HITOS ("Médicos") DE LA CARRERA ESPACIAL

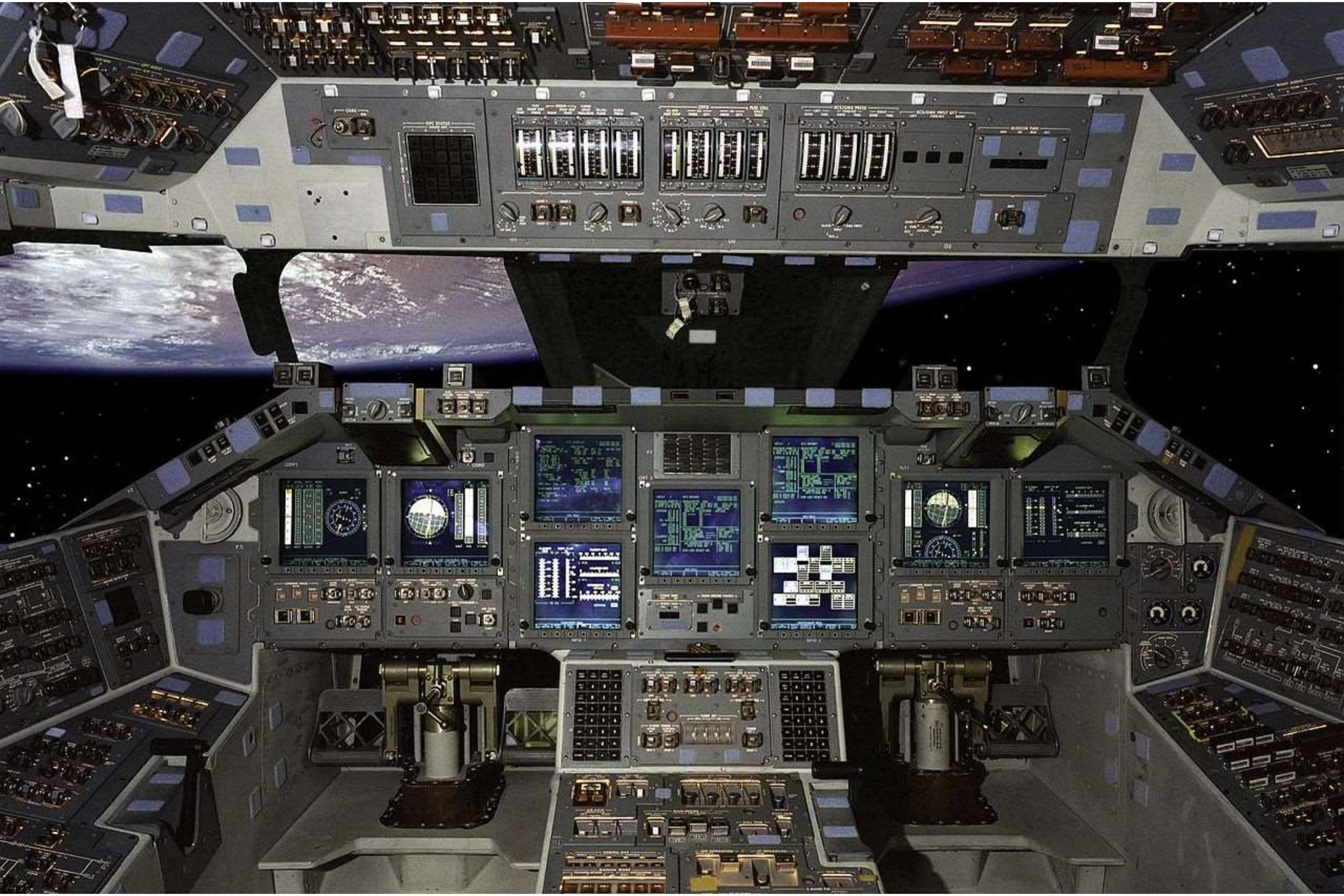
- **MIR:**
  - Estación espacial originalmente soviética, que después del colapso de la URSS pasó a ser rusa.
  - La primera estación espacial de investigación habitada de forma permanente de la historia, y la culminación del programa espacial soviético.
  - Estaba prevista para que estuviera funcionando durante tan sólo 5 años; lo hizo durante 13 años **(1986-2001)**
  - A través de numerosas colaboraciones internacionales, fue accesible a cosmonautas y astronautas.
  - Se batieron records de permanencia



HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Transbordador STS: Space-Shuttle o *Space Transport System*:**
  - Primera nave espacial reutilizable y la primera capaz de poner satélites en órbita, y traerlos de vuelta a la superficie.
  - Cada transbordador tenía una vida útil proyectada de 100 lanzamientos.
  - La flota de transbordadores espaciales, junto con los vehículos soviéticos, fueron los encargados de elevar los distintos módulos de la Estación Espacial Internacional, así como de la provisión regular de suministros (hasta 2011).

2003 1986



HITOS ("Médicos") DE LA CARRERA ESPACIAL

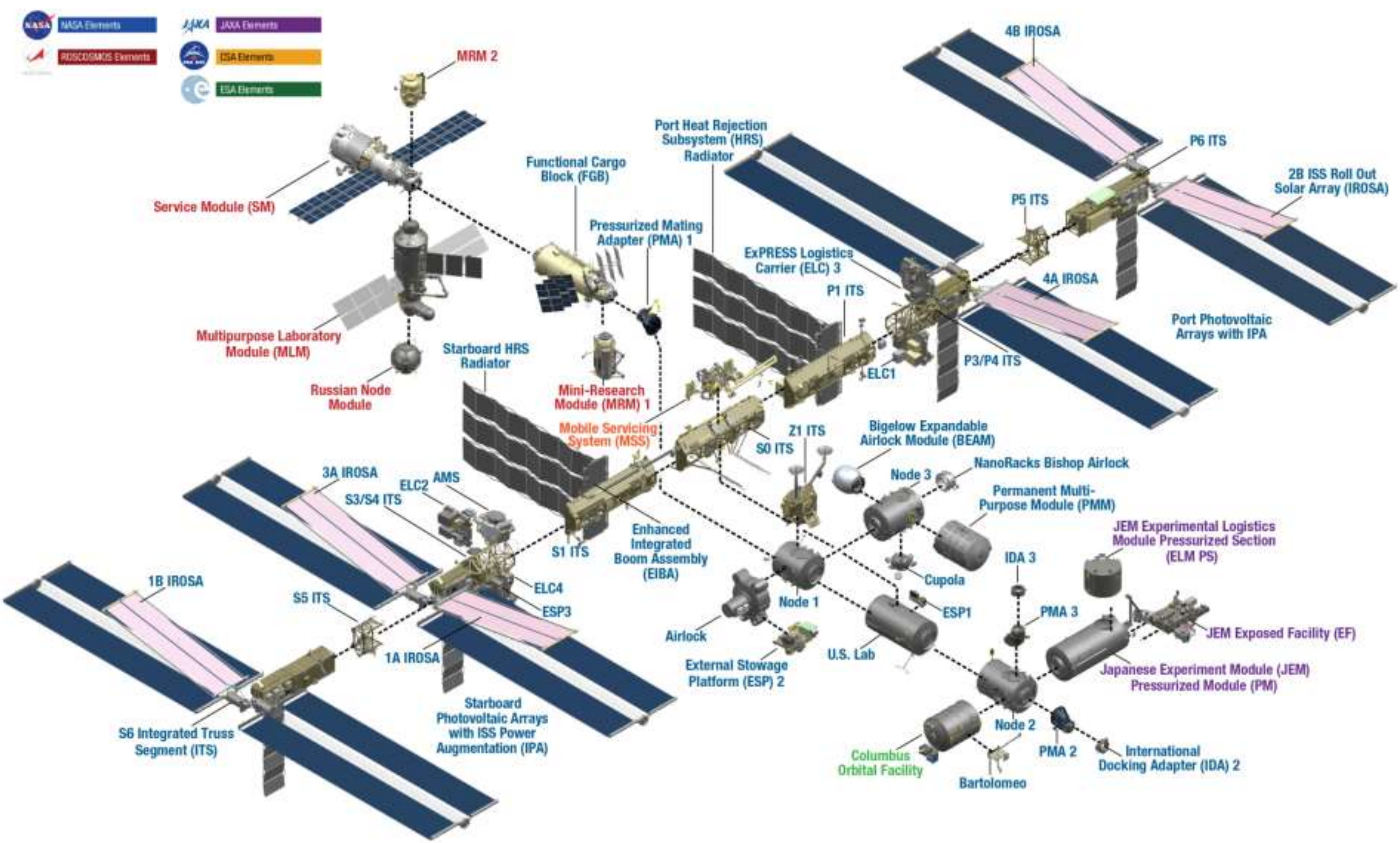
Altitud: 370-460 Km
Velocidad orbital: 27 600 km/h
Período orbital: 90 min
Órbitas por día: 16
Área paneles solares: 2,247 m2
Masa superior a 400,000 kg

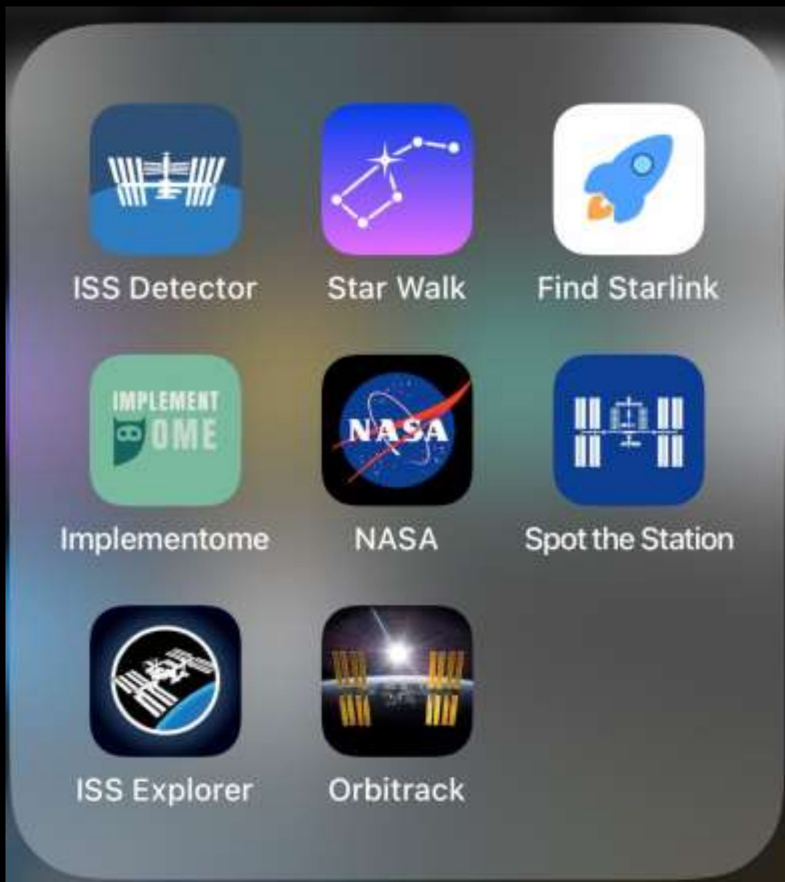
HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Estación Espacial Internacional (ISS):**
  - Estación espacial permanentemente tripulada, en la que rotan equipos de astronautas e investigadores de las cinco agencias del espacio participantes: la Agencia Administración Nacional de la Aeronáutica y del Espacio (NASA), la Agencia Espacial Federal Rusa (FKA), la Agencia Japonesa de Exploración Espacial (JAXA), la Agencia Espacial Canadiense (CSA) y la Agencia Espacial Europea (ESA).
  - Centro de investigación internacional, en construcción desde 1998.
  - El 2 de Noviembre se cumplieron 24 años de la presencia humana permanente en el espacio a bordo de la ISS.
    - Desde el 2 de Noviembre del año 2000 ha habido siempre por lo menos dos personas a bordo del complejo orbital.
    - Records permanencia: Frank Rubio 371 días consecutivos y Peggy Whitson 665 días acumulados.
  - Ha sido visitada por más de 270 astronautas de 21 países y ha sido también el destino de los primeros turistas espaciales.
  - Se han realizado más de 260 paseos espaciales y más de 3000 experimentos científicos.
  - Se prevé extender su vida hasta 2030.

https://youtu.be/0JU4z-iLmGQ

International Space Station - NASA




ISS Detector
Star Walk
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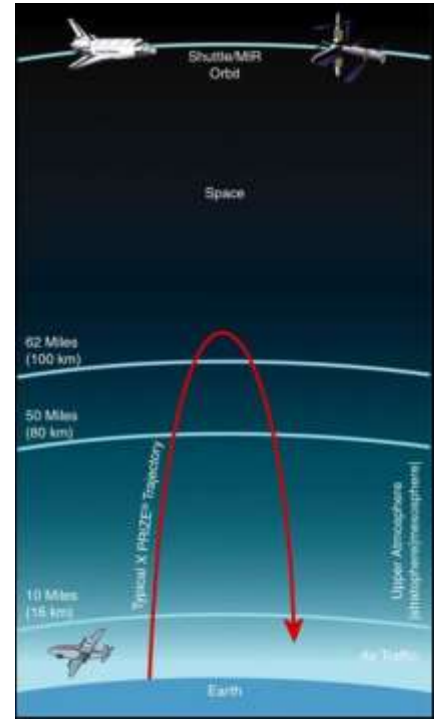
NASA
Spot the Station
ISS Explorer
Orbitrack


AMAZON ORIGINAL
A MILLONES
DE KILÓMETROS
NASA

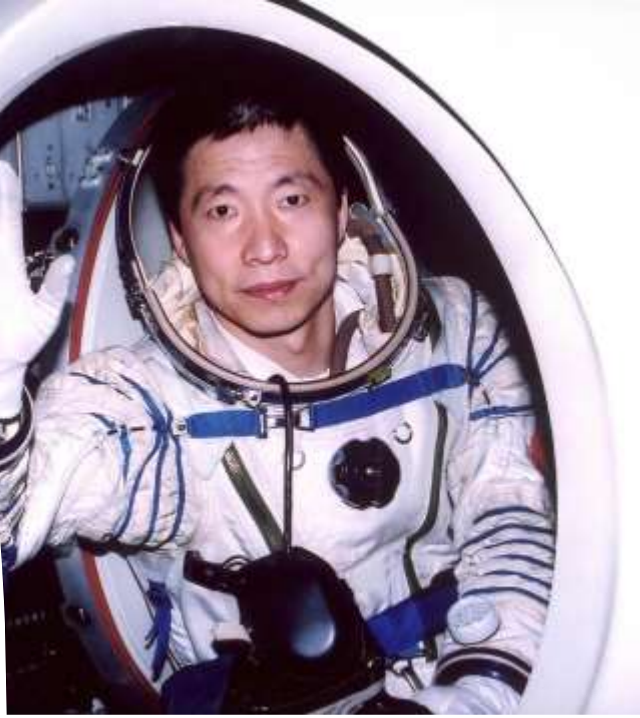
HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **El "TURISMO ESPACIAL":**
  - *"…any commercial activity offering customers direct or indirect experience with space travel"*
    - S. Hobe and J. Cloppenburg "Towards a new aerospace convention? – Selected Legal issues of Space Tourism", published by the American Institute of Aeronautics and Astronautics (AIAA)
  - Se ha definido como una modalidad de turismo que se realiza a más de 100 km de altura de la Tierra (**línea de Kármán)**, lo que se considera la "frontera del espacio".
  - El primer turista espacial fue el magnate norteamericano y ex ingeniero de la NASA Dennis Tito. Entró en la ISS el 30 de abril de 2001 (20 millones de dólares).
  - "Fly at your own risk" policy vs Requirements

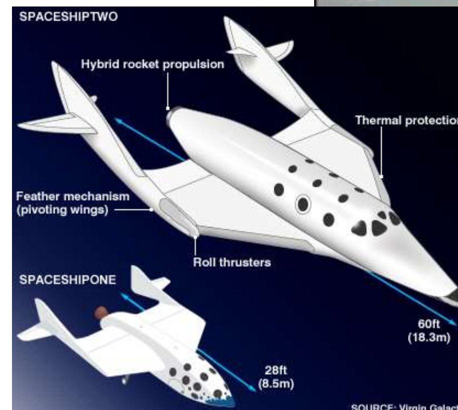


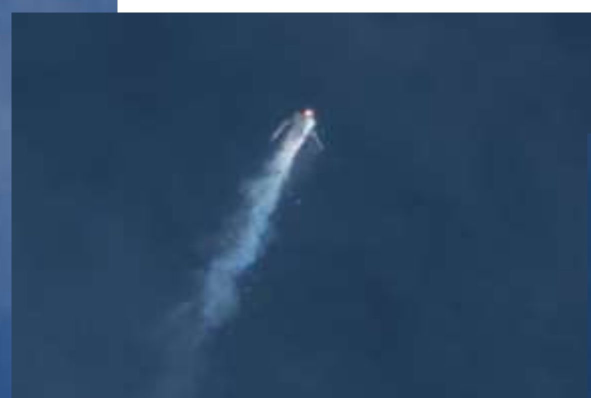
HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **China:**
- El primer taikonauta de la historia fue Yang Liwei al salir al espacio en la nave Shenzhou 5 en **octubre de 2003**



- **Virgin Galactic:**
  - Empresa de Sir Richard Branson, fundada en 2004
  - Planea proporcionar **vuelos espaciales suborbitales tripulados**, lanzamientos suborbitales para misiones científicas y lanzamientos orbitales para satélites pequeños. En el futuro planea ofrecer también vuelos orbitales.

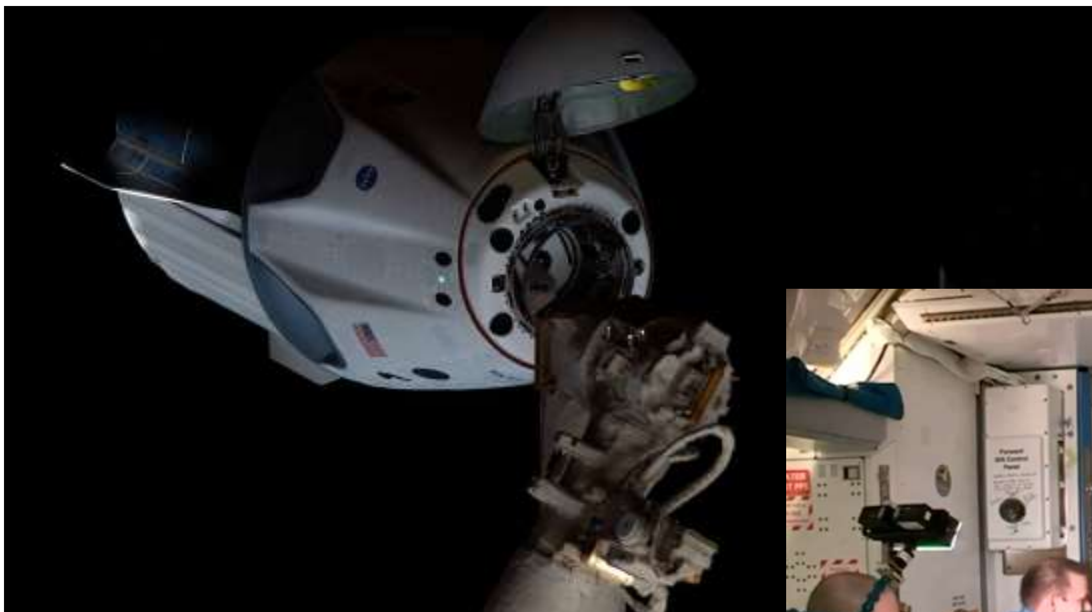




31 Oct 2014 SpaceShip Two, Mojave, CA

HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **2020** – SpaceX
  - **Primera misión tripulada privada**
  - SpaceX has been delivering cargo to and from the International Space Station since 2012, and in 2020 SpaceX began transporting people to the orbiting laboratory under NASA's Commercial Crew Program.



30 Mayo 2020

HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **China: Estación Espacial Tiangong**
- El lanzamiento del módulo central fue realizado el 29 de abril de 2021
- Entre 340 y 450 km
- Masa 100 000 kg
- Periodo orbital 92 minutos

Representación de la estación espacial Tiangong en 2023, con sus tres módulos Tianhe, Mengtian y Wentian, más dos naves Shenzhou acopladas en el frontal y nadir y una nave de carga Tianzhou en el p. trasero.

HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **20 Julio 2021– Blue Origin NS-16**
  - **Primer vuelo de turismo espacial privado (4 pax)**
  - Suborbital (107 Km)
  - 10 minutes, 18 seconds
- Posteriormente ha habido más vuelos similares:
  - NS-18: 13 October 2021
  - NS-19: 11 December 2021
  - NS-20: 31 March 2022
  - NS-21: 4 June 2022
  - NS-22: 4 August 2022

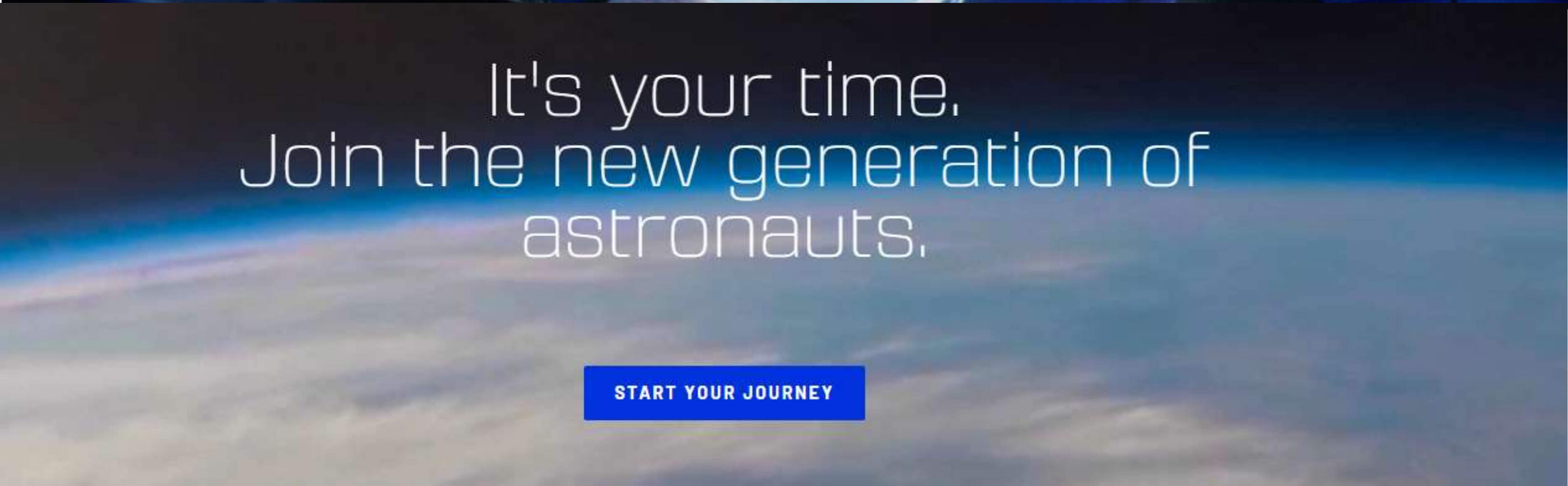
HITOS ("Médicos") DE LA CARRERA ESPACIAL

- **Virgin Galactic**
- Galactic 01- **29 junio 2023**
- Primer vuelos turismo espacial privado
- Suborbital: 13:50 min; 85.1 km

Han realizado otros vuelos:

- Galactic 02: 10 August 2023
- Galactic 03: 8 September 2023
- Galactic 04: 6 October 2023
- Galactico 05: 2 November 2023

[Home | Blue Origin]



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SPACEFLIGHT EXPERIENCE

GO BEYOND ZERO-GRAVITY

What are the pre-flight fitness requirements?

×

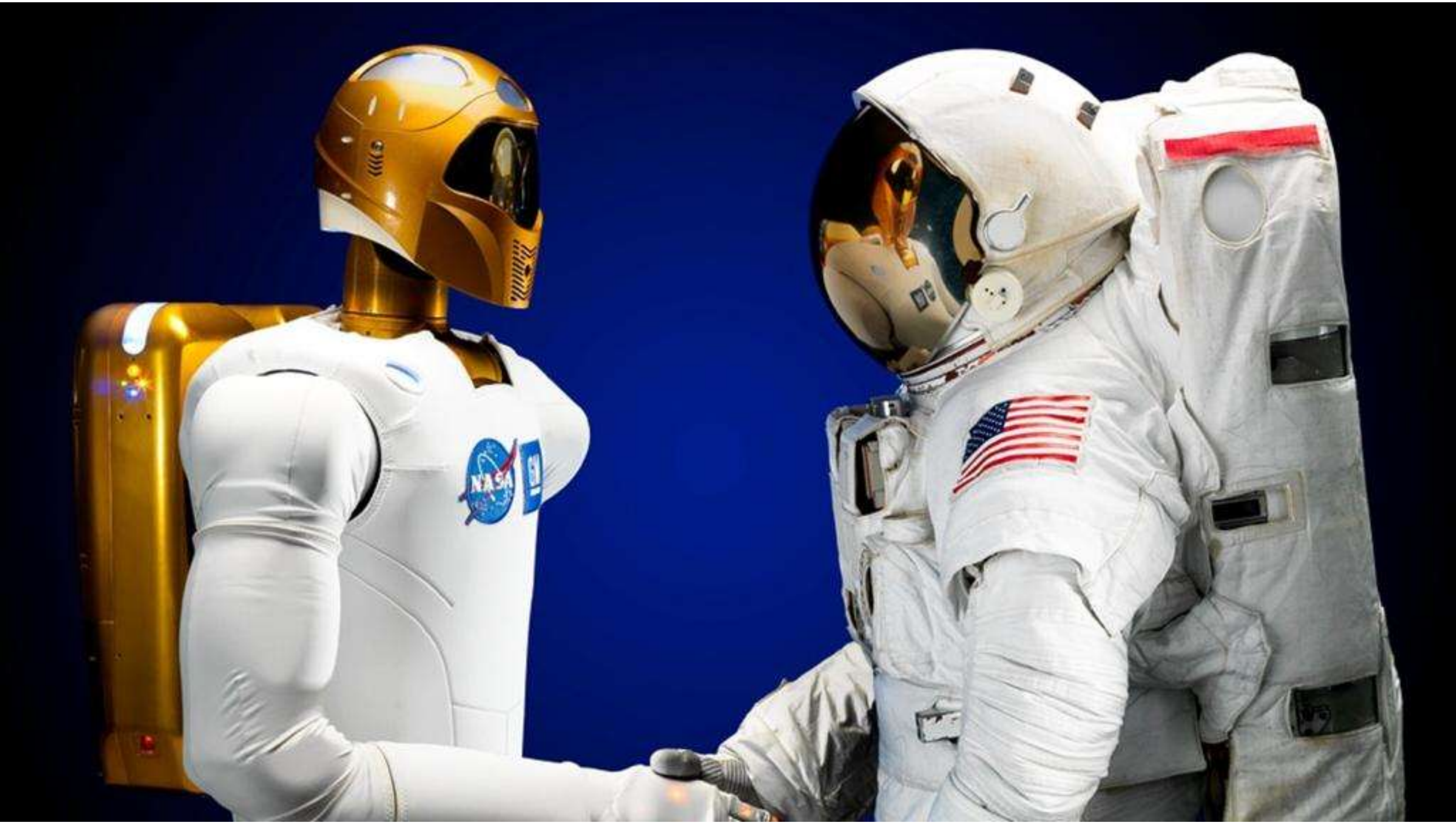
Completion of a traditional fitness test is not required, but the flight is a relatively intense sensory and physical experience. If you are able-bodied and cleared by a medical practitioner, you should be able to enjoy both your training and your spaceflight. However, like many things in life, being in the best possible shape is likely to enhance your experience, and we will align with you on your personal goals during your spaceflight readiness program.

Polaris Dawn crew conduct first commercial spacewalk

written by William Graham | September 11, 2024

Two days into their mission, the Polaris Dawn crew conducted the highlight of their mission on Thursday, with Jared Isaacman and Sarah Gillis stepping outside Dragon *Resilience* for the first EVA by commercial astronauts. The spacewalk marks another milestone in the development of the commercial space industry.

REQUISITOS MÉDICOS PARA VIAJAR AL ESPACIO (COMO TURISTA)



[Human Space Flight | Federal Aviation Administration (faa.gov)]

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Airspace Integration
Stakeholder Engagement
Compliance, Enforcement & Mishap
Commercial Human Spaceflight
Careers
Additional Information

Human Space Flight

Human space flight is changing. What once was an exclusive government-led activity is now open to commercial space operators and private individuals.

Image provided by SpaceX

The FAA's safety oversight responsibilities are designed to protect the safety of the public on the ground and others using the National Airspace System. Congress has both given and restricted the FAA's authority.

The FAA issues commercial space licenses, verifies launch or reentry vehicles meant to carry humans operate as intended and provides regulation of flight crew qualifications and training. The FAA also performs safety inspections and safely integrates commercial space operations into the National Airspace System.

However, Congress has limited the FAA's authority in specific ways. Under federal law, the FAA is prohibited from regulating the safety of individuals on board. This legislative "moratorium", originally established in 2004, and extended four times by Congress, will now expire January 1, 2024.

In April 2023, the FAA established an Aerospace Rulemaking Committee (SpARC) to collaborate with industry on the development and cost of possible future regulations for commercial human space flight occupant safety. This safety focused SpARC is expected to submit a recommendation report in the summer of 2024.

[“Doctor, Doctor, Can I Go?” Medical Rules, Standards, and Guidelines for Suborbital Space – (spacesafetymagazine.com)]

ELSEVIER

Acta Astronautica

Volume 187, October 2021, Pages 529-536

Medical guidelines for suborbital commercial human spaceflight: A review

G. Starr Schroeder, Jessica C. Clark, Dr. Michael Gallagher, Dr. Shawna Pandya

https://www.sciencedirect.com/science/article/abs/pii/S0094576521001016?via%3Dihub

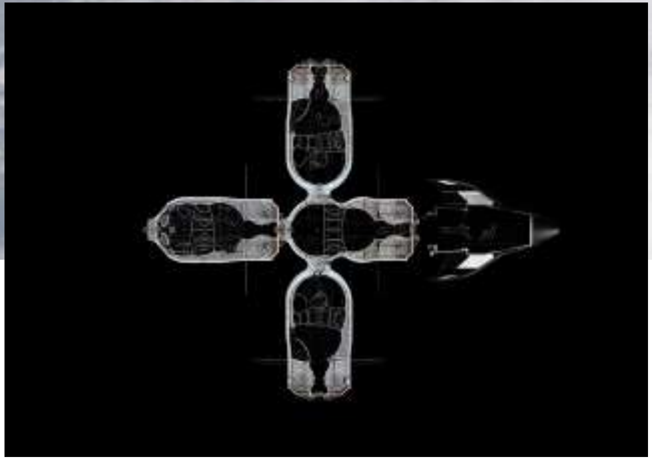
GALACTIC SUITE

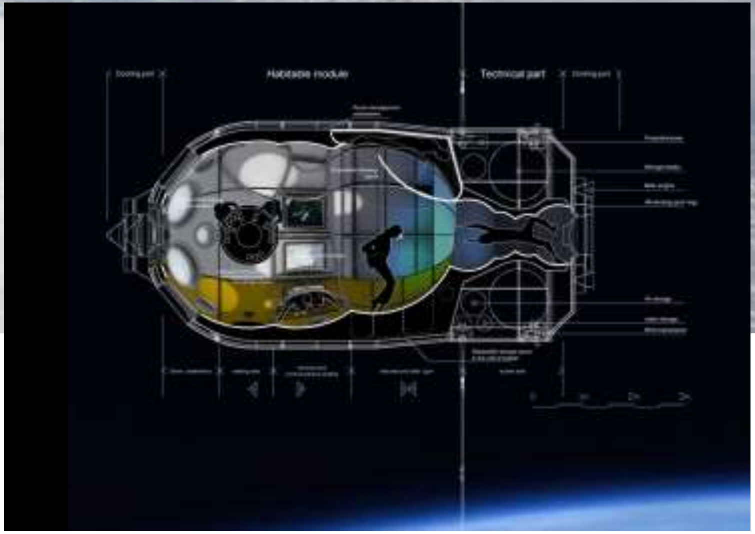
01.VISION
02.MISSION
03.EXPERIENCE
04.RESERVATIONS
05.PROJECT
06.IMAGERY
07.ABOUT
08.JOIN
09.CONTACT
10.MEDIA
11.BLOG
12.NEWS

03. EXPERIENCE

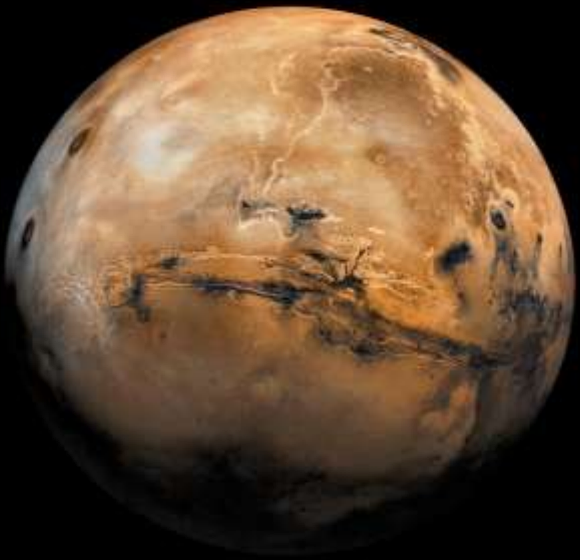
We aim to offer you the most thrilling and transcendent experience ever: an orbital stay onboard The Galactic Suite Space Resort, and become the world's next space tourist. Our SpacePort facilities will be situated in an island, and they will also provide you with a challenging and exhilarating program that will not only carry you through a briefed astronaut training process, it will be a very relaxing time in a tropical paradise island. After a few weeks of training you will be

2022 - galacticsuite



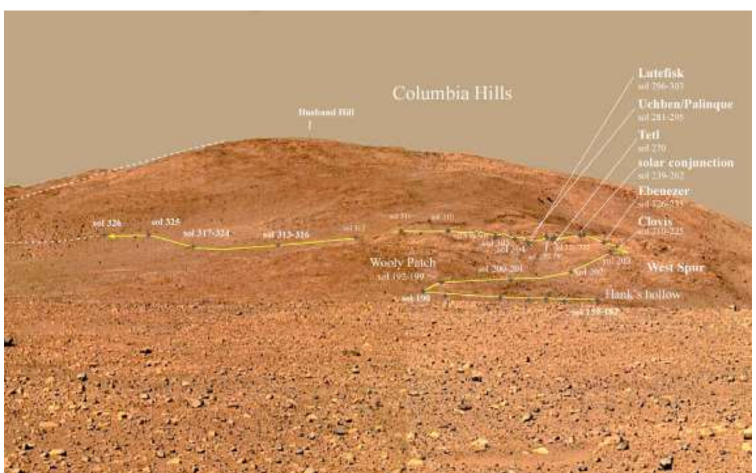


Marte

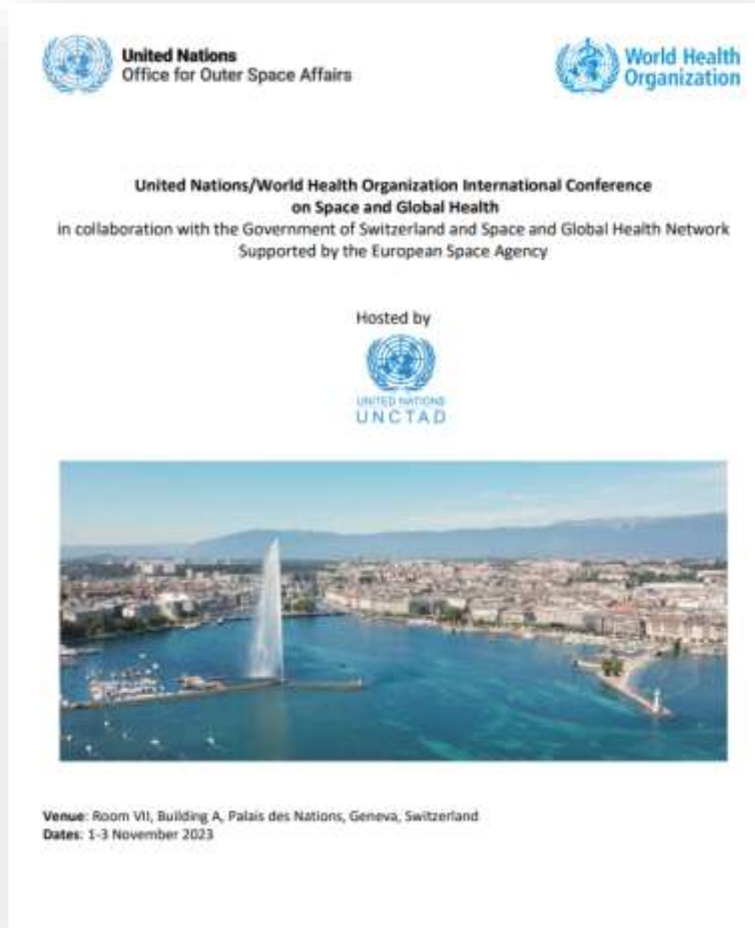


Marte

The Martian
20th Century Studios



Medicina Espacial y Salud Global



United Nations
Office for Outer Space Affairs

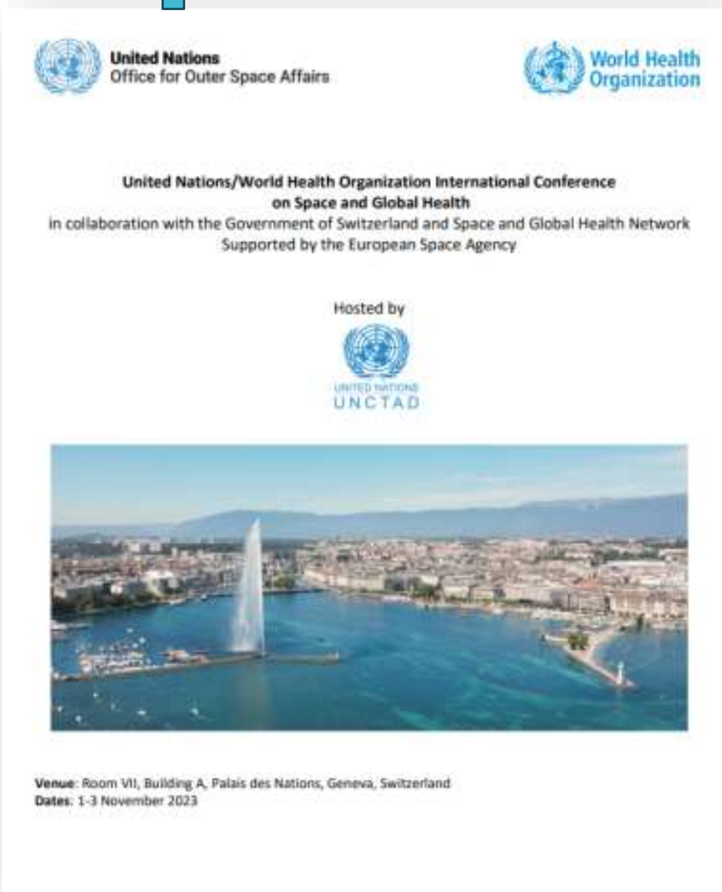
World Health Organization

United Nations/World Health Organization International Conference on Space and Global Health
in collaboration with the Government of Switzerland and Space and Global Health Network
Supported by the European Space Agency

Hosted by

UNITED NATIONS
UNCTAD

Venue: Room VII, Building A, Palais des Nations, Geneva, Switzerland
Dates: 1-3 November 2023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United Nations
Office for Outer Space Affairs

UNOOSA

LA OFICINA DE ASUNTOS DEL ESPACIO ULTRATERRESTRE DE LAS NACIONES UNIDAS

Medicina Espacial y Salud Global

- UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS & SPACE MEDICINE

UNOOSA

Se encarga de promover la cooperación internacional respecto de la utilización del espacio ultraterrestre con fines pacíficos y ayuda a todos los países a utilizar la ciencia y la tecnología espacial para lograr el desarrollo sostenible.

Cubre todos los aspectos relacionados con el espacio, desde el derecho a las aplicaciones espaciales

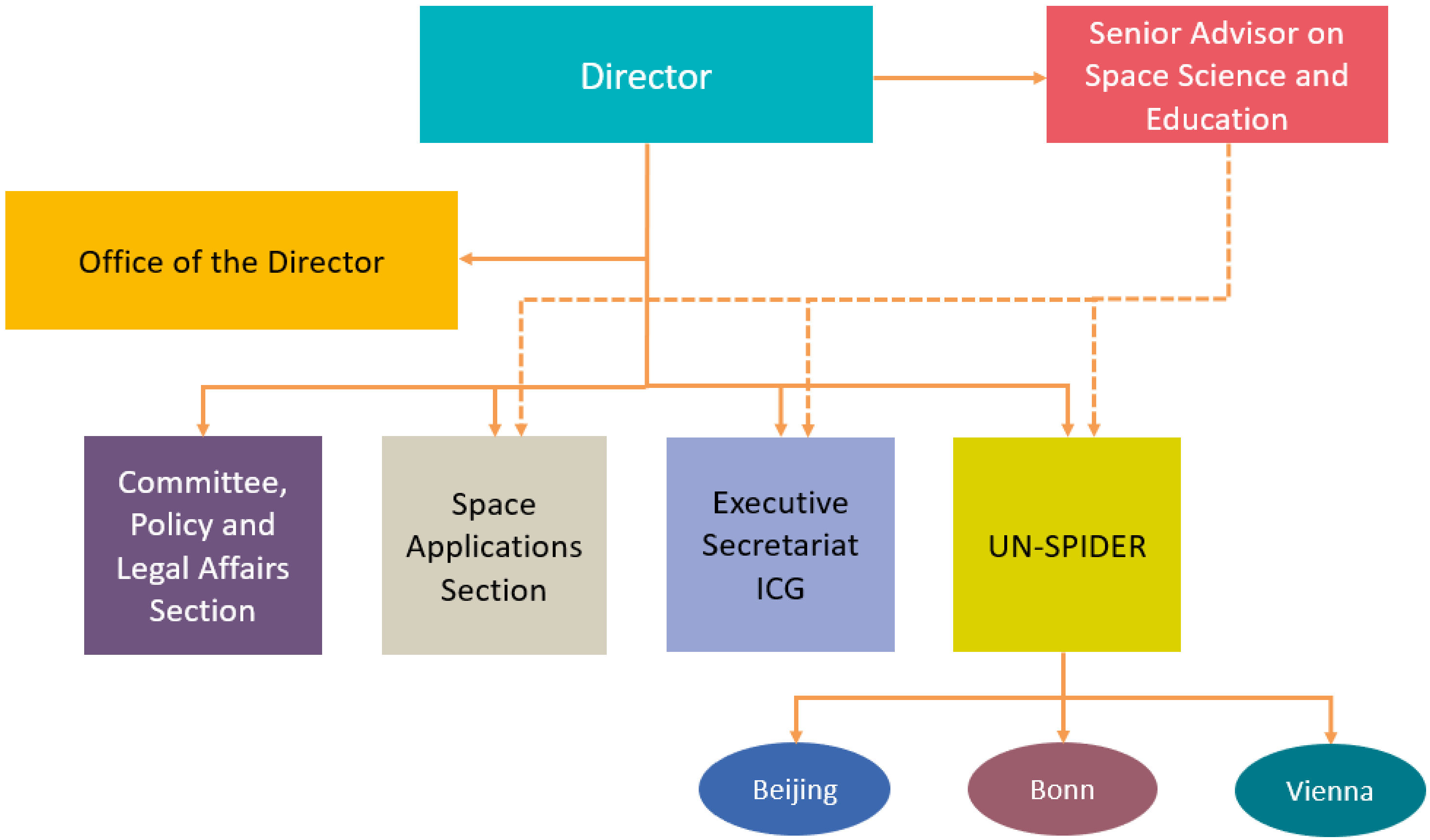
UNOOSA roles and responsibilities

- Support transparency in space activities, through measures such as the Register of Objects Launched in Outer Space, which UNOOSA maintains, and which links each object to its responsible country.
- Work not only to promote sustainable development through space but also to ensure the sustainability of outer space activities, fostering international solutions to problems such as the rapid increase in space debris, to preserve space for future generations.
- Work with space agencies and space leaders around the world to devise solutions to challenges that require an international response, such as the threat of a Near-Earth Object impact and the need to accelerate the compatibility of GNSS systems.

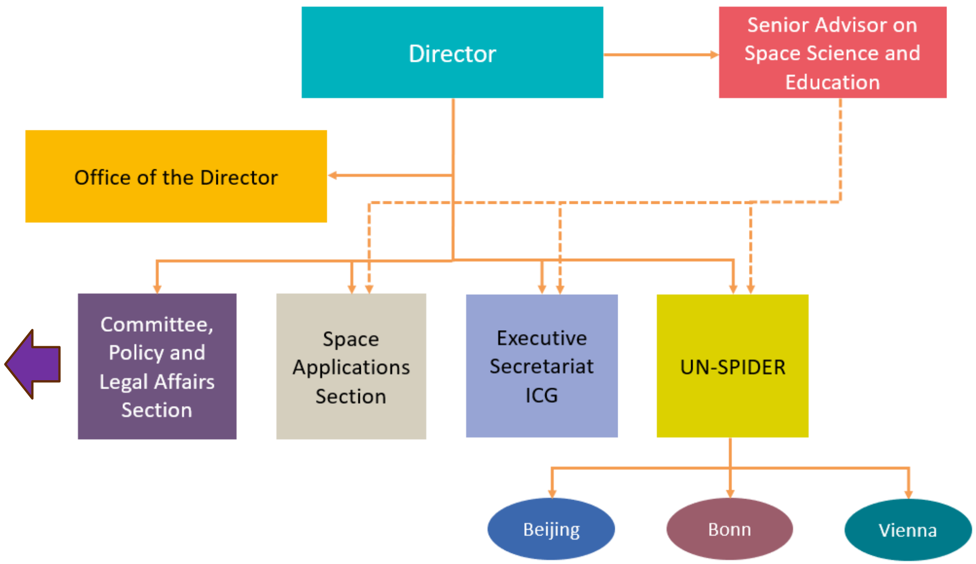
UNOOSA roles and responsibilities

- Help countries build their capacity to develop and make the most out of the space sector through a two-fold approach:
  - providing resources such as training, workshops, conferences and knowledge-sharing portals;
  - complementing these with concrete opportunities for countries to expand their space capabilities, such as fellowships and competitive programmes, some of which targeting specifically developing countries, for example under our Access to Space 4 All Initiative.
- In the area of disaster risk reduction, a dedicated programme, UN-SPIDER, helps countries use space data and technologies, such as satellite imagery, to prevent and manage disasters.
- Help countries understand the fundamentals of international space law and increase their capacity to draft or revise national space law and policy in line with international normative frameworks on space.

UNOOSA Organisational Chart



UNOOSA Organisational Chart



CPLA provides substantive, secretariat, organisational and administrative support to COPUOS, its **Scientific and Technical Subcommittee (STSC) and its Legal Subcommittee (LSC)**, both established in 1961.

The scientific and Technical Subcommittee (STSC)

Working Group on Space and Global Health

STSC meets every year to discuss questions related to the scientific and technical aspects of space activities.
Topics for discussion include space weather, near-Earth objects, the use of space technology for socioeconomic development, or for disaster management support, global navigation satellite systems, and the long-term sustainability of outer space activities.

UNITED NATIONS
Office for Outer Space Affairs

Search

STSC Working Group on Space and Global Health (unoosa.org)

Working Group on Space and Global Health

MANDATE OF THE WORKING GROUP ON SPACE AND GLOBAL HEALTH

The Committee on the Peaceful Uses of Outer Space, at its sixty-first session held from 20 to 29 June 2018, agreed to introduce a new item on Space and global health in the agenda of the Scientific and Technical Subcommittee (STSC), and also agreed that a working group, established under that agenda item, should be convened at the fifty-sixth session of the Subcommittee in 2019, with **Antoine Geissbühler (Switzerland)** as Chair. The Committee further agreed that the Chair of the newly established working group, together with the Secretariat, would present to the fifty-sixth session of the Subcommittee, a proposal for a multi-year workplan for that working group, taking into account the role of the Expert Group on Space and Global Health.

▼ OUTCOMES OF THE WORK OF THE WORKING GROUP

- **Final Report of the Working Group**

Symbol	Year	Title	Available languages
A/AC.105/C.1/121	2022	Report of the Working Group on Space and Global Health on the work conducted under its multi-year workplan *Prepared by the Chair of the Working Group*	عربي 中文 English Fr ançais Русский Español

- **General Assembly resolutions on the establishment of the SGH Platform and SGH Network and on Space and Global Health**

Symbol	Year	Title	Available languages
A/RES/77/120	2022	Space and global health	عربي 中文 English Français Русский Español
A/RES/77/121	2022	International cooperation in the peaceful uses of outer space	عربي 中文 English Français Русский Español

Our Work
Secretariat of COPUOS
Committee and its Subcommittees
COPUOS 2023 Session
STSC 2024 Session
LSC 2024 Session
Past sessions
Working Groups
General Assembly Joint Panel
History
Member States and Observer Organizations
Meetings Schedule
Documents
Programme on Space Applications
UN-SPIDER
International Committee on GNSS
UN-Space
Space Law
Moon, Mars and Beyond
Benefits of Space
Access to Space for All
Space Law for New Space Actors
Space for Persons with Disabilities

Working Group on Space and Global Health

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- ► OUTCOMES OF THE WORK OF THE WORKING GROUP
- ► Multi-year workplan of the Working Group (2019-2022)
- ► 2022 Meeting of the Working Group on Space and Global Health
- ► Intersessional meeting of the Working Group, 1 December 2021
- ► Workshop on knowledge management and sharing, 15 June 2021
- ► 2021 Meeting of the Working Group on Space and Global Health
- ► National points of Contacts
- ► Questionnaire on the use of space science and technology for global health
- ► Informal online meeting of the Space and Global Health Working Group on COVID-19
- ► 2020 Meeting of the Working Group on Space and Global Health
- ► 2019 Meeting of the Working Group on Space and Global Health
- ► Health as UNISPACE+50 Thematic Priority (2018)
- ► STSC Expert Group on Space and Global Health (2015-2018)
- ► Action Team 6 Follow-up Initiative (AT6-FUI) (2011-2014)
- ► UNISPACE III Action Team on Public Health (2001-2011)

BACKGROUND DOCUMENTS:

Report of the Working Group on Space and Global Health on the work conducted under its multi-year workplan

Annex I

Relationship between space activities and global health applications at a glance

		Individual health	*Individuals and communities*		*Population health*	
Key health activities		Medical practice	Health services	Medical research	Prevention and control of infectious and chronic diseases	Global health security
Key space activities		Telemedicine	Telehealth	Health sciences	Tele-epidemiology	Disaster management
Satellite activities	**Telecommunications**	• Specialist • Second opinion • Remote monitoring • Tele-diagnostics • Tele-consultation • Peer-to-peer • Telerobotics	• Professional training • Community health worker training • Community health education • Tele-education • Peer-to-peer training	• Knowledge transfer	• Data dissemination through centres of expertise • Water levels and waterborne diseases • Emergency communication for outbreak and pandemic management	• Flexible and deployable capacities • Strategic planning, coordination and communication among relief workers, coordination sites, experts and individuals
	Global navigation satellite systems and geographic information systems	• Routing medical emergencies	• On-site contextual information • Health services optimization		• Geographical occurrences of diseases • Location of sources of infection and pollution • Tracking animals as disease sentinels	• Detailed site information • Coordination of response worker location
	Remote sensing of the Earth and the atmosphere				• Tracking disease and risk factors • Vector-borne diseases (malaria) • Airborne disease, including as a result of dust or air pollution (e.g. asthma) • Waterborne diseases (e.g. cholera) • Food security	• Disaster mapping (before and after) • Planning and response • Emergency tele-epidemiology
Human space flight	**Space life science**			• Knowledge of the human body (e.g. ageing) • Infection prevention		
	Technology development	• Digital applications		• Point-of-care medicine		

Note: The table is not intended to be comprehensive and there may be additional contributions of space activities to global health; the table is to be completed with information from national experts.

United Nations

General Assembly

Resolution adopted by the General Assembly on 12 December 2022

77/120. Space and global health

The General Assembly,

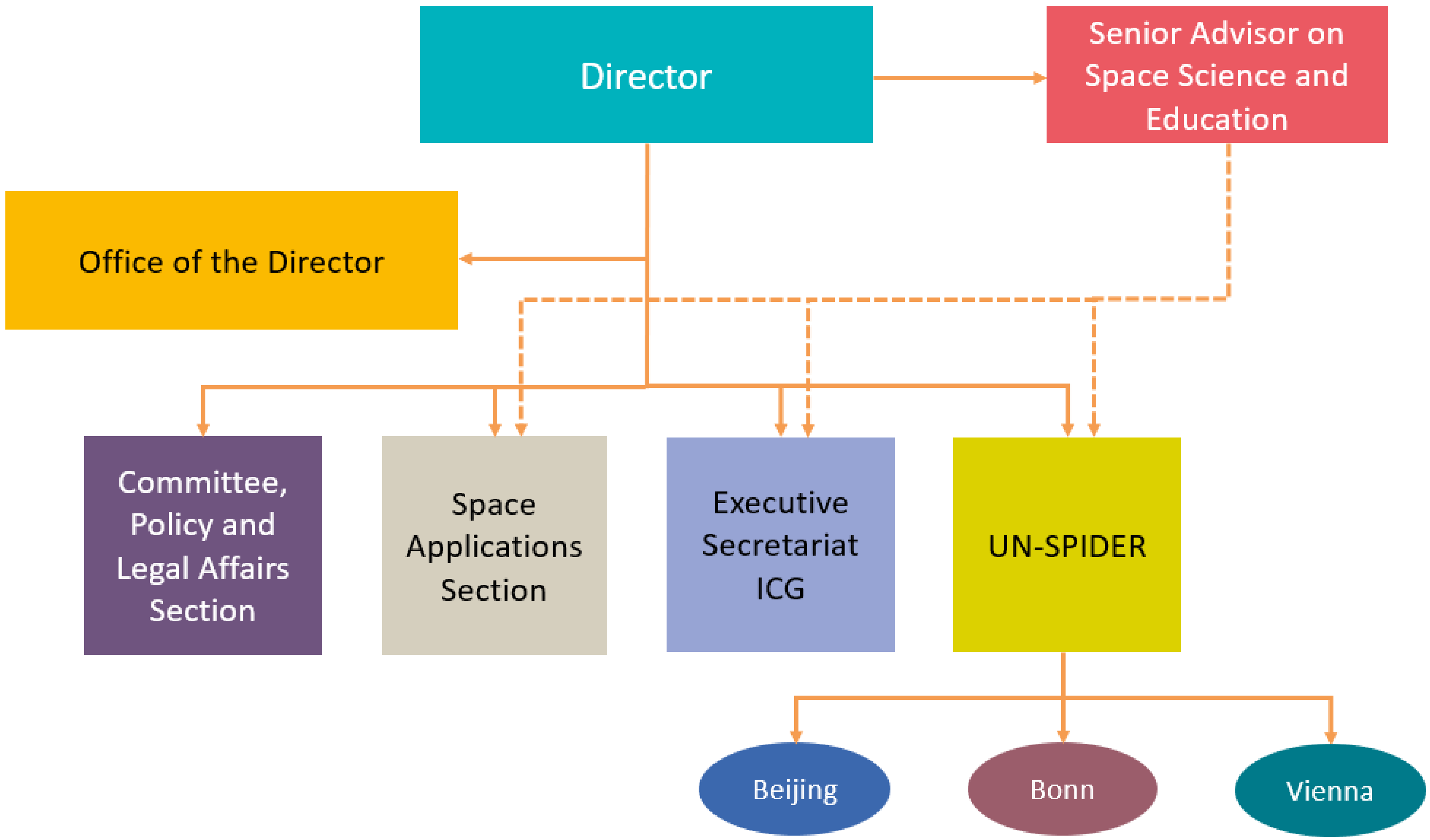
2022 Outcomes:

GA Resolution on Space and Global Health

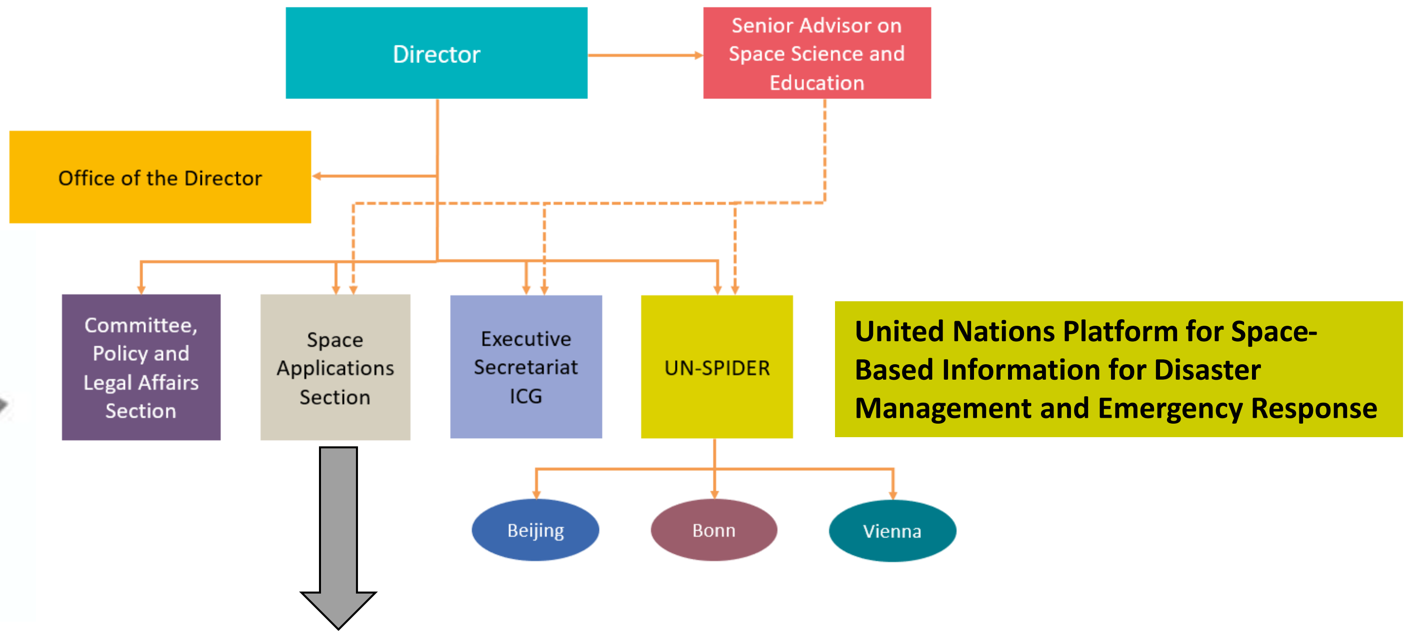
SGH Platform based in Geneva

Space and Global Health Network (Coordinator: Antoine Geissbuhler)

UNOOSA Organisational Chart



UNOOSA Organisational Chart



SAS plans and implements the UN Programme on Space Applications to build national capability in the areas of basic sciences, basic space technology and human space technology.

The Programme helps all countries leverage space data and applications to achieve the SDGs, in particular in the areas of global health, disaster management, climate change, humanitarian assistance, environmental monitoring and natural resources management.


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

3 GOOD HEALTH AND WELL-BEING

SPACE4SDGS

- Space Solutions in support of:
  - **Telemedicine and tele-health:** Space technology, including satellites, enables telemedicine and remote healthcare services
  - **Tele-epidemiology for epidemic and disease monitoring:** Satellites and space-based sensors can be used to monitor the spread of diseases, track vector populations (such as mosquitoes carrying diseases like malaria),and assess environmental factors that contribute to disease outbreaks. This data can aid in early detection and response to epidemics.
  - **Spinn-off benefits of space research and development:** Medical Imaging and Diagnostics; Health Monitoring Wearables; Vaccine Development and Drug Testing
  - **Disaster Management and Humanitarian Aid**: Space technology assists in disaster management and humanitarian aid efforts by providing rapid and accurate information about disaster-affected areas. This information helps coordinate relief efforts, assess infrastructure damage, and plan medical response operations effectively.
  - **Human development through health education and outreach:** Space agencies often engage in public outreach and education programs to promote interest in science, technology, engineering, and mathematics (STEM) fields. These programs can inspire students to pursue careers in healthcare, leading to an increased pool of skilled professionals.

https://www.unoosa.org/oosa/en/benefits-of-space/global-health.html

st_space-o88S.pdf (unoosa.org)

Agenda

Recuerdo Histórico

Fisiología Humana en el espacio

Requisitos médicos para viajar al espacio

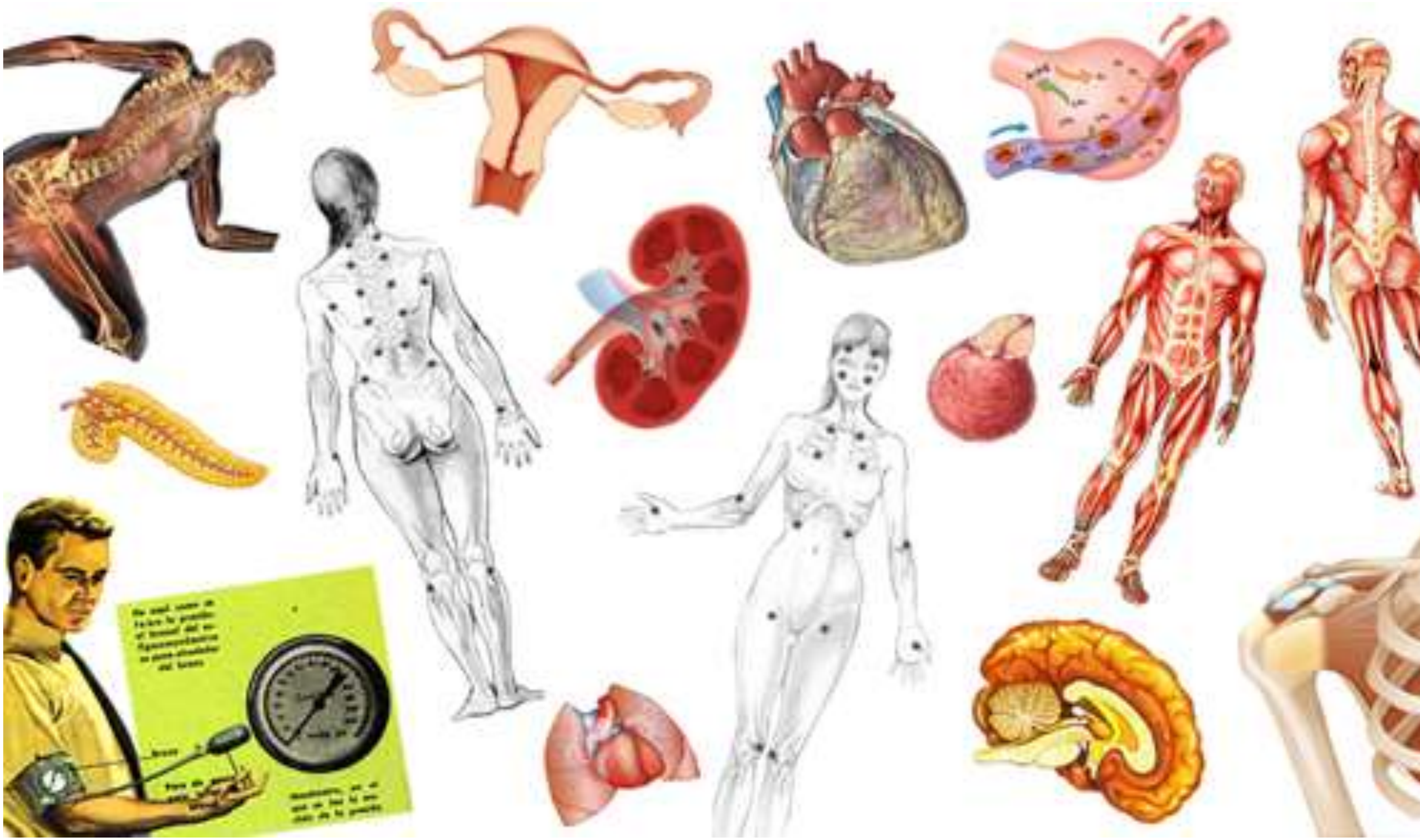
Agenda

Recuerdo Histórico

Fisiología Humana en el espacio

Requisitos médicos para viajar al espacio

Bases Fisiológicas

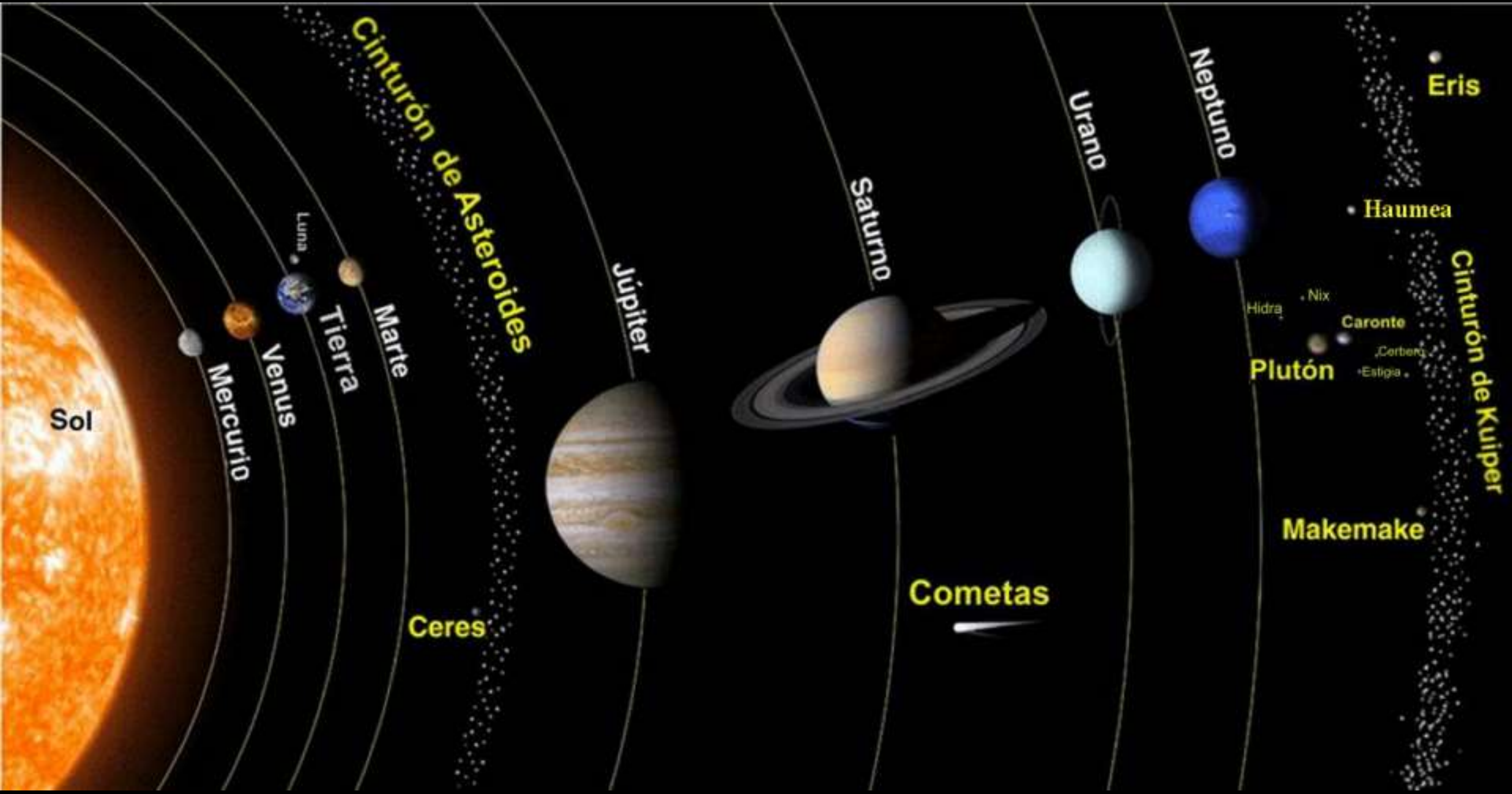


Principios Básicos

- LA ATMOSFERA TERRESTRE
- EFECTOS DE LA ALTITUD
- MICRO/INGRAVIDEZ
- OTROS

¿Qué es la Atmósfera?

Masa de gases que rodea un planeta



$G = 9,8\ m/s^2$

Distancia al Sol = 149.600.000 Km

Masa atmosférica = $5,29 \times 10^{21}$ g

LIMITE SUPERIOR:

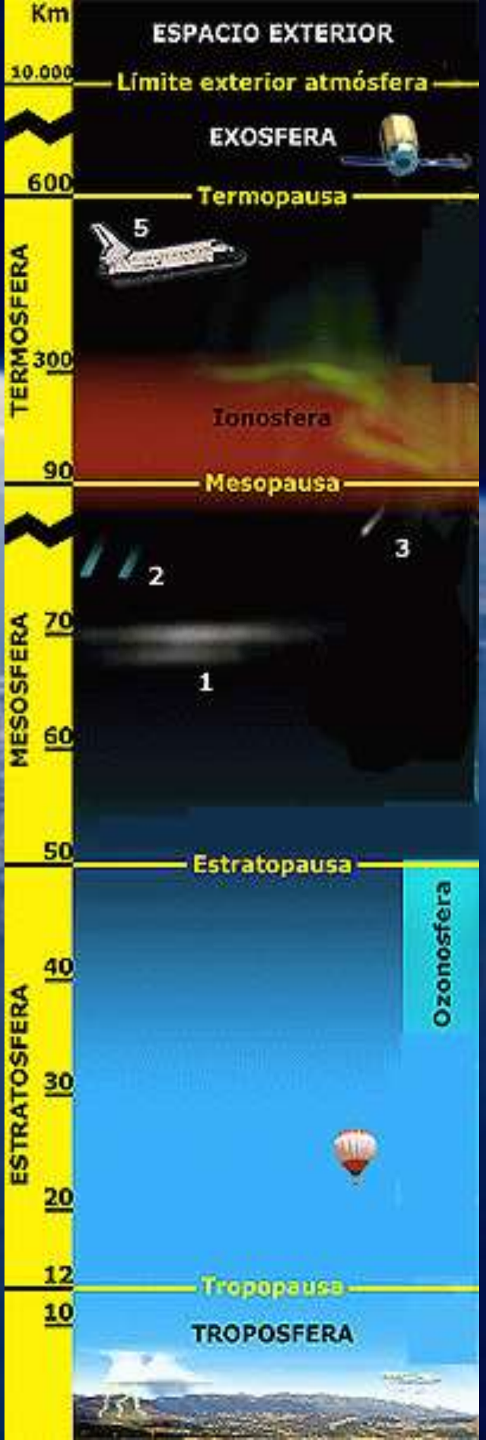
Nivel de escape

700 Km

Nuestra Atmósfera

FUNCIONES:

- Es fuente de oxígeno (vida animal) y de dióxido de carbono (vida vegetal)
- Mantiene la temperatura y la humedad
- Escudo protector frente a la radiación (cósmica y ultravioleta)
- Protección frente a meteoritos



Atmósfera Terrestre

Composición química CONSTANTE:

HOMOSFERA (< 80 Km)

Nitrógeno (N_2) 78%

Oxígeno (O_2) 21%

Otros: Argon (Ar) 0.93%, CO_2 0.03%

Presión barométrica a nivel del mar:
101,325 Pa (1,013.25 hPa), equivalente a 1,013.25 millibars, 760 mm Hg, 29.9212 inches Hg, o 14.696 psi.

Atmósfera con altura:

Presión y densidad disminuyen

La presión parcial de O_2 se reduce

Temperatura cae

Composición química de la atmósfera

CONSTANTE (HOMOSFERA) hasta 300.000 pies (100 Km)

NITRÓGENO	78.084%
OXÍGENO	20.946%
ARGON	0.934%
NEON	0.001818%
HELIO	0.000524%
ANHÍDRIDO CARBÓNICO	0.03%
VAPOR DE AGUA	0.01-4%

OTROS (Kripton, Xenon, Hidrógeno, Amoniaco, Metano, Oxido nitroso, Ozono, gas de orogen industrial, etc)

Nitrógeno

78%

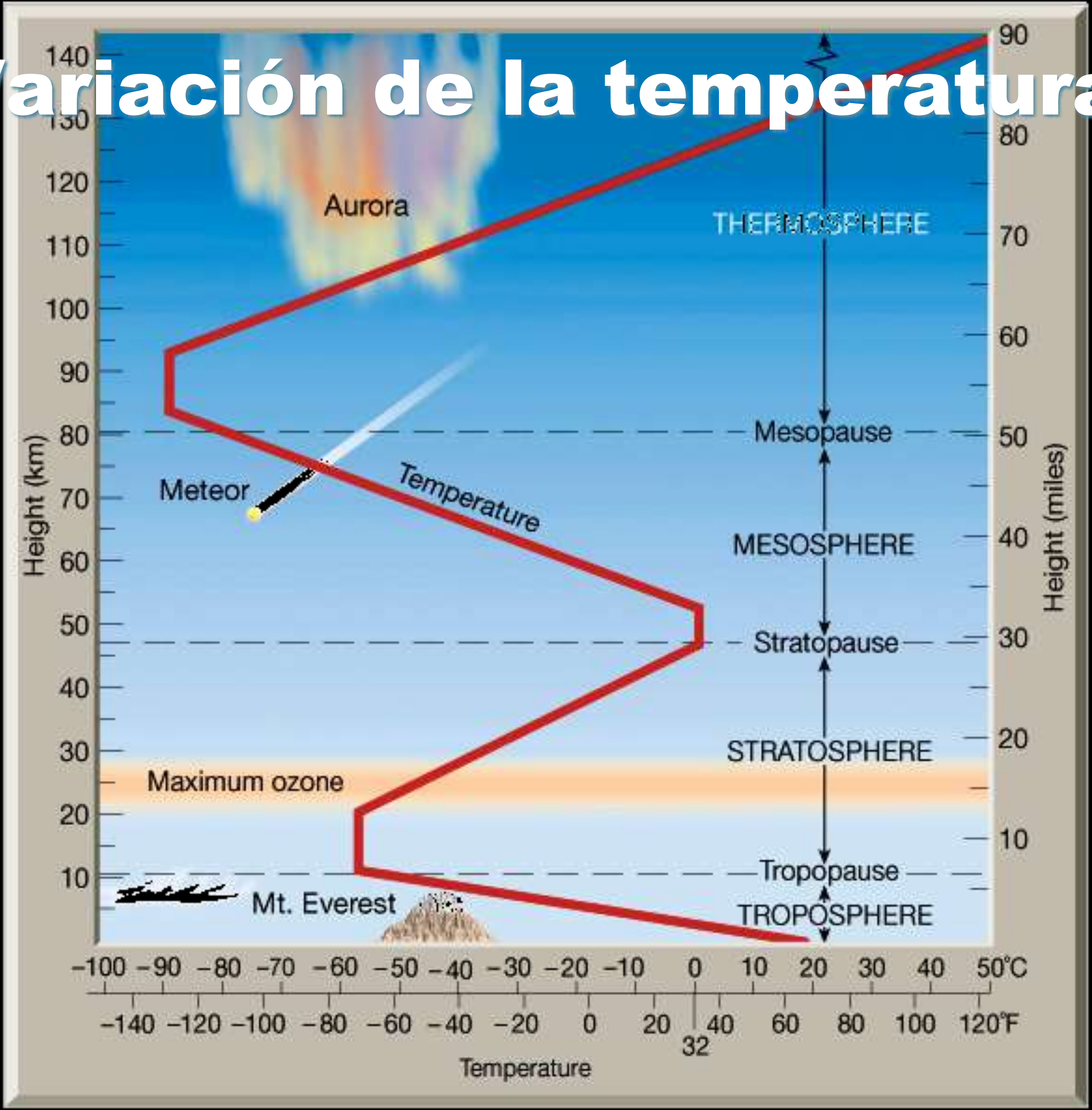
Oxígeno

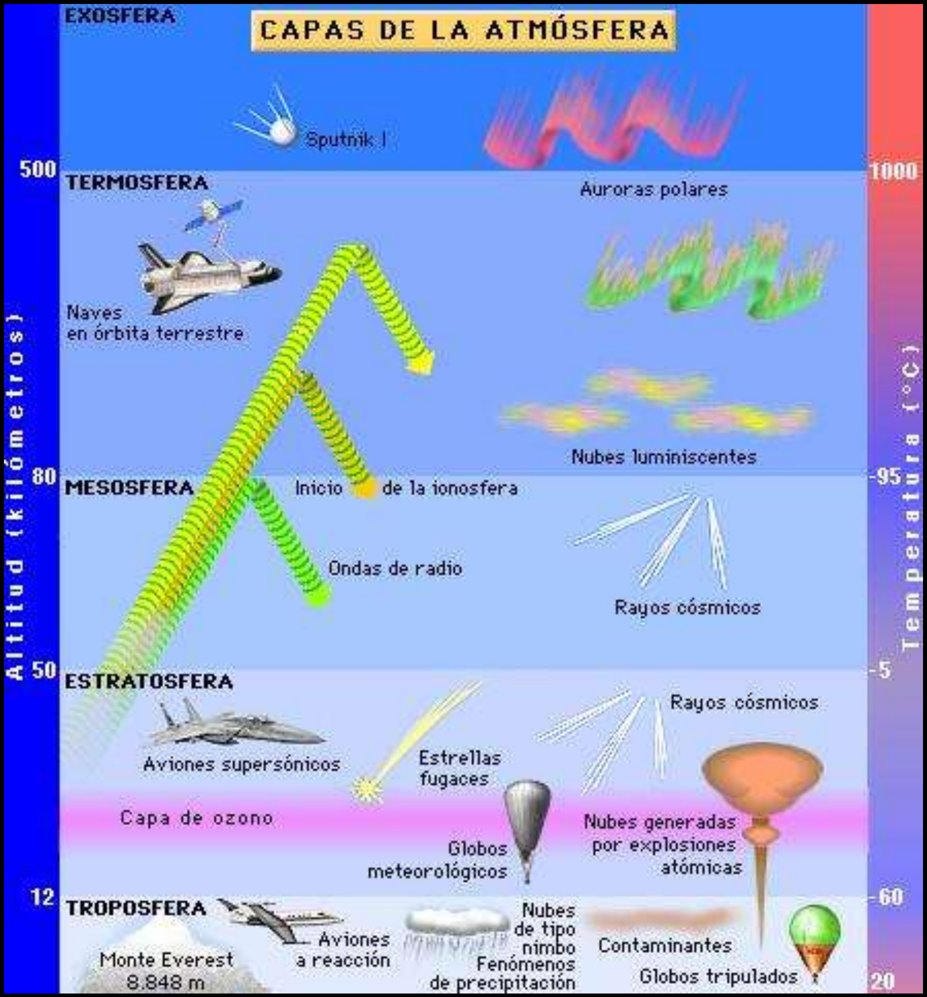
21%

Otros

1%

Variación de la temperatura





¡FISIOLÓGICAMENTE A LOS 3000 METROS…!

UN POCO DE FÍSICA…

1. Ley de Dalton
2. Ley de Boyle-Mariotte
3. Ley de Henry

LEY DE DALTON

$$P_{total} = Ppr1 + Ppr2 + Ppr3 + \ldots.. = \Sigma\ Ppr$$

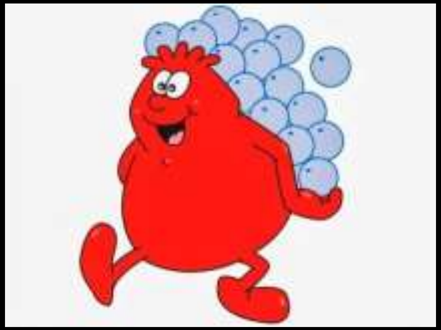
Hipoxia

"La presión total de una mezcla de gases (que no reaccionan químicamente entre sí) es igual a la suma de las presiones parciales de cada uno de los gases que componen la mezcla"

Altitud crucero normal 36.000 pies

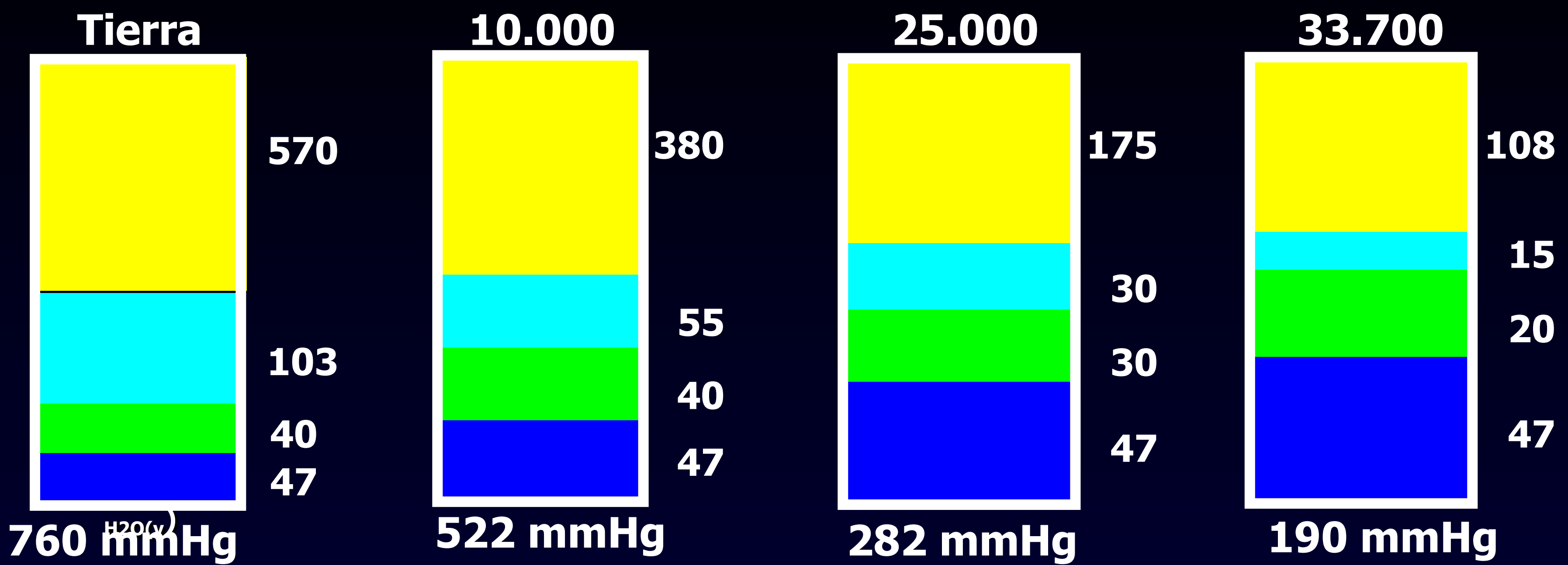
Altitud (metros)	Altitud (pies)	ATM	Presión barométrica (mmHg)	Presión de Oxígeno (mmHg)
Nivel del mar		1	760	159
3.048	**10.000**		**523**	**110**
5.486	18.000	1/2	380	80
6.096	20.000		349	73
8.231	27.000	1/3	259	54
9.144	30.000		226	47
10.363	34.000	1/4	188	39
12.192	40.000		141	29
15.240	50.000	1/7	87	18
18.288	60.000	1/14	54	11

Everest (8.848 m) 29.029 pies; Teide (3.718 m) 12.198 pies; Mont Blanc (4.810 m) 15.781 pies; La Paz, Bolivia (3.650 m) 11.975 pies.



Altitud (metros)	Altitud (pies)	Presión barométrica (mmHg)	Presión de Oxígeno en la atmósfera (mmHg)	Presión de Oxígeno en el alveolo (mmHg)	Saturación arterial de Hb (%)
Nivel del mar		760	159	100	97
OXIGENACIÓN CORRECTA					
3.048	**10.000**	523	110	67	90
EFECTOS COMIENZAN A SER SIGNIFICATIVOS (O_2 suplementario)					
6.096	**20.000**	349	73	40	70
OXIGENACIÓN DEL TODO INSUFICIENTE					

Gases alveolares – respirando aire



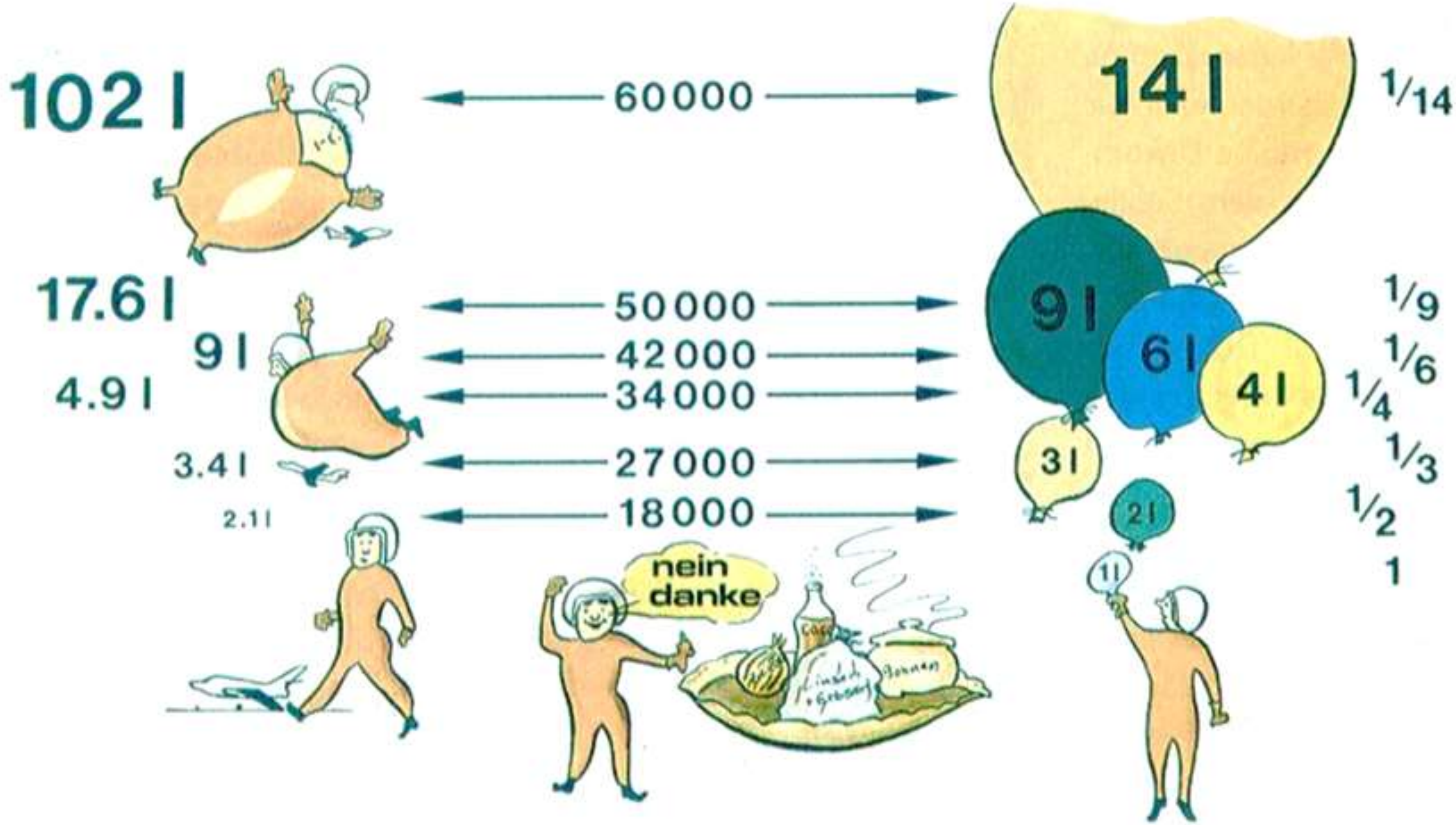
LEY DE BOYLE-MARIOTTE

Si Tª constante P X V = Constante P1 X V1 = P2 X V2

Altitud (pies)	Volumen gases
18.000	**X 2**
25.000	**X 3**
34.000	**X 5**
42.000	**X 9**

"El volumen que ocupa un gas es inversamente proporcional a la presión a la que está sometido; si la temperatura permanece constante"

Barotraumatismos



102 l
60000
14 l
1/14
17.6 l
50000
9 l
1/9
9 l
42000
6 l
1/6
4.9 l
34000
4 l
1/4
3.4 l
27000
3 l
1/3
2.1 l
18000
2 l
1/2
1 l
1
nein danke

LEY DE HENRY

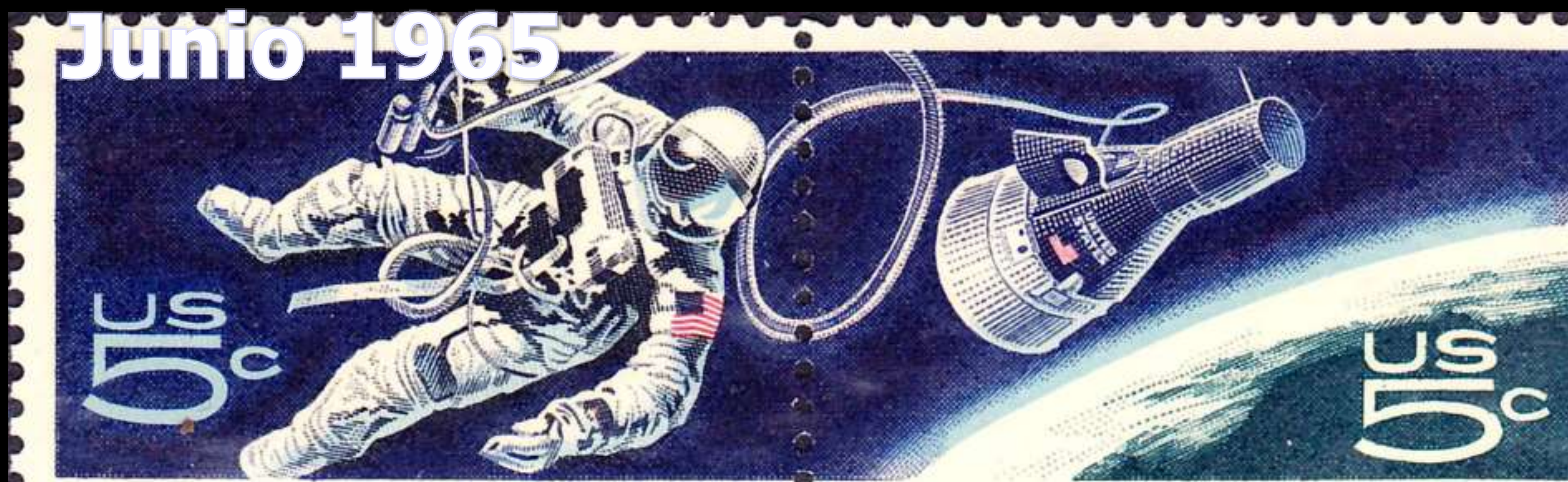
"*La cantidad de gas que se disuelve en un líquido (con el que no se combina químicamente) depende de:*

El coeficiente de solubilidad de ese gas en ese líquido

Y es directamente proporcional a la presión a la que se encuentra dicho gas sobre el líquido"

Enfermedad Descompresiva


Marzo 1965
ВПЕРВЫЕ
ОСУЩЕСТВЛЕН
ВЫХОД ЧЕЛОВЕКА
ИЗ КОРАБЛЯ
„ВОСХОД-2"
В КОСМИЧЕСКОЕ
ПРОСТРАНСТВО
18 марта
1965 года
ПОЧТА СССР
МОСКВА


Junio 1965
US
5c
US
5c

Extra-vehicular activity

They are physically demanding and generate significant metabolic heat that is challenging to manage.

For spacewalks astronauts must don space suits that protect against environmental threats including thermal stress, micrometeroids, radiation hazards and hard vacuum, while maintaining a breathable, habitable atmosphere.

These space suits are pressurised, but to lower than normal atmospheric pressures in order to reduce suit rigidity and maintain mobility.

The ISS is pressurised to sea level, whereas NASA space suits provide only 29.5 kPa (4.3 psi). This pressure difference, however, creates the possibility of decompression sickness (DCS).

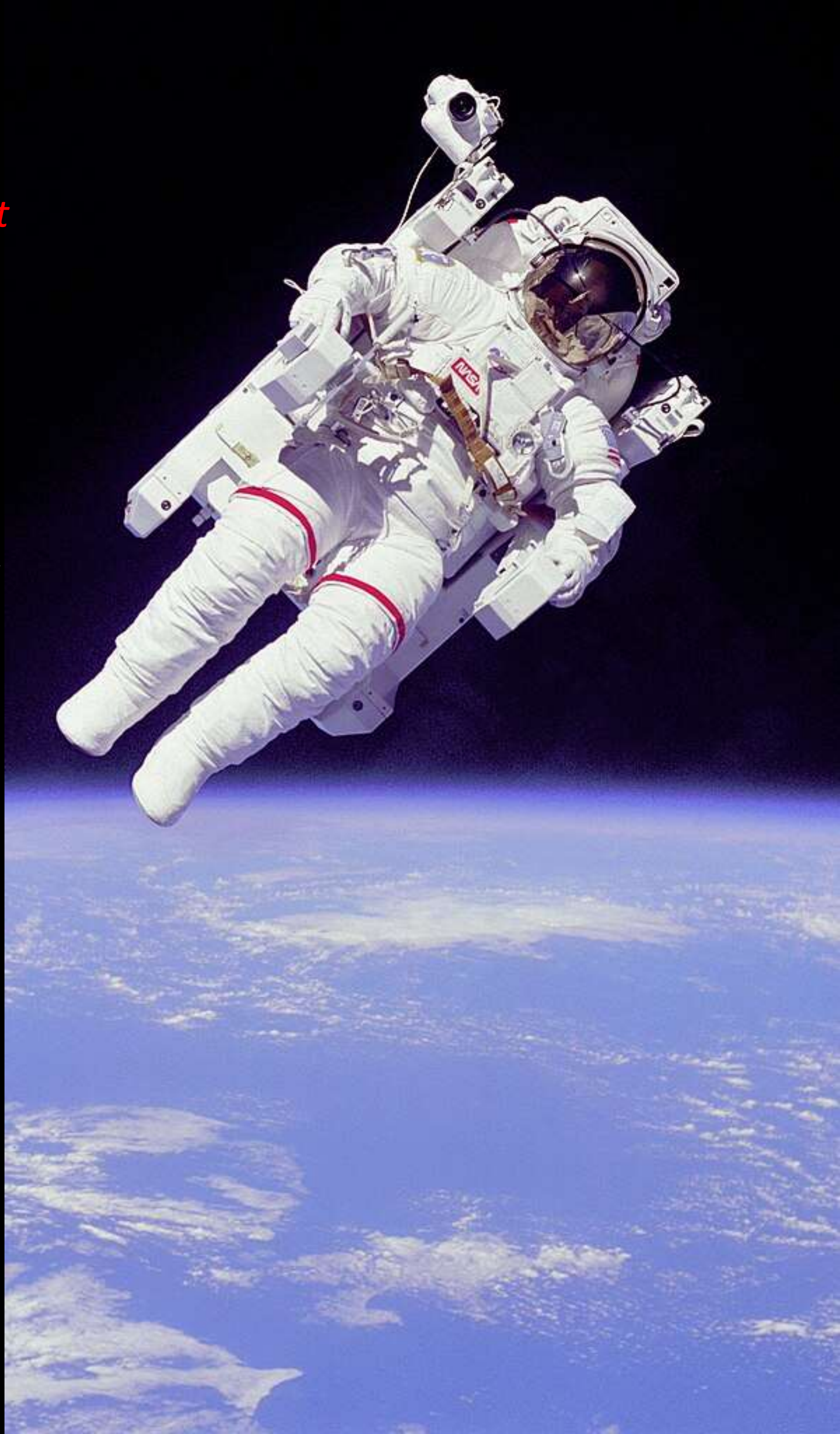
Decompression sickness in the space environment

Decompression sickness is caused by evolution of nitrogen gas from tissue or body fluids when an individual is exposed to reduced ambient pressure.

Symptoms range from joint pain (the bends) to, more seriously, the incapacitating neurological effects of confusion, motor incoordination and loss of consciousness.

Many factors can increase the risk of DCS during hypobaric exposure including individual susceptibility and activity.

Before spacewalks astronauts breathe 100% oxygen to off-load the body's nitrogen stores and reduce the risk of DCS; currently this is enhanced with In-Suit Light Exercise (ISLE).



¿Se puede vivir fuera de la atmósfera terrestre?

A duras penas

[5 Hazards of Human Spaceflight - NASA]

5 Hazards of Human Spaceflight

Astronauts encounter five hazards as they journey through space.

Space Radiation

Invisible to the human eye, space radiation is not only stealthy but considered one of the most hazardous aspects of spaceflight.

Isolation and Confinement

Behavioral responses occur among groups of people far from Earth who are isolated and confined in a small space over a long period of time.

Distance from Earth

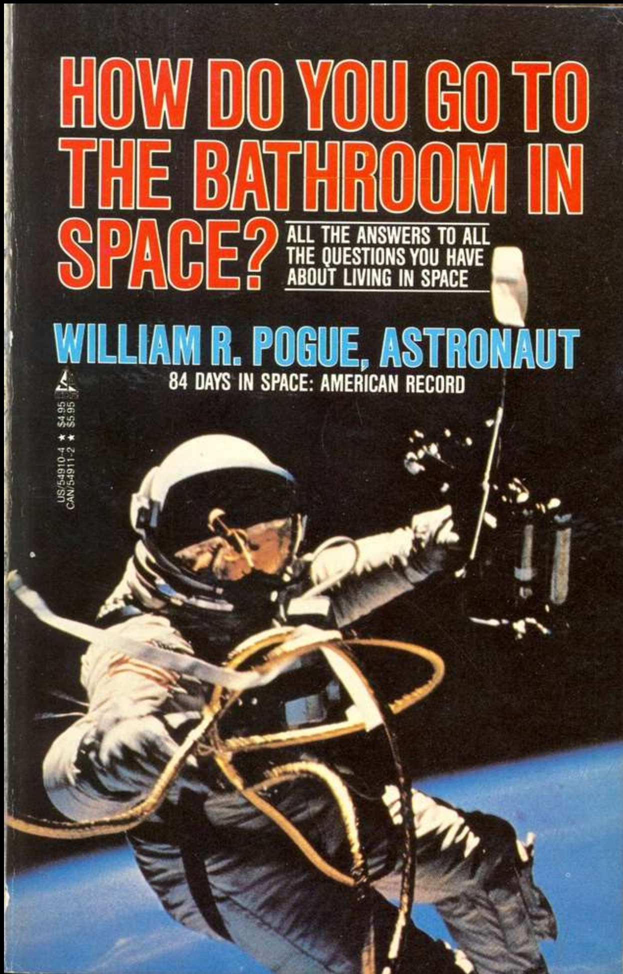
Instructions, new supplies, medical care, and more become increasingly challenging to receive from Earth as astronauts venture deeper into space.

Gravity Fields

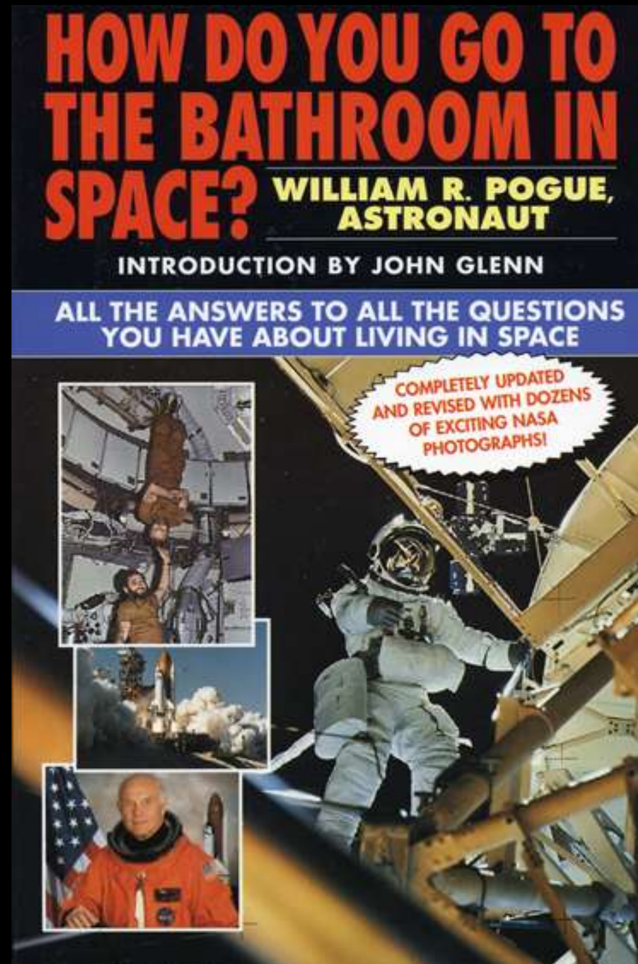
Astronauts' entire bodies – muscles, bones, inner ear, and organs – must adjust to the new gravities encountered on the space station or their spacecraft, as well as on the Moon, Mars, and Earth once they return home.

Hostile/Closed Environments

Astronauts' entire bodies – muscles, bones, inner ear, and organs – must adjust to the new gravities encountered on the space station or their spacecraft, as well as on the Moon, Mars, and Earth once they return home.


HOW DO YOU GO TO THE BATHROOM IN SPACE?
ALL THE ANSWERS TO ALL THE QUESTIONS YOU HAVE ABOUT LIVING IN SPACE
WILLIAM R. POGUE, ASTRONAUT
84 DAYS IN SPACE: AMERICAN RECORD

1985


HOW DO YOU GO TO THE BATHROOM IN SPACE?
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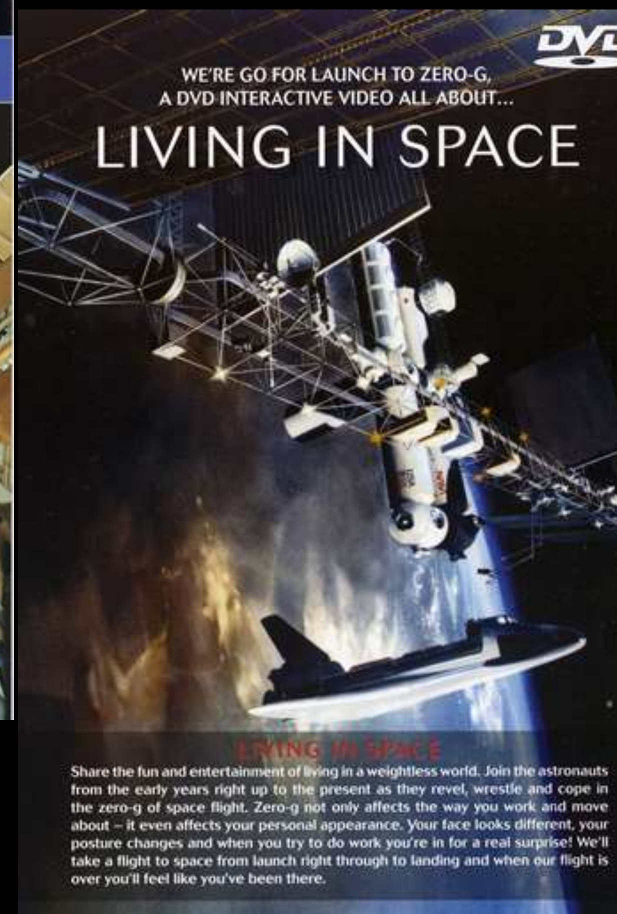
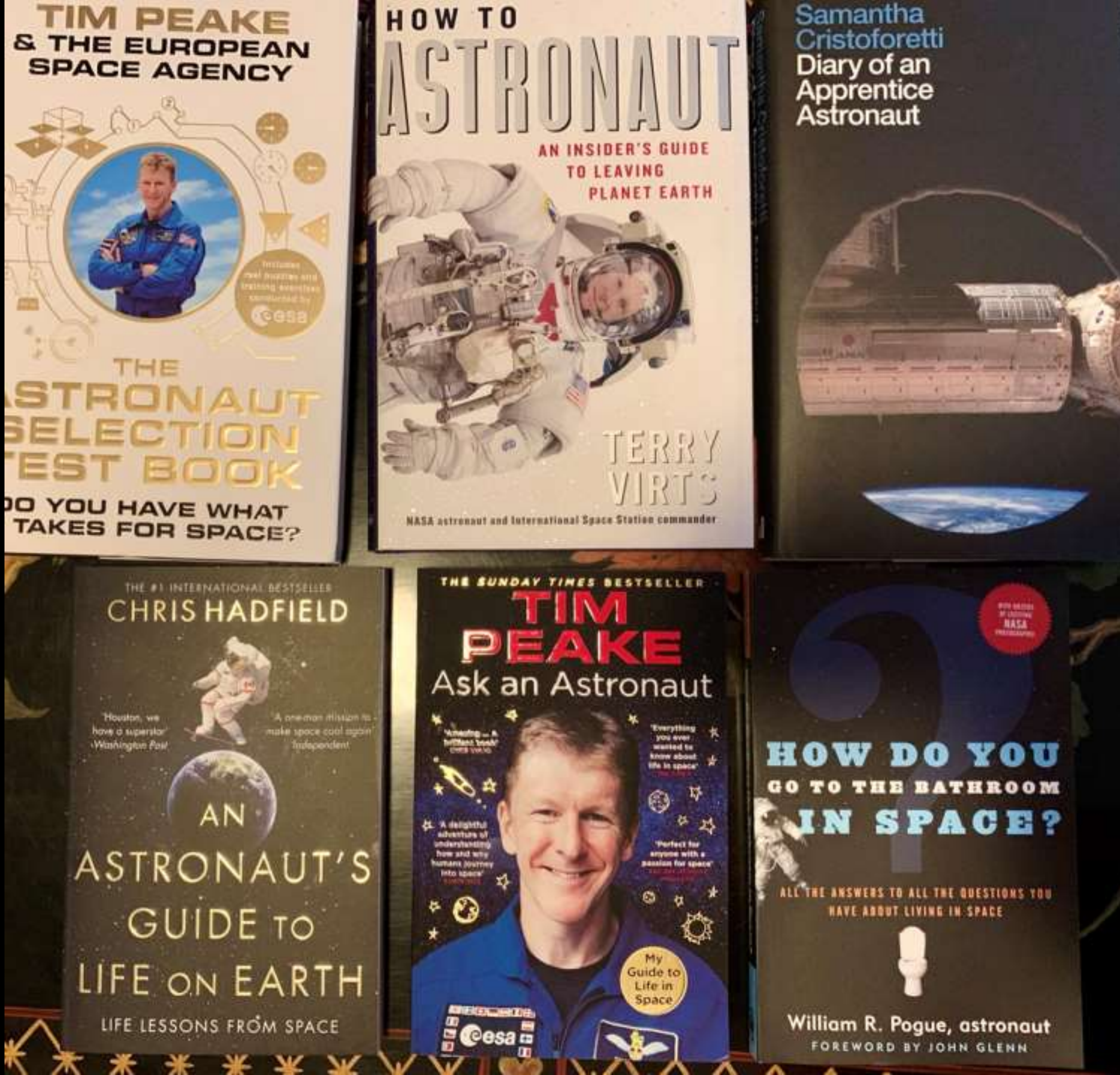
INTRODUCTION BY JOHN GLENN
ALL THE ANSWERS TO ALL THE QUESTIONS YOU HAVE ABOUT LIVING IN SPACE
COMPLETELY UPDATED AND REVISED WITH DOZENS OF EXCITING NASA PHOTOGRAPHS!

1999


DVD
WE'RE GO FOR LAUNCH TO ZERO-G, A DVD INTERACTIVE VIDEO ALL ABOUT...
LIVING IN SPACE
Share the fun and entertainment of living in a weightless world. Join the astronauts from the early years right up to the present as they revel, wrestle and cope in the zero-g of space flight. Zero-g not only affects the way you work and move about – it even affects your personal appearance. Your face looks different, your posture changes and when you try to do work you're in for a real surprise! We'll take a flight to space from launch right through to landing and when our flight is over you'll feel like you've been there.


TIM PEAKE
& THE EUROPEAN
SPACE AGENCY
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TEST BOOK
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TAKES FOR SPACE?
HOW TO
ASTRONAUT
AN INSIDER'S GUIDE
TO LEAVING
PLANET EARTH
TERRY
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NASA astronaut and International Space Station commander
Samantha
Cristoforetti
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Apprentice
Astronaut
THE #1 INTERNATIONAL BESTSELLER
CHRIS HADFIELD
'Houston, we have a superstar' Washington Post
'A one-man mission to make space cool again' Independent
AN
ASTRONAUT'S
GUIDE TO
LIFE ON EARTH
LIFE LESSONS FROM SPACE
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PEAKE
Ask an Astronaut
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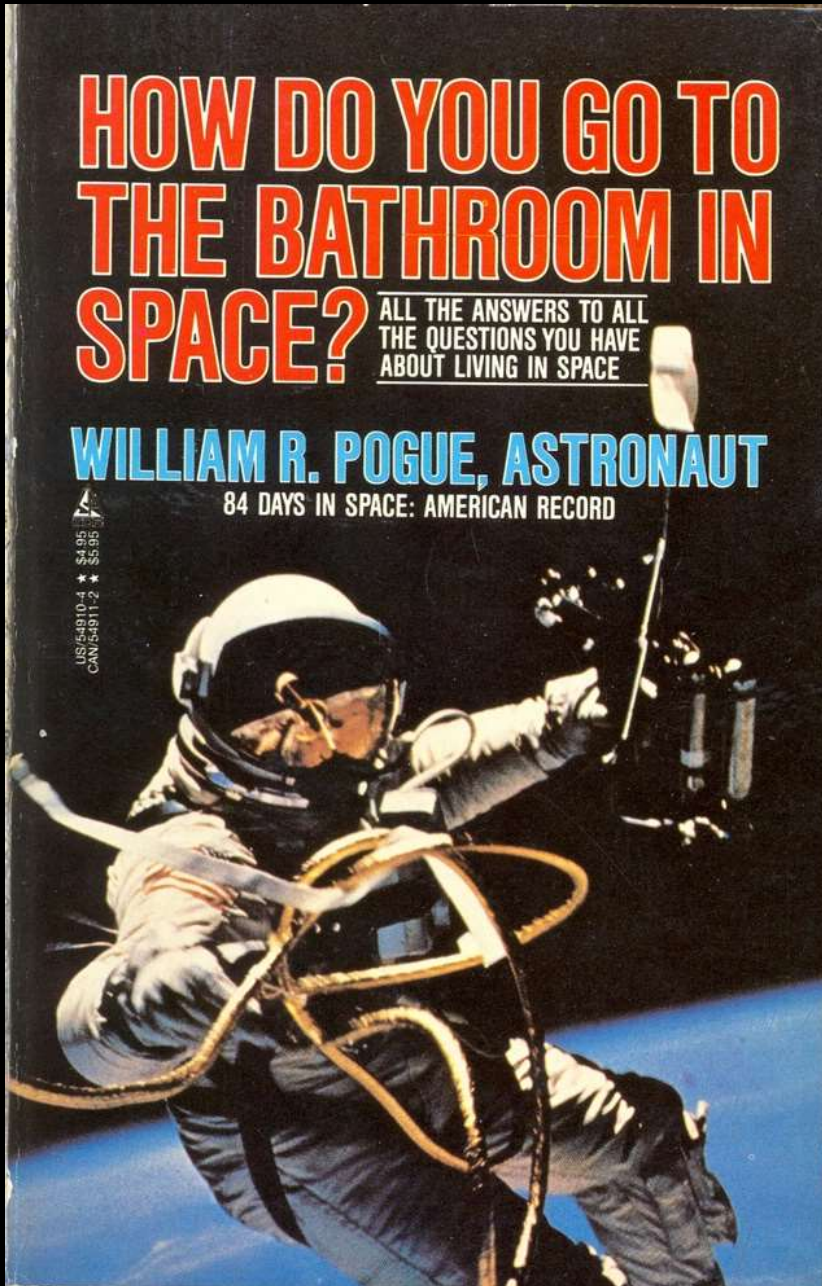
FOREWORD BY JOHN GLENN



APPENDIX A
SUMMARY OF PHYSIOLOGICAL EFFECTS

1. WEIGHTLESSNESS: FLUID SHIFT—An abnormally high volume of blood and tissue fluid tends to concentrate in the upper part of the body.

EFFECT OR SYMPTOM

1.1 Giddy, light-headed feeling
1.2 Bug-eyed sensation
1.3 "Flush" feeling in face
1.4 Awareness of neck pulse; throbbing in head
1.5 Distended veins in forehead and neck
1.6 Hypersensitivity to head movements; excessive or exaggerated sensation of rotation caused by head movements (Note 1)
1.7 Moderate to severe headache
1.8 "Full" feeling in head
1.9 Head stuffiness; nasal, sinus or ear congestion
1.10 Facial edema: puffiness in face; bags under eyes
1.11 Early flight malaise—nausea, vomiting (Note 2)
1.12 Bloodshot eyes
1.13 Reduced visual accommodation; decrease in ability to focus on near objects (most significant effect in older crewmembers)
1.14 Reduced total blood volume; orthostatic intolerance
* Prolonged cessation of red cell production with

eventual stabilized total red cell population commensurate with the reduced blood volume (long flights)
- Post flight anemia (long flights)

1.15 Decreased girth measurements of thighs and calves of legs due to lowered volume of blood & tissue fluids in the legs

1.16 Fluid infusion into internal organs (U.S. tissue tests on Cosmos in 1129)

2. WEIGHTLESSNESS: VESTIBULAR SENSITIVITY

EFFECT OR SYMPTOM

2.1 Hypersensitivity to head movements; excessive or exaggerated sensation of rotation caused by head movements (Note 1)

2.2 Early flight malaise—nausea, vomiting (Note 2)

3. WEIGHTLESSNESS; TISSUE FLOAT—The tendency of surface and internal body tissue to "float" or shift upward on the body, in relation to its position as normally observed on Earth.

EFFECT OR SYMPTOM

3.1 Facial tissue rise; high cheekbone, Oriental appearance. In combination with facial edema (puffiness), 1.10, above, facial appearance is altered. Most edema subsides after three-five days.

3.2 Internal organs shift upward, creating a "wasp waist" appearance and, possibly, a reduced vital capacity or inability to breathe as deeply as on Earth.

3.3 Hair float (long hair)

3.4 Raised or elevated breasts (females)

3.5 Floating or raised genitalia (males)

4. WEIGHTLESSNESS; MUSCULO-SKELETAL EFFECTS—Changes occur in the relaxed body posture; ability to assume certain body positions is reduced; bone demineralization occurs during early exposure to weightlessness.

EFFECT OR SYMPTOM

4.1 Relaxed body posture is semi-erect, knees bent slightly, upper back curled slightly forward, loss of curvature in small of back; arms float upward at chest height, shoulders rise up in a "shrug" position.

4.2 Spinal lengthening and straightening causes increased body length (height). Approximately 2 inches.

4.3 Inability or difficulty in bending forward or in assuming a seated position; seat belt required to hold body seated in chair. Easier to bend forward after several weeks.

4.4 Bone mass loss or bone demineralization occurs during early weeks of flight (extent of loss varies with the individual). Soviet flight results on long missions indicate the bone mass loss stops after extended exposure to weightlessness.

4.5 Loss (atrophy) of muscle mass and tone in the large muscles of the legs. Partially arrested by exercise during flight. Rapid recovery after return. Main cause is inability to achieve the normal workload stress present on Earth. Contributes to decreased girth measurements of thighs and calves (see 1.15, above).

5. WEIGHTLESSNESS; MISCELLANEOUS EFFECTS—Temporary episodic or periodic effects experienced

EFFECT OR SYMPTOM

5.1 "Space crud"—a general malaise or "down" feeling that occurs 3–4 hours after eating; similar to onset of flu or a cold. Quickly relieved by eating

5.2 Reluctance to belch; risk of regurgitation; excessive flatus due to gas retention (gas retention problem may be less for Shuttle—cabin pressure is higher)

5.3 Lingering body odor may occur if crewmember is in an area where fan circulation is poor (no convective circulation)

5.4 Head congestion is relieved by exercise and, to some extent, by eating (see 1.9, above)

5.5 "Head nod" during sleep probably caused by carotid pulse; causes nausea in some crewmembers (10%)

5.6 During heavy exercise, auxiliary fan circulation may be required to prevent overheating; sweat accumulation can be a problem

5.7 Eyeglasses may tend to bob up and down or fly off during rapid head turns if ear pieces don't fit properly

5.8 "Inverse déjà vu"; surroundings appear unfamiliar when viewed from unusual perspective; immediately corrected by assuming a familiar body position relative to the physical environment

5.9 Persistent tendency to throw objects too high when tossing items (apparently allowing for non-existent gravity drop)

6. SPACE RADIATION: EFFECTS DUE TO IONIZING RADIATION

EFFECT OR SYMPTOM

6.1 Radiation tissue damage (extent unknown)

6.2 Light flashes "seen" by dark-adapted crewmembers when passing through low spots or regions in the Earth's radiation belts, polar regions or while traveling through deep space beyond the Earth's trapped radiation zones. (Note 5)

7. SPACECRAFT ATMOSPHERE; EFFECTS DUE TO LOW PRESSURE, LOW HUMIDITY OR, POSSIBLY, DUE TO HIGH OXYGEN CONCENTRATIONS. (Note 6)

EFFECT OR SYMPTOM

7.1 Tissue drying; chapped hands and lips, dryness in the eyes (eye irritation or sensitivity)

7.2 Peculiar soft or puffy texture/feeling in the mouth, sometimes described as a "cotton fuzz" feeling. Effect has not been well documented.

8. EFFECTS ON BASIC SENSORY AND PHYSIOLOGICAL FUNCTIONS OR PERFORMANCE DUE TO THE SPACE OR SPACECRAFT ENVIRONMENT

EFFECT OR SYMPTOM

8.1 Slight changes in sense of taste and smell; statistical differences slight—pattern varies with individual

8.2 No detectable change in motor skills or coordination tasks

8.3 Slight changes in proportionate time spent at various levels of sleep. Also sleep requirement appears to be 1–2 hours less (per day) for crewmembers while in space

8.4 Enhanced clarity of vision of objects viewed in space vacuum. This increased ability to see with increased sharpness has led some to describe such views as "gemlike" or "unreal in clarity." Most probably due to absence of light scattering in vacuum.

8.5 Ability to see 10–20% more stars (see 8.4, above)

8.6 Reduced visual accommodation (see 1.13, above)—most significant in older crewmembers

8.7 Visual scene orientation prejudice; predisposition to view scenes as one is accustomed to seeing them (even though there is no sensed gravity vector). Crewmember will move to orient "eye plane" to achieve the preferred scene orientation

8.8 Ambient spacecraft noise can vary from benign to distracting levels and may affect a crewmember's ability to go to sleep

9. POSTFLIGHT REACTIONS

EFFECT OR SYMPTOM

9.1 Postflight anemia (see 1.14)

9.2 Perception of magnitude of heft and weight forces
- Objects feel heavier
- External body pressure sensations due to sitting, lying (particularly when rolling on one's side) feel unnaturally excessive

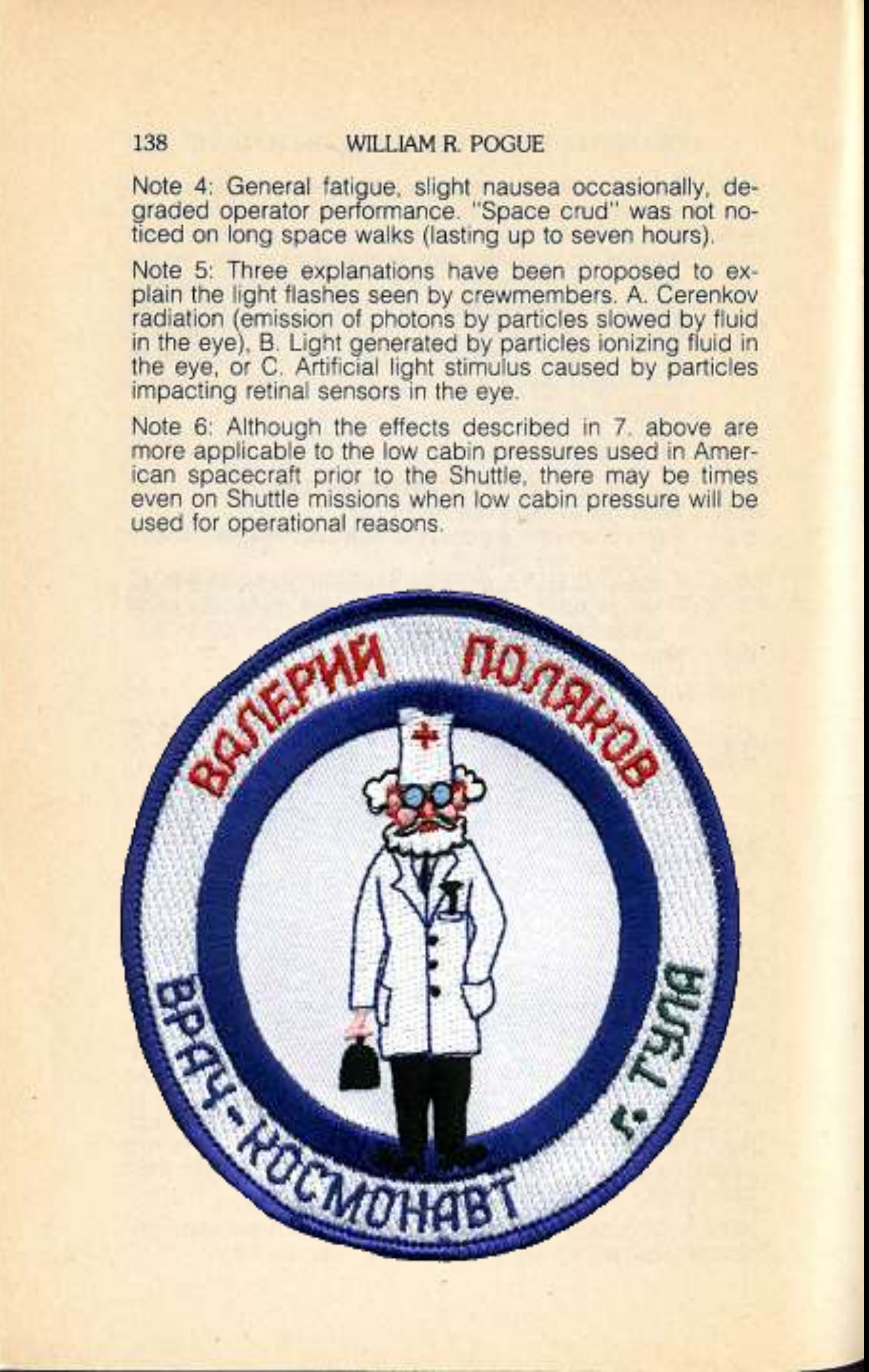
9.3 Muscle/tendon/joint soreness
- Lower back and calf muscle soreness
- Achilles tendon soreness/ache
- Knee joint soreness during long distance running

9.4 Standing/walking difficulties
- Faintness (orthostatic intolerance)
- Unsteadiness and balance problems

Note 1: Disagreement exists regarding the cause of hypersensitivity—whether it is a direct result of weightlessness, a secondary effect of the fluid shift or due to causes unidentified.

Note 2: Disagreement exists regarding the cause of early flight malaise (nausea)—whether it is caused by the fluid shift, hypersensitivity to head motions (a form of motion sickness), a combination of both, or due to an unidentified cause. American medical teams have insisted that the problem is due to a form of motion sickness and have attempted to treat it accordingly with a notable lack of success. Russian space personnel, reportedly, contend that the primary cause is the fluid shift; information is not available on the success of any preventive measures they have tried.

Note 3: Decrease in visual accommodation has been verified on Shuttle flights.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Note 4: General fatigue, slight nausea occasionally, degraded operator performance. "Space crud" was not noticed on long space walks (lasting up to seven hours).

Note 5: Three explanations have been proposed to explain the light flashes seen by crewmembers. A. Cerenkov radiation (emission of photons by particles slowed by fluid in the eye), B. Light generated by particles ionizing fluid in the eye, or C. Artificial light stimulus caused by particles impacting retinal sensors in the eye.

Note 6: Although the effects described in 7. above are more applicable to the low cabin pressures used in American spacecraft prior to the Shuttle, there may be times even on Shuttle missions when low cabin pressure will be used for operational reasons.

- Efectos debidos a la micro/ingravidez
- Efectos debidos a la exposición a radiaciones
- Efectos secundarios al ambiente atmosférico en cabina
- Efectos sobre el sistema sensorial
- Efectos Post-vuelo
- Otros

Efectos exposición al medio espacial

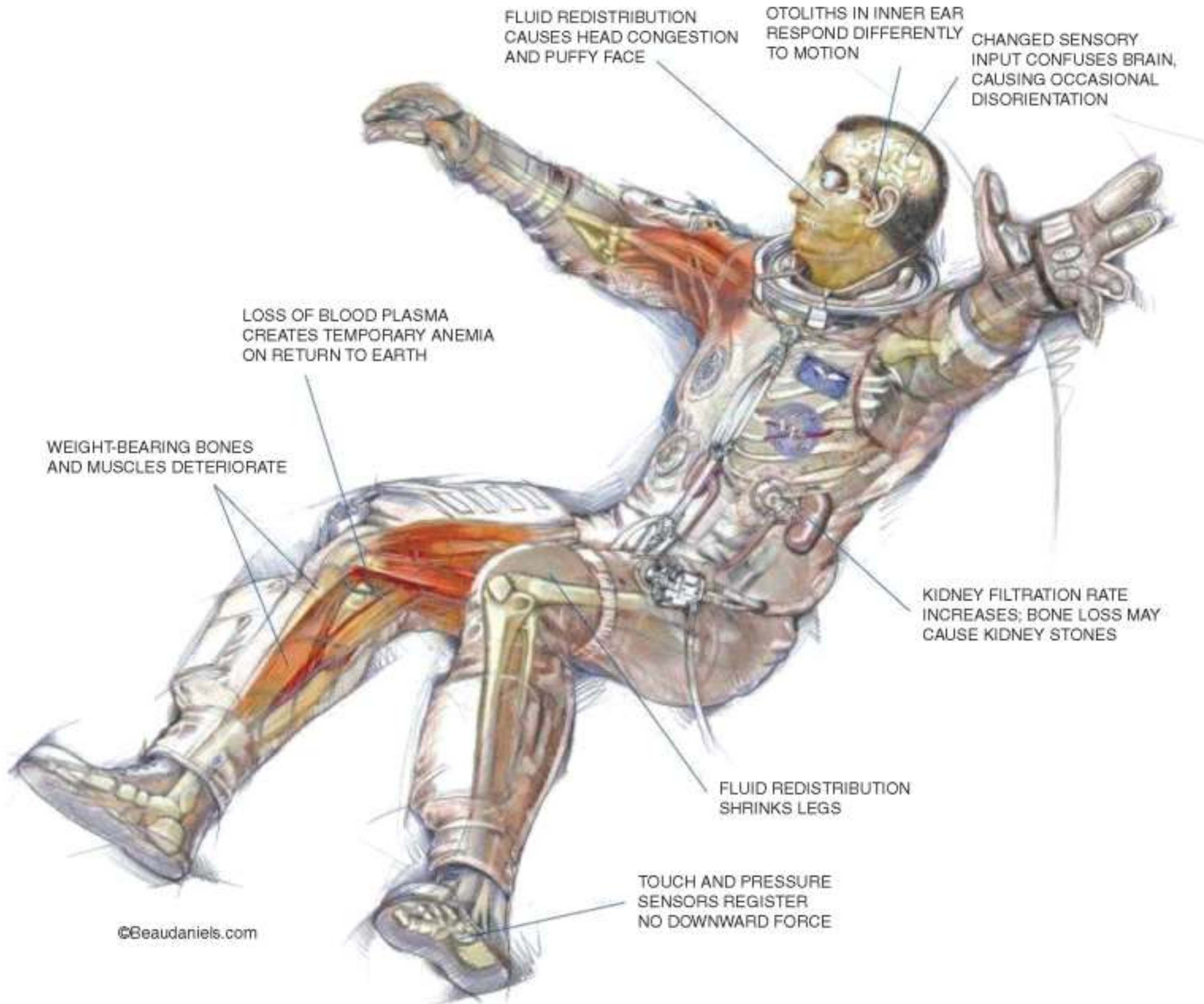
A CORTO PLAZO

- Redistribución de fluidos
- Cinetosis espacial
- Alteraciones equilibrio y orientación
- Cambios células plasmáticas
- Compromiso inmune
- Fatiga
  - Alteraciones del sueño
  - Alteraciones ritmos circadianos
- Pérdida masa muscular
- Molestias de espalda
- Alteraciones higiene personal
- Efectos psicológicos

A LARGO PLAZO

- Pérdida de masa ósea
- Pérdida de masa muscular
- Reorganización celular
- Radiaciones ionizantes
- Fatiga
- Alteraciones higiene personal
- Efectos psicológicos y psico-sociales

Effects of space flight on human body:



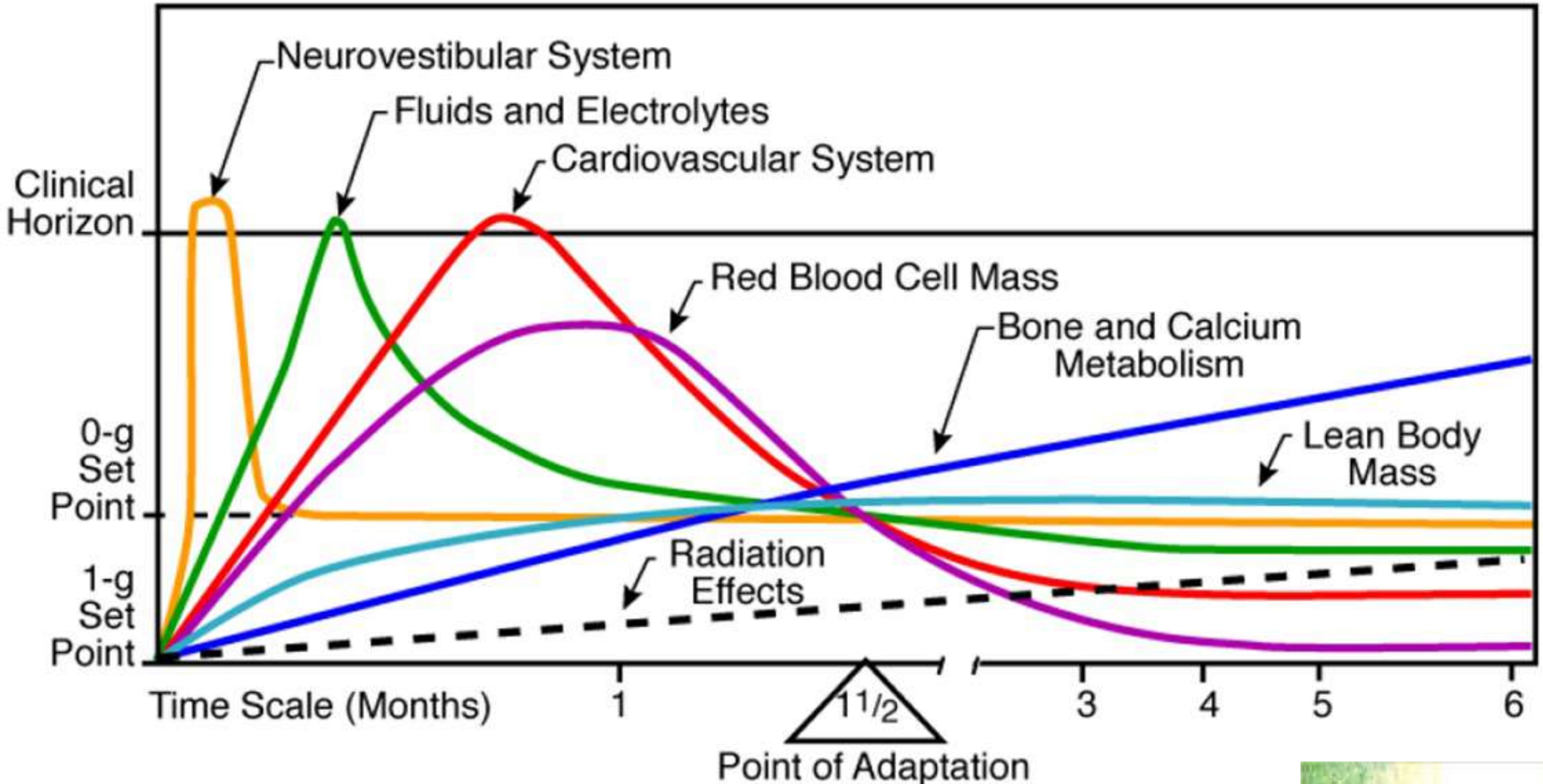
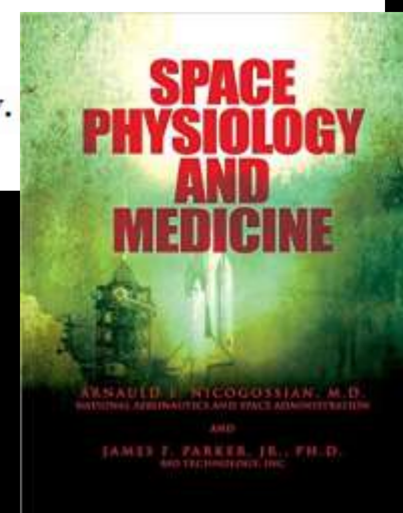
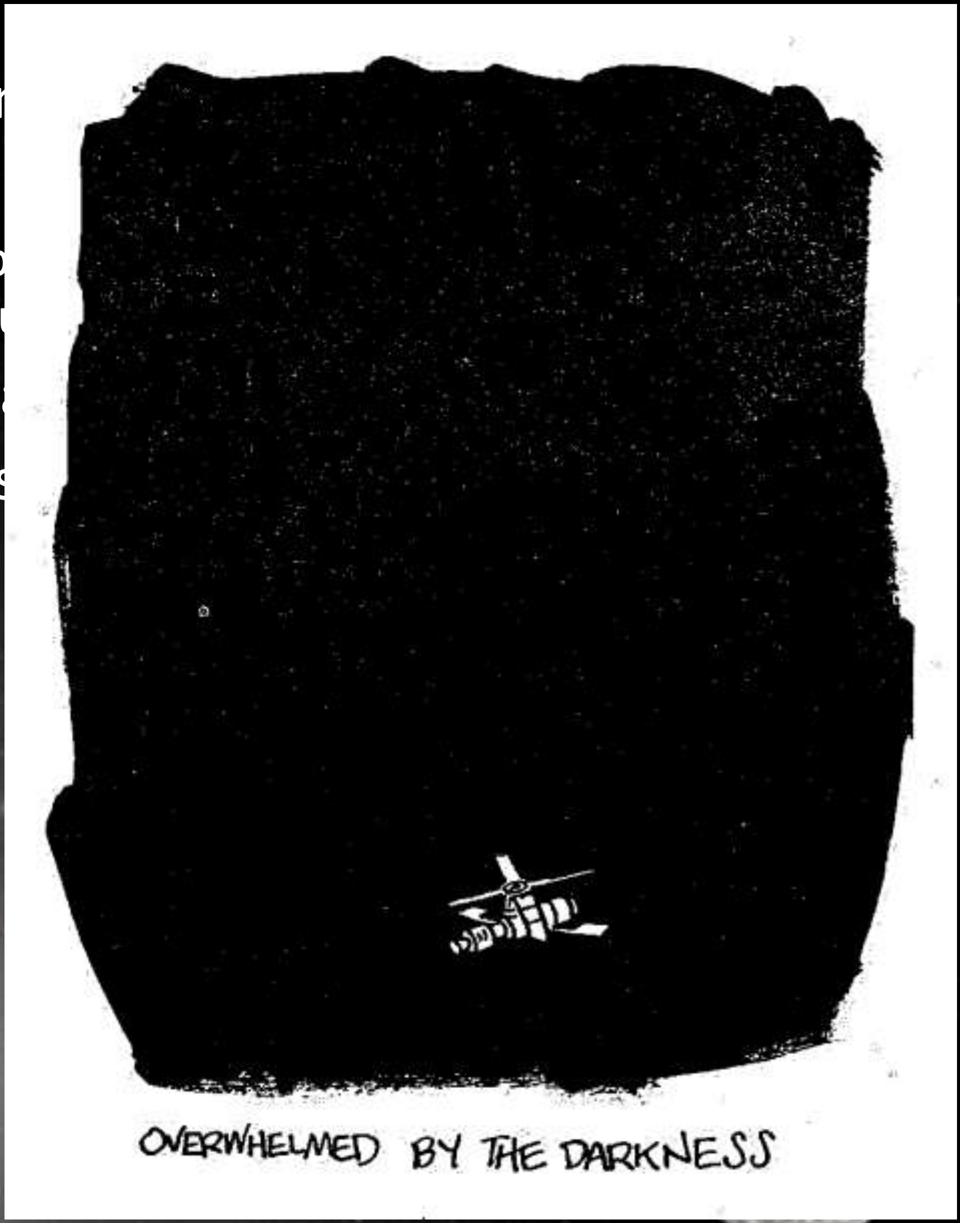


Figure 7: Physiologic changes of various systems during adaptation to microgravity.
http://asgsb.org/slidesets/slidesets.html)



Sin atmósfera:

- HIPOBARIA:
  - No hay presión de oxíger
  - Línea de Armstrong:
    - ✓ Entre los 62.000-63.500 p
      atmosférica es tan baja q
  - Vacío y oscuridad espaci
  - Enfermedad descompres



Presurización en cabina espaciales

Nave	Presión mmHg psi	O_2 %	N_2 %

International Space Station Bioenvironmental Parameters

Pressure (mm Hg/psia)	740–780/14.2–14.9
Oxygen partial pressure (mm Hg/psia)	146–178/2.82–3.44
Temperature (°C)	18–29.5
Dew point	≤14°C
Carbon dioxide (mm Hg)	5.3 or less averaged over 5 d (peak 7.6)

psia, pounds per square inch absolute.

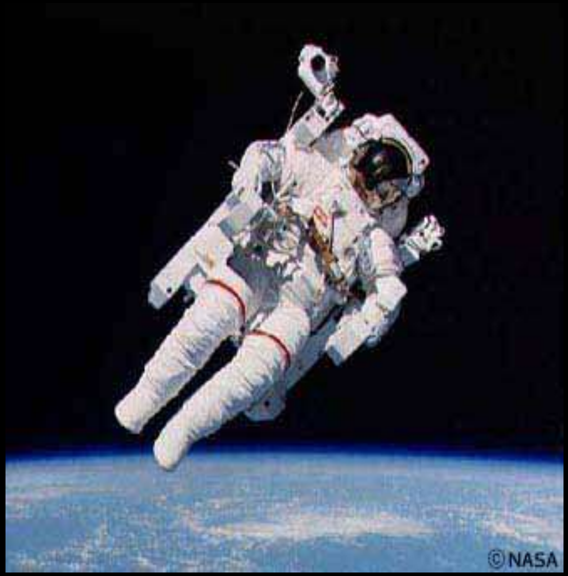
Despresurización en cabinas espaciales

Riesgo de Enfermedad Descompresiva

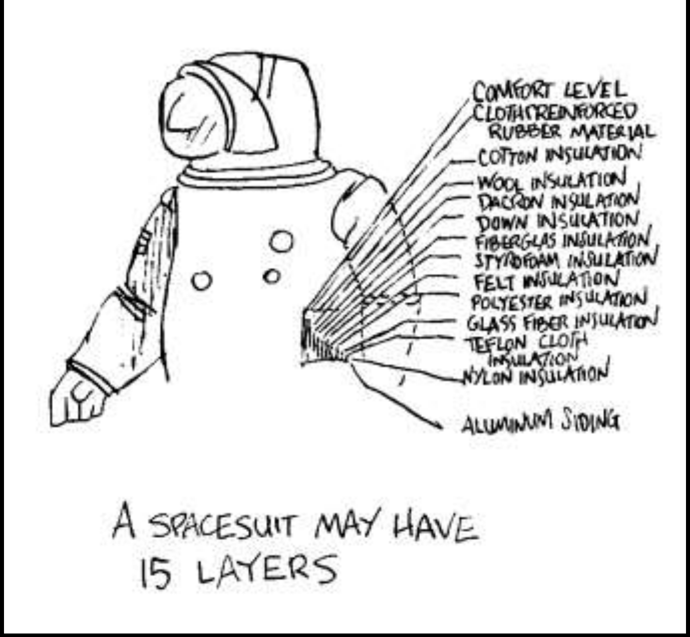
- Mercury …. Apollo (5 psi (258 mmHg)):
  - En despegue: desnitrogenación con O_2 100 % durante 3 horas antes de despegue.
  - En E.V.A. (3,7 psi (191 mmHg))
- STS (14,7 psi)
  - En E.V.A.:
    - 1 h desnitrogenación
    - Despresurización a 10,2 psi (530 mmHg)
    - 40 min. desnitrogenación en traje presurizado
    - Despresurización en traje a 4,3 psi (223 mmHg)

Extra Vehicular Activity

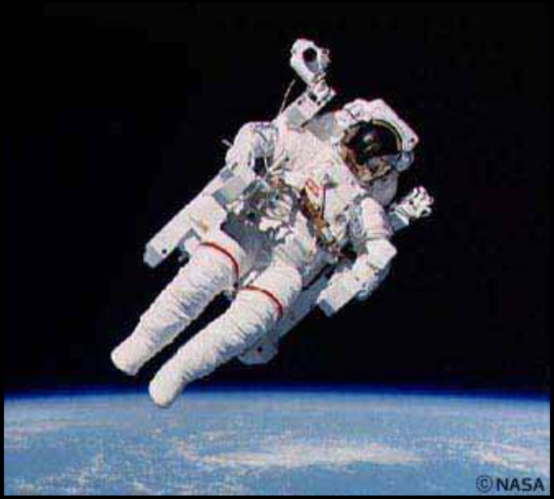
(P suit 0.4 atm)



Extra Vehicular Activity



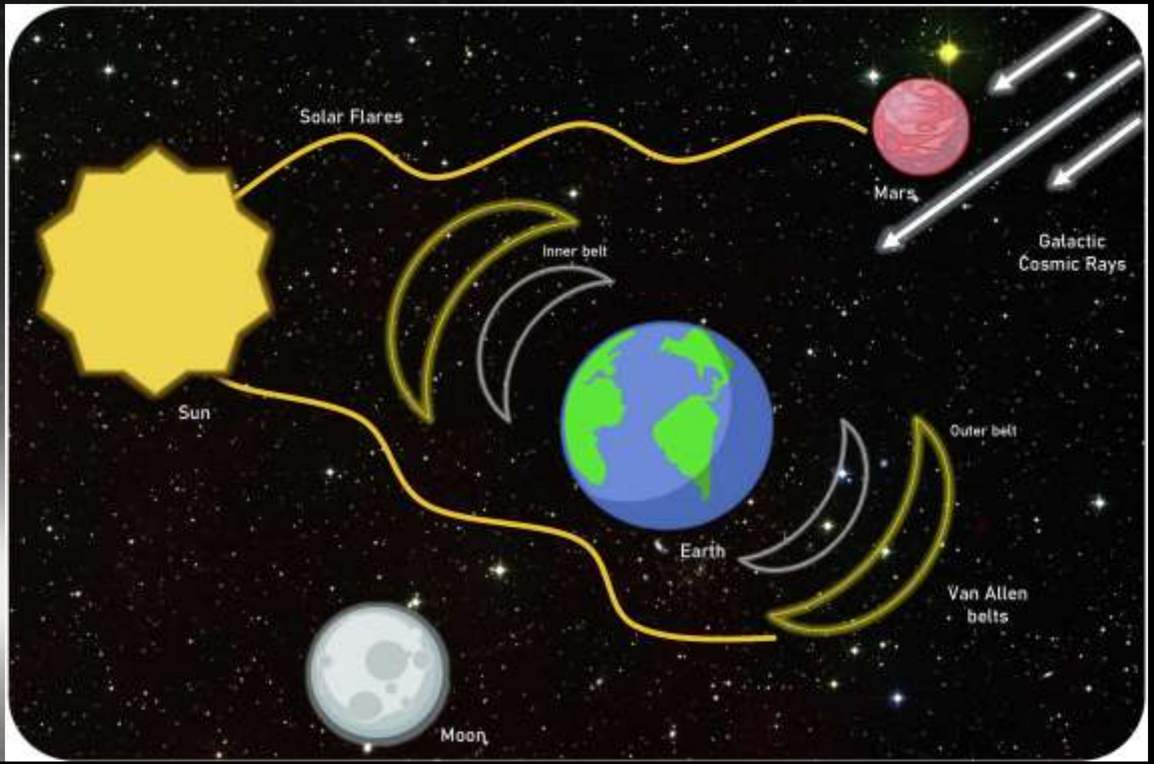
- Deshidratación
- Enfermedad descompresiva
- Termorregulación
- Monitorización médica
- Gasto energético



Sin atmósfera:

- Exposición a Temperaturas Extremas
  - ✓ +/- 120ºC en un paseo espacial-luz solar/sombra
  - ✓ En reentrada~4425ºC

- Exposición a Radiación Ionizante y UV



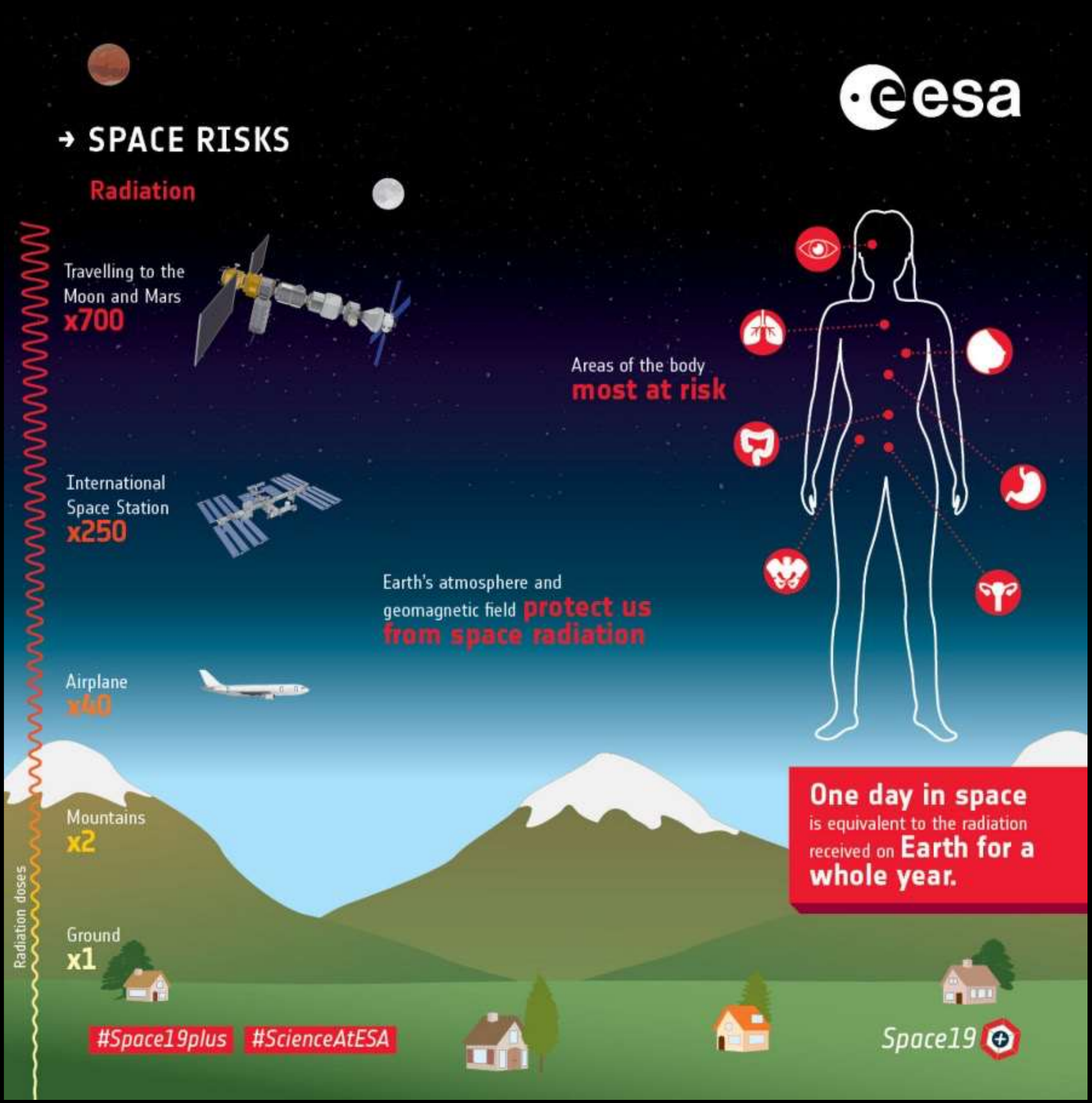

esa
→ SPACE RISKS
Radiation
Travelling to the Moon and Mars x700
International Space Station x250
Airplane x40
Mountains x2
Ground x1
Radiation doses
Areas of the body most at risk
Earth's atmosphere and geomagnetic field protect us from space radiation
One day in space is equivalent to the radiation received on Earth for a whole year.
#Space19plus #ScienceAtESA
Space19

Table 1. Table demonstrating common medical exposure types and their estimated radiation dose compared to the risks of space radiation [45].

Exposure type	Cumulative radiation dose (mSv)
Chest radiograph (PA and lateral)	0.05 – 0.24
Pelvis radiograph	0.6
Abdomen radiograph	0.04 – 1.1
CT head	0.9–4
Average background radiation exposure on Earth (per year)	3
CT spine	1.5–10
CT chest	4.0–18
CT abdomen and pelvis	3.5–25
CT angiogram aorta	5.0–32
Average astronaut space radiation exposure in ISS orbit (per year)	182.5
Average astronaut space radiation exposure to Mars (per year)	672

Key: PA (posterior-anterior), ISS (International Space Station), mSv (millisieverts)

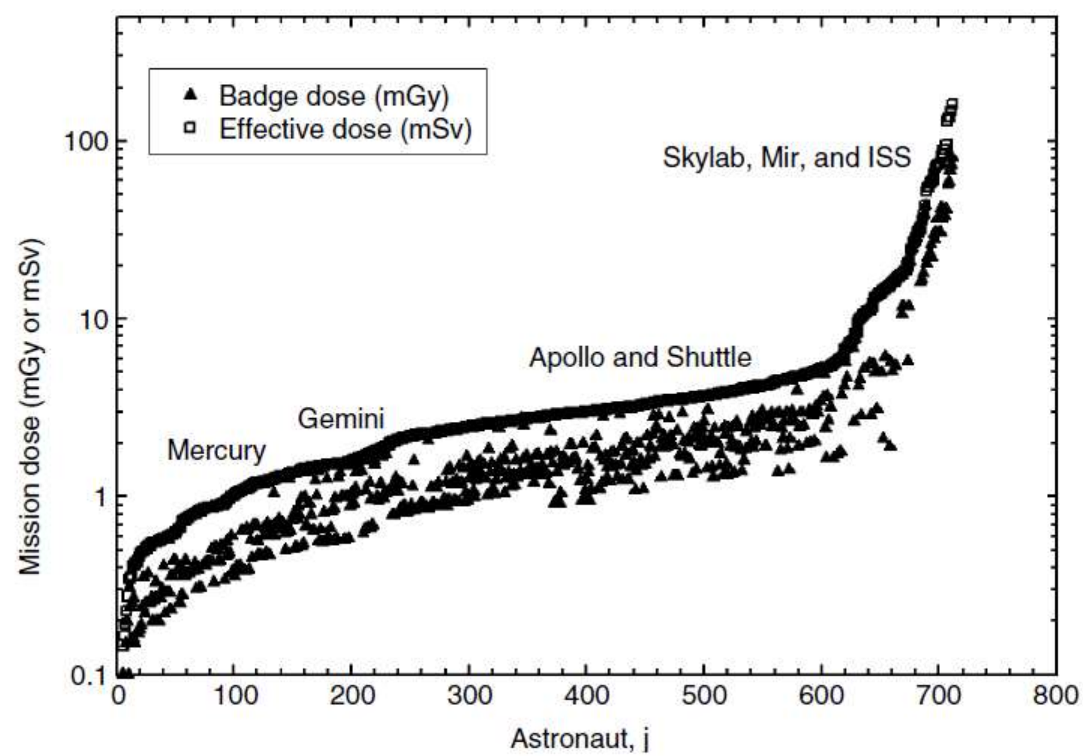
https://doi.org/10.1093/bja/aex336

Table 2. Typical aviation and space radiation exposures. Adapted from Chancellor and colleagues[24]

Mission/Scenario	Dose equivalent (cosmic ray exposure)
Average U.S background	2.2 mSv yr^{-1}
Standard chest radiograph	0.2 mSv
Airline Crew (annual limit)	2 mSv yr^{-1} (6 mSv yr^{-1})
Apollo average dose	12 mSv
Apollo 14 (highest skin dose)	14 mSv
Shuttle (average skin dose)	4 mSv
Shuttle (highest skin dose)	79 mSv
MOL nominal skin dose	41.7-64.6 mSv
Skylab 4 (highest skin dose)	178 mSv
ISS (avg. 6 month dose)	75 mSv
ISS (approx. 1-yr mission dose)	215-310 mSv
2.5yr Mission to Mars Surface	~1000 mSv

https://doi.org/10.1093/bja/aex336

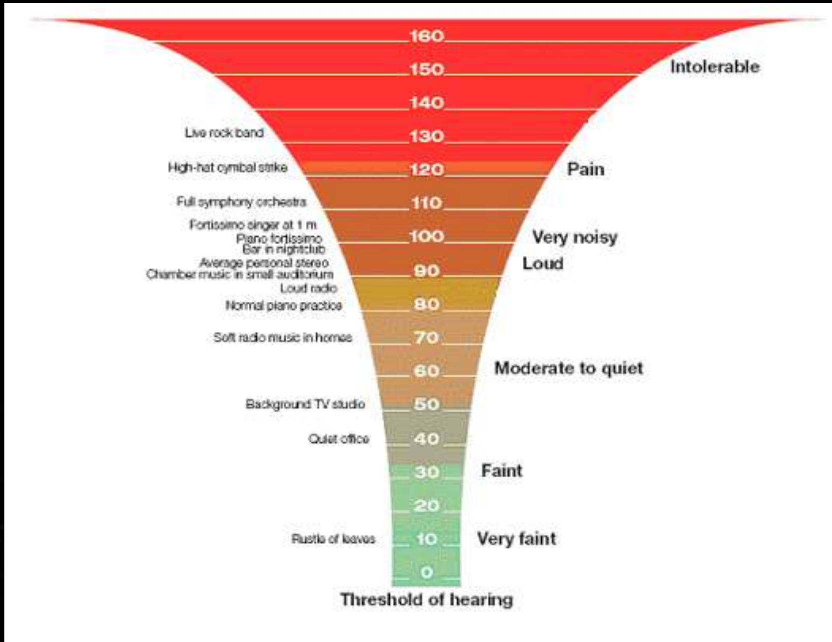
FIGURE 8-5 The badge doses and effective doses versus calendar year from all astronauts on all National Aeronautics and Space Administration (NASA) space missions [Mercury, Gemini, Apollo, Skylab, Apollo-Soyuz, Shuttle, Mir, and ISS (Expedition 1–10)]. (Updated from Cucinotta FA, Wu H, Shavers MR, et al. Radiation dosimetry and biophysical models of space radiation effects. *Gravit Space Biol Bul* 2003;16(2):11–18.)



Sin atmósfera:

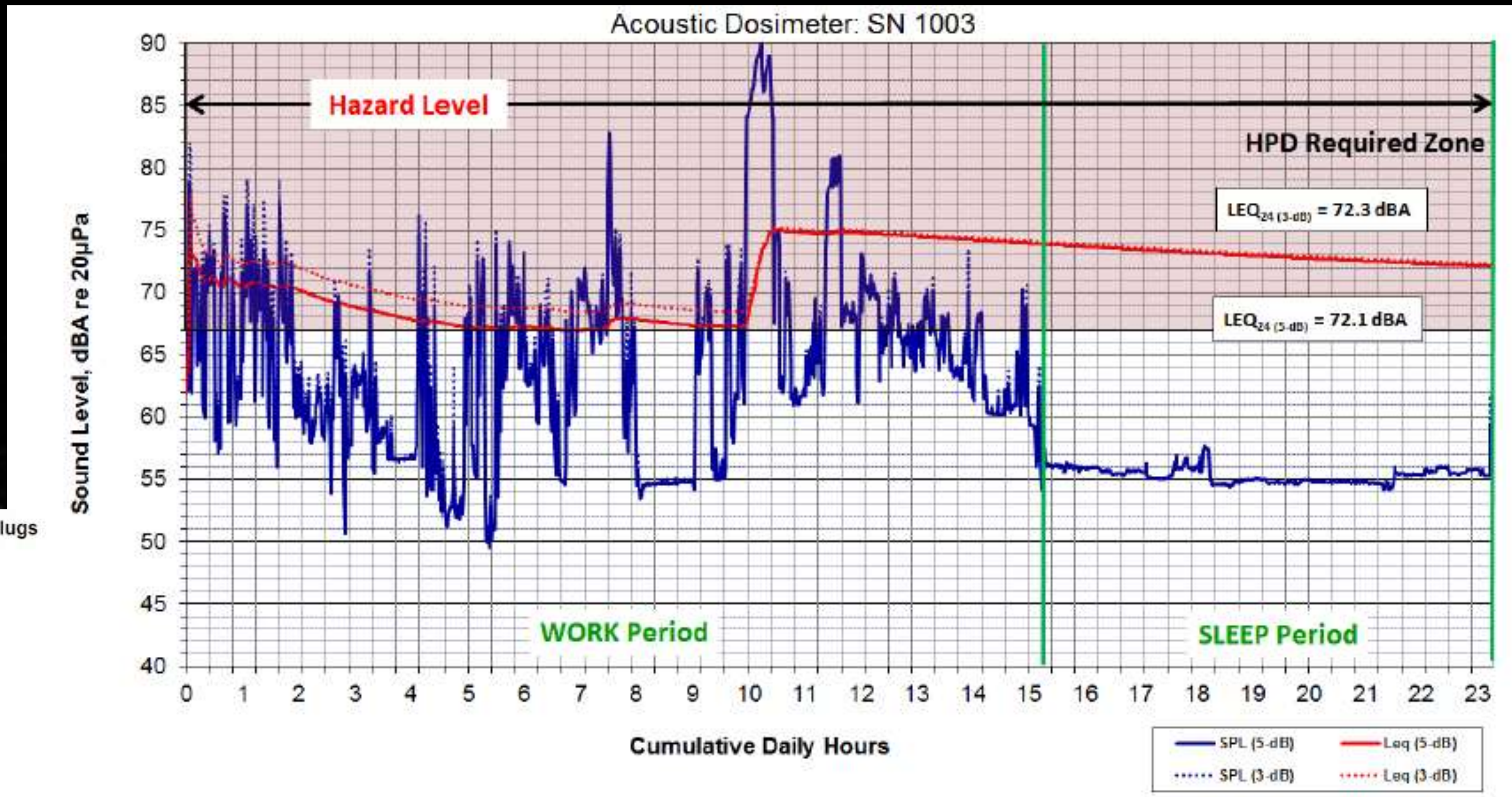
- Alteración de los ritmos circadianos
  - ✓ Skylab/ ISS: 16 amaneceres al día…
  - ✓ Alteraciones del sueño

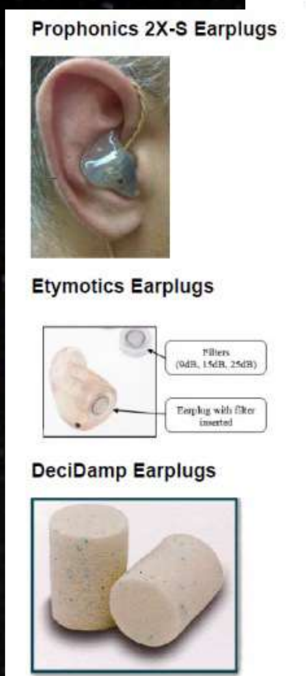
Ruido en la ISS:



Module	NC-Level	dBA	SIL(4)*	Survey Date	Normal Level
PMA1	NC 42.7	47.7	40.8 dB	July 31, 2015	NC 43.0
JLP	NC 43.0	50.0	42.8 dB	May 28, 2015	NC 42.0
Airlock	NC 44.7	49.1	40.6 dB	May 28, 2015	NC 48.0
PMM	NC 46.6	50.5	41.4 dB	July 31, 2015	NC 48.0
JPM	NC 46.7	53.0	45.9 dB	May 28, 2015	NC 48.0
Cupola	NC 46.9	53.0	43.3 dB	Sept 21, 2015	NC 45.0
Columbus	NC 49.9	53.5	45.7 dB	Apr 1, 2015	NC 43.0
US Lab	NC 50.6	57.4	50.4 dB	July 31, 2015	NC 52.0
Node 1	NC 51.7	55.1	47.6 dB	July 31, 2015	NC 49.0
Node 2	NC 52.4	55.8	47.2 dB	July 31, 2015	NC 49.0
DC1	NC 53.8	58.6	51.3 dB	Apr 1, 2015	NC 61.0
Node 3 w/UPA DA ON	NC 56.8	61.1	53.3 dB	Sept 15, 2014	NC 56.0
Node 3 w/UPA DA OFF	NC 56.8	60.9	51.2 dB	Sept 21, 2015	NC 55.0
MRM1	NC 58.6	62.9	54.6 dB	Sept 21, 2015	NC 65.0
SM	NC 59.0	65.0	58.0 dB	Sept 21, 2015	NC 60.0
MRM2	NC 59.9	64.4	57.6 dB	July 31, 2015	NC 62.0
FGB	NC 60.6	64.8	56.6 dB	Apr 1, 2015	NC 58.0

Ruido en la ISS:

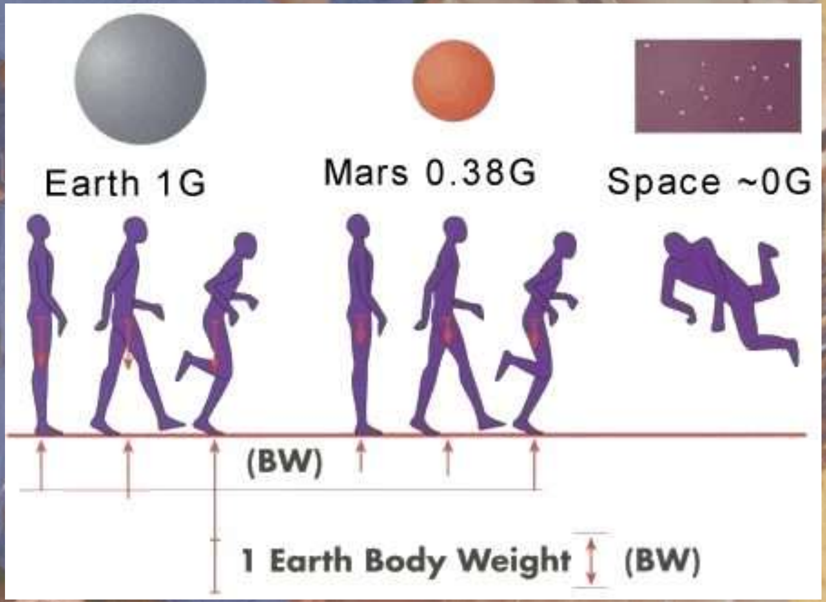




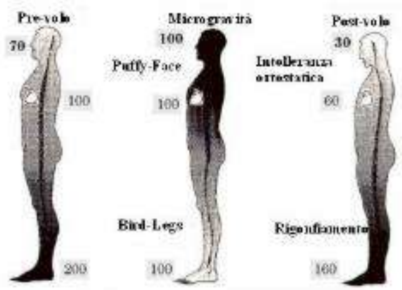
MICRO/INGRAVIDEZ

MICRO/INGRAVIDEZ

- Como consecuencia de los procesos biológicos de adaptación, se producen efectos sobre:
  - Sistema Cardiovascular.
  - Sistema Esquelético.
  - Sistema Muscular.
  - Cinetosis Espacial: Adaptación neurovestibular.
  - Sist. Hematológico e Inmune.



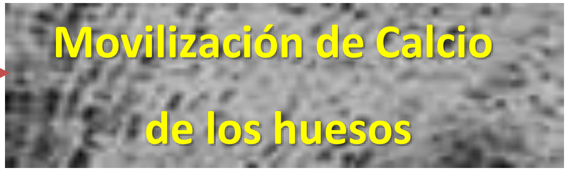
MICRO/INGRAVIDEZ



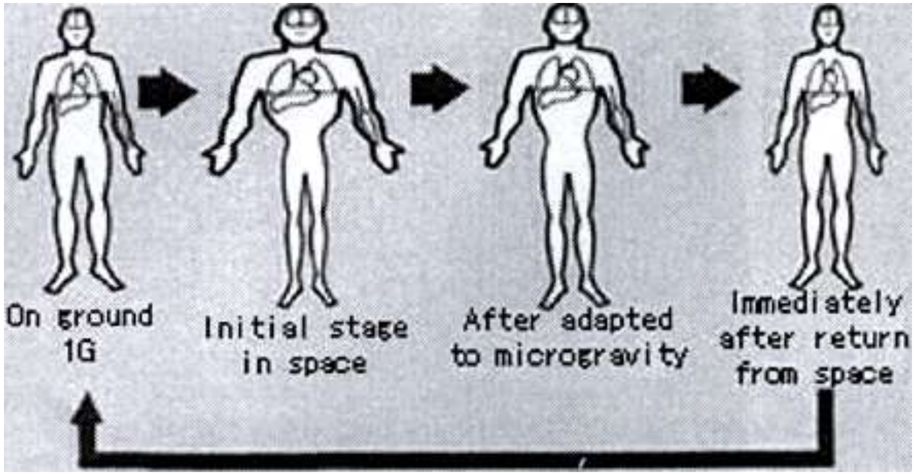
Microgravedad

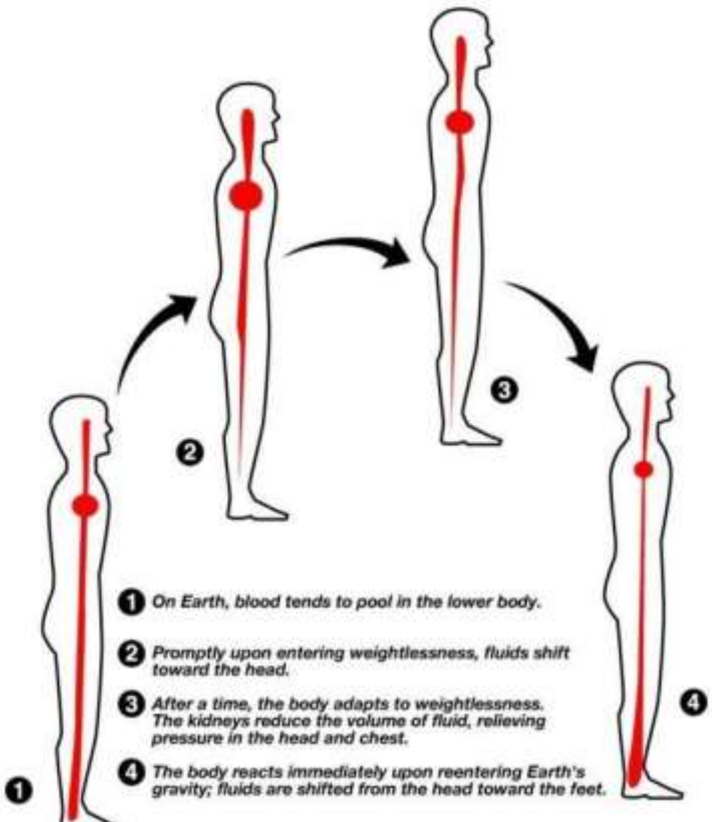
Desplazamientos de fluidos corporales

- **Disminución ingesta de líquido. Diuresis conservada**
  - Pérdida neta de fluidos
  - Descenso volumen sanguíneo y extracelular
  - Aumento v. hematocrito
  - Aumento de destrucción y disminución de producción de eritrocitos
- **Cara hinchada**
- **Congestión de senos**



Space Motion Sickness

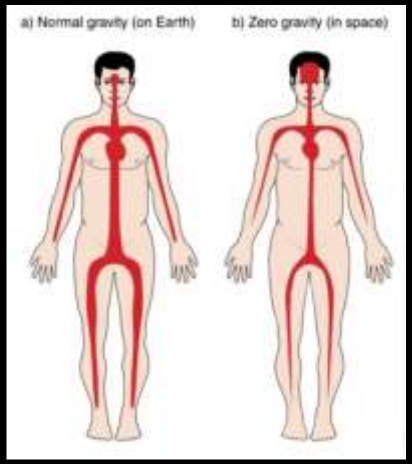

On ground 1G
Initial stage in space
After adapted to microgravity
Immediately after return from space

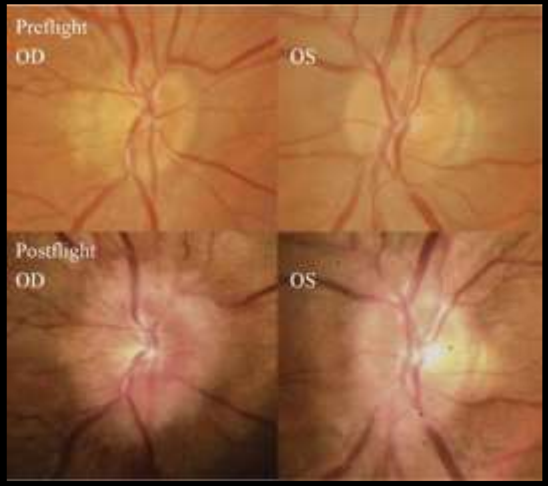

1 On Earth, blood tends to pool in the lower body.
2 Promptly upon entering weightlessness, fluids shift toward the head.
3 After a time, the body adapts to weightlessness. The kidneys reduce the volume of fluid, relieving pressure in the head and chest.
4 The body reacts immediately upon reentering Earth's gravity; fluids are shifted from the head toward the feet.

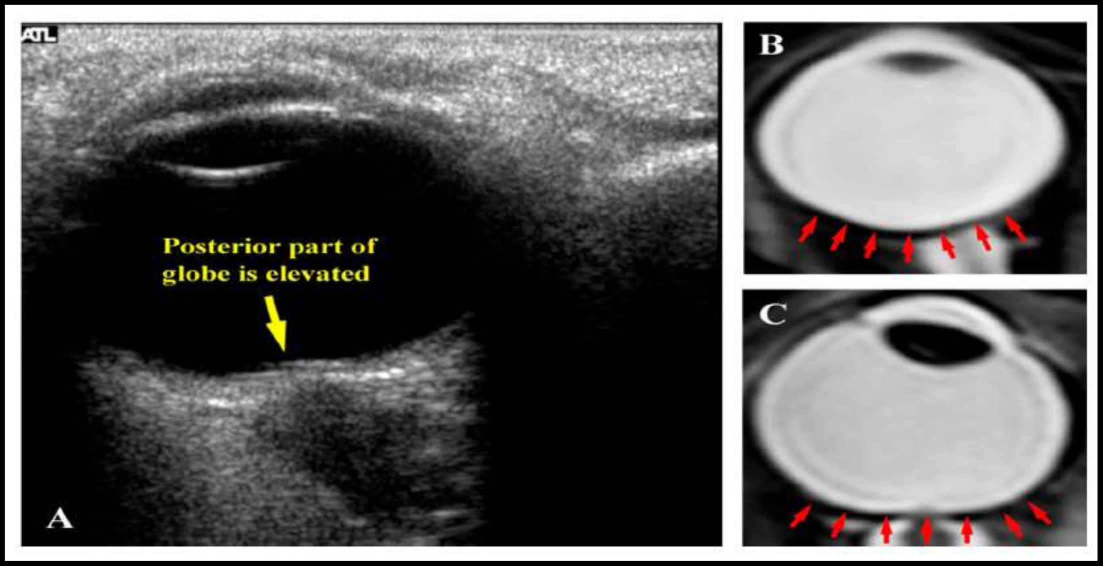

BIRDLEGS

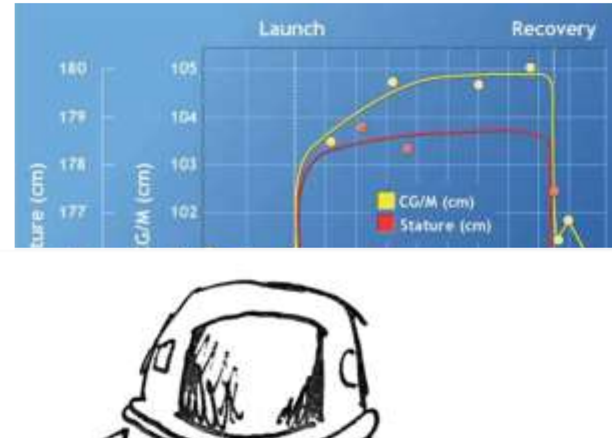
Space Associated Neuro-ocular Syndrome (SANS)

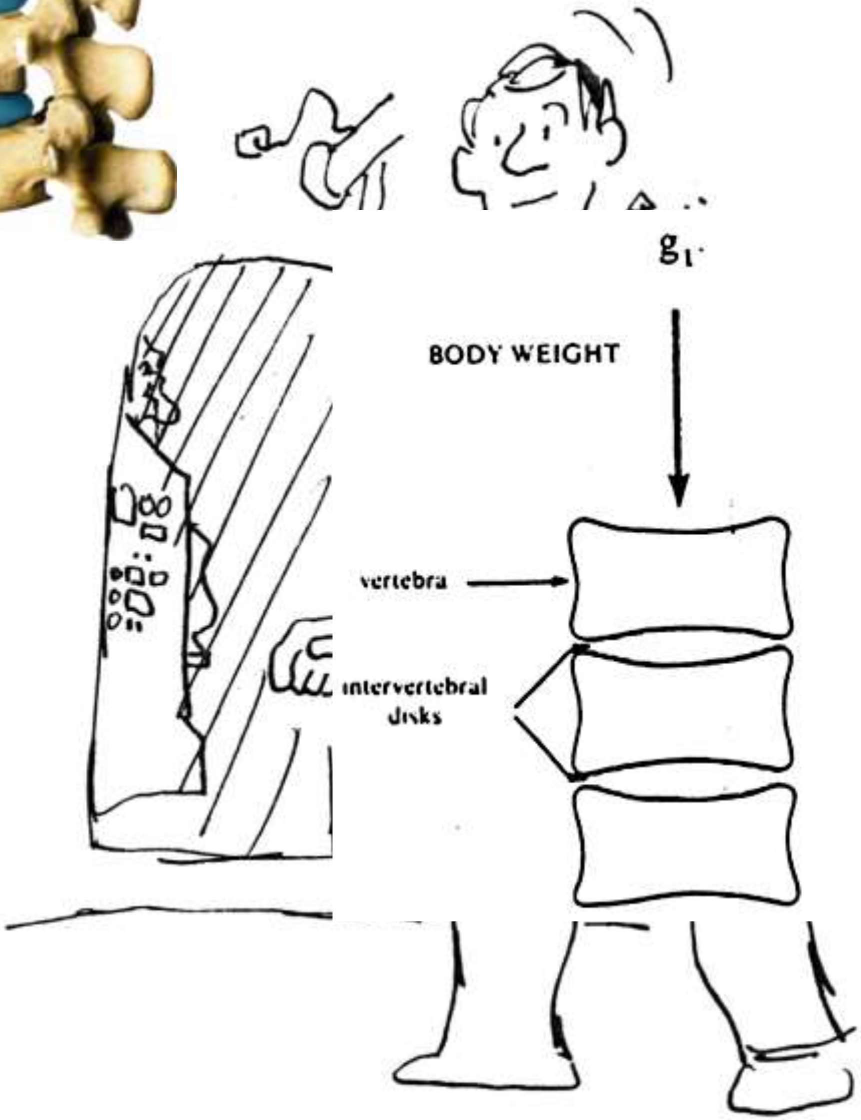
- Risk to long duration spaceflight
- Swelling of optic nerve
- Affects over two thirds of astronauts: 29% report degradation in near vision after short flights; 60% after long-duration











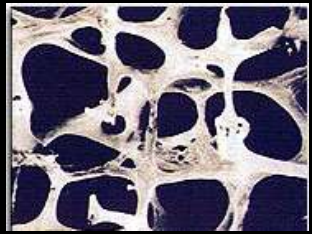
WE GREW TALLER

WE LOST ALL OF THE HEIGHT

The Spine in Space

- > 50% inflight back pain
- Medication
- Skin Suit

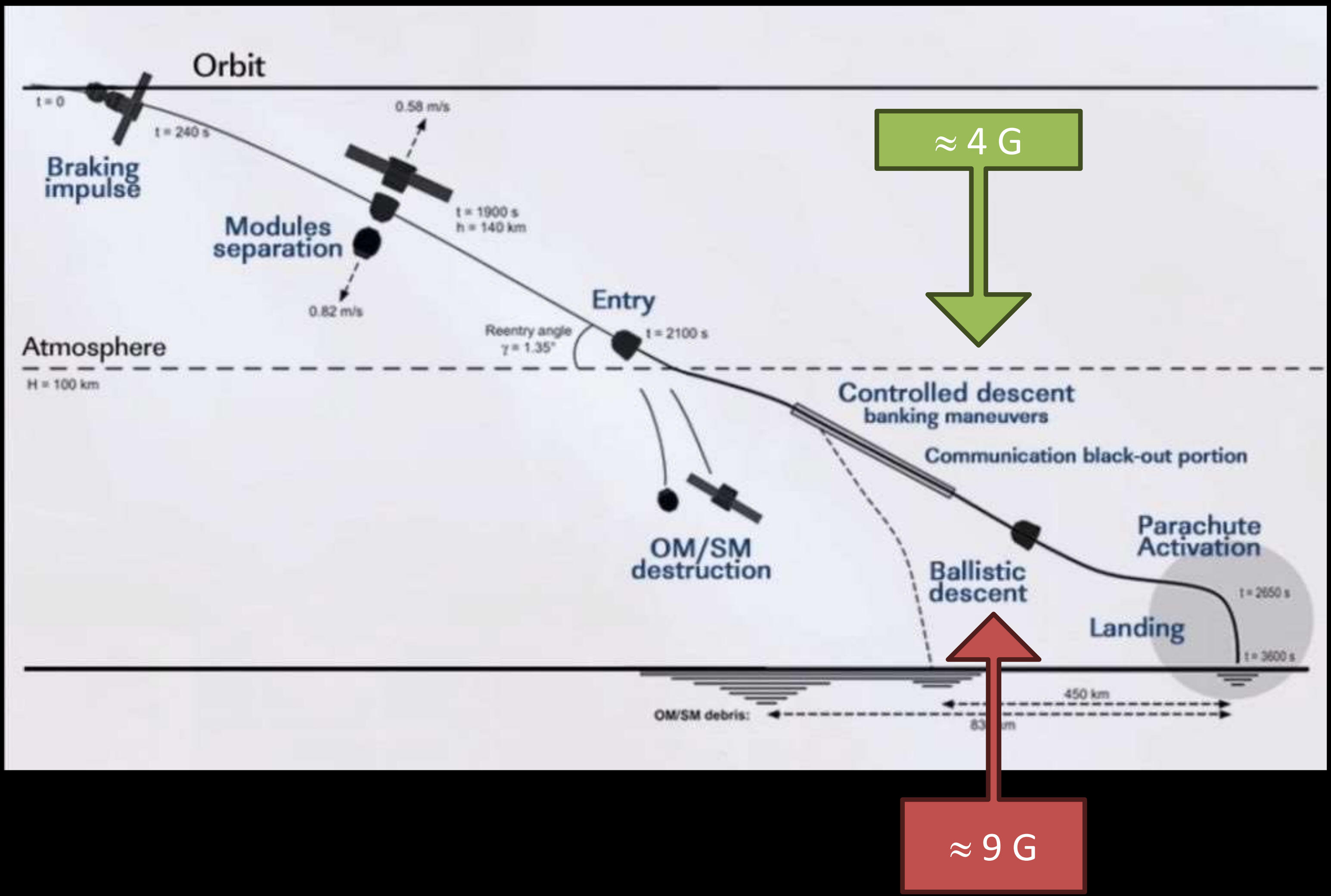
Desmineralización/Osteoporosis



- U.S. Skylab 4
  - 84 días
  - Pérdida media masa ósea: 4%
- Soyuz T-10
  - 237 días
  - Pérdida masa ósea: 13-19%
- Atrofia muscular

FIGURE 24-7 Senator John H. Glenn, Jr. pictured with the osteoporosis experiment in orbit (OSTEO) (photo courtesy National Aeronautics and Space Administration).

Reentrada y aceleraciones



OTROS

- EFECTOS PSICOSOCIALES
- SUPERVIVENCIA:
  - Contramedidas
  - Higiene a bordo, alimentación, etc…

- Confinamiento.
- Ciclo Sueño/Vigilia.
- Deprivación Sensorial.
- Pérdida de privacidad.
- Monotonía física y social.
- Higiene (ventilación, etc)

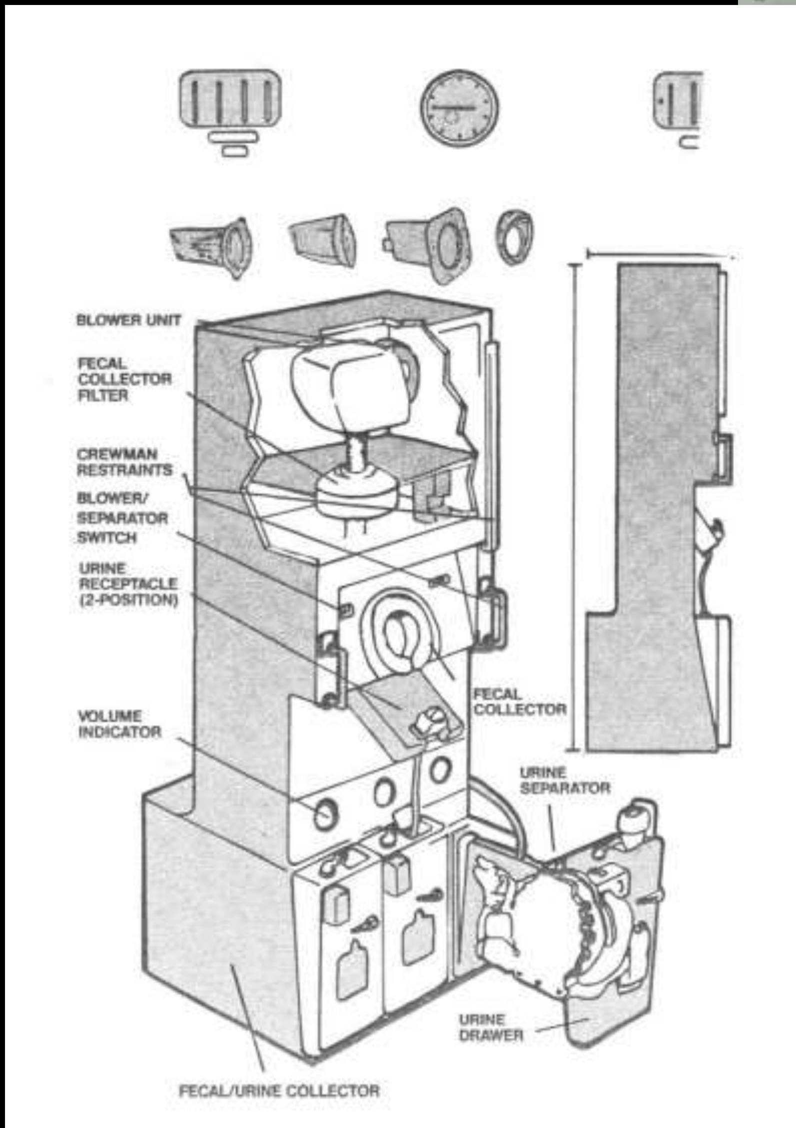

FGB

- Cambios en humor y moral.
- Conflictos personales (tripulación)
- Conflictos culturales (lenguaje, higiene…)
- Irritabilidad.
- Separación ambiente familiar y profesional.
- Aislamiento Emocional.
- Tensión y sobrecarga de trabajo

Perfil psicológico

- Tipo de misión
- Duración
- Equipo
- Convivencia previa
- CRM

Higiene y Alimentación



Pudin de plátano - misión Apolo (1968 y 1972)

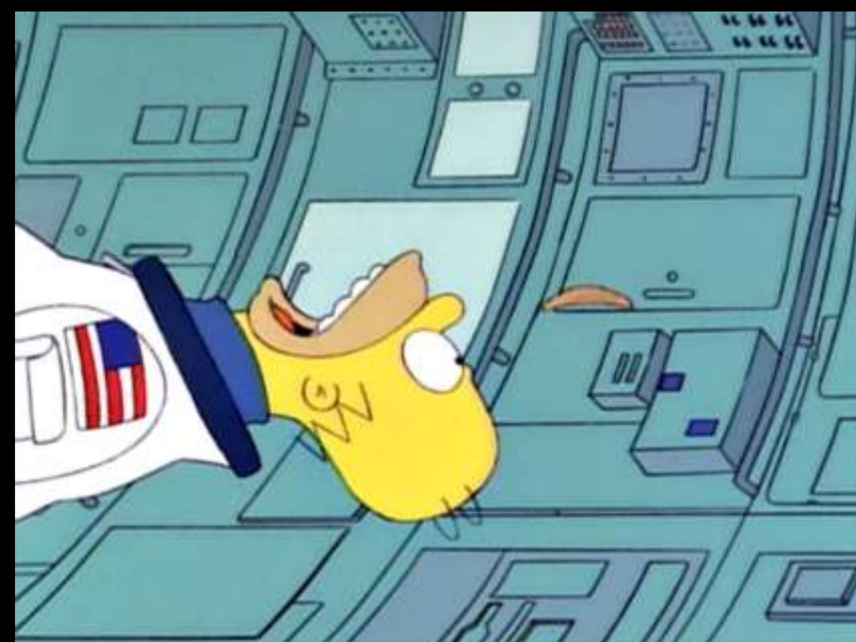
Desayuno instantáneo de vainilla - estación Skylab (1973-1974)

Espaguetis ISS (1994-2016)

Cóctel de gambas ISS (1994-2016)


NASA



Alimentación en proyecto Apollo

Pastel de piña

Te, limón

y azucar

Ternera con verduras

melocotón

Brownies

comida individual

de astronauta

Skylab





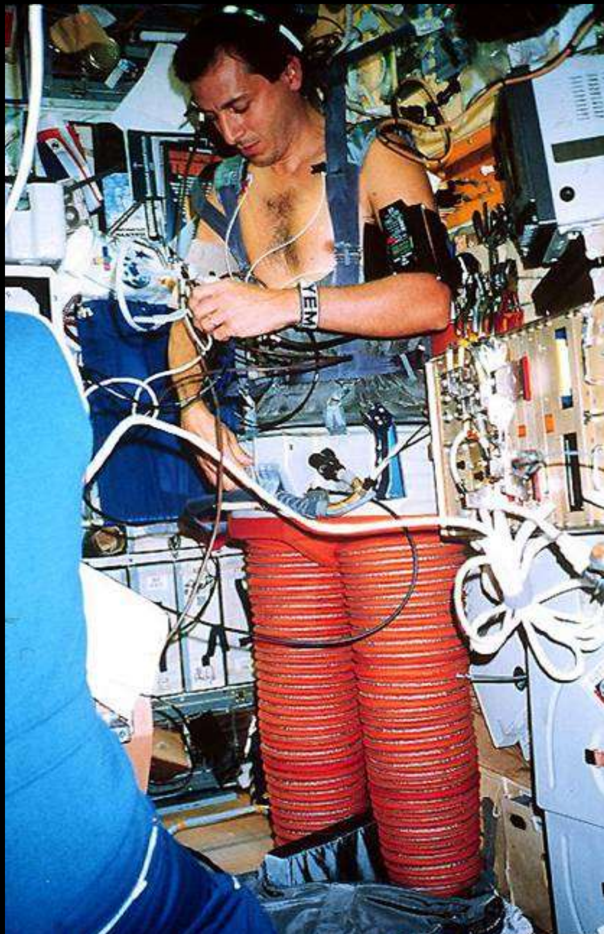
asc-csa.gc.ca

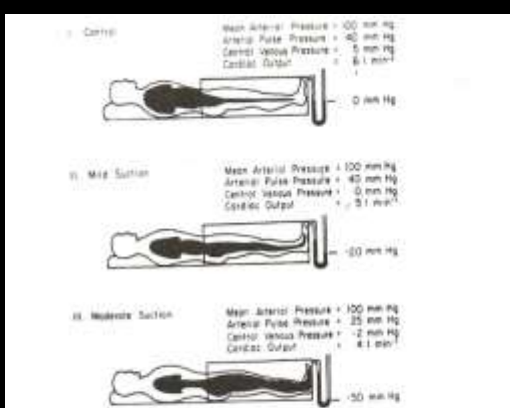
Ejercicio

Physical activity in space | Canadian Space Agency (asc-csa.gc.ca)


DECK


OVHD




Control
Mean Arterial Pressure = 100 mm Hg
Arterial Pulse Pressure = 40 mm Hg
Central Venous Pressure = 5 mm Hg
Cardiac Output = 6 l min⁻¹
0 mm Hg
Mild Suction
Mean Arterial Pressure = 100 mm Hg
Arterial Pulse Pressure = 40 mm Hg
Central Venous Pressure = 0 mm Hg
Cardiac Output = 5 l min⁻¹
-20 mm Hg
Moderate Suction
Mean Arterial Pressure = 100 mm Hg
Arterial Pulse Pressure = 25 mm Hg
Central Venous Pressure = -2 mm Hg
Cardiac Output = 4 l min⁻¹
-50 mm Hg

Agenda

Recuerdo Histórico

Fisiología Humana en el espacio

Requisitos médicos para viajar al espacio

Agenda

Recuerdo Histórico

Fisiología Humana en el espacio

Requisitos médicos para viajar al espacio

El proceso de selección

EL PAÍS

ARCHIVO

EDICIÓN IMPRESA

Hemeroteca

PORTADAS A LA CARTA

Regala algo diferente, reg
una portada

"Más de 8.000 personas se han presentado a la convocatoria.
Sólo 923 aspirantes superan la primera ronda de exámenes"

DOMINGO, 24 de agosto de 2008

SECCIONES EDICIONES SUPLEMENTOS

REPORTAJE:

¿Quiere ser astronauta?

La Agencia Europea del Espacio saca a concurso cuatro plazas de cosmonauta - Miles de candidatos han sido examinados; 900 pasan la primera criba

A la última convocatoria de la NASA en 2012 se presentaron más de 6.000 peticiones, el record histórico.

VIÑETAS · PAÍS VASCO

JOSÉ ÁNGEL MARTOS | 24 AGO 2008

Archivado en: ESA Agresiones físicas Astronautas Violaciones Agresiones sexuales Sudáfrica Integridad personal Astronáutica Organizaciones internacionales Delitos sexuales Gente Delitos

Selección astronautas ESA (1990-91)

- ✓Selección médica CIMA: > 600 → 11
- ✓Selección psicológica UAM: 5

2 0 0 0

Enviar
Imprimir
Guardar

¿Cuánto es 12 por 0? ¿Qué fórmula se utiliza para calcular el voltaje? Si un aeroplano ha sido recargado con 4.000 kilos de queroseno, que tiene un peso específico de 0,8, ¿cuántos litros hay dentro del depósito? Complete la frase "I would apply for the job if I... you" ("Yo presentaría mi solicitud para el trabajo si... tú").

El camino para ser astronauta comienza contestando con rapidez a preguntas similares a éstas -extraídas de un cuestionario de la Agencia Europea del Espacio (ESA)- y a otras bastante más difíciles. Así lo han hecho en Hamburgo durante todo el mes de julio los 923 candidatos cuyos excelentes currículos académicos y profesionales fueron considerados los mejores de entre más de 8.000 solicitudes para participar en la primera ronda de exámenes de la que saldrá la nueva promoción de astronautas europeos. Cuando finalice el durísimo proceso de selección, se escogerá tan sólo a cuatro hombres o mujeres.

Más de 8.000 personas se han presentado a la convocatoria

Sólo 923 aspirantes superan la

Cuatro elegidos para la gloria, destinados a protagonizar "futuras misiones tripuladas a la Estación Espacial Internacional (ISS, en sus siglas en inglés), la Luna y más allá",

Tres astronautas experimentados, Jeff Hoffman, Pedro Duque y Robert Thirsk, se encontraron en la sede de CosmoCaixa. / SUSANA SÁEZ

ESA, 2008

ESA, 2008

- **Primer "filtro":**
  - Respondieron inicialmente casi **10.000** personas de los 17 países miembros de la ESA
  - Se admitieron **8.413** solicitudes (preferentemente entre 27 y 37 años) que debían incluir un certificado médico conforme muestran las condiciones físicas equivalentes a las requeridas a un **piloto privado (Clase 2 JAR)**
- **Posteriores:**
  - Rapidez de cálculo, fluidez en inglés, habilidades matemáticas, conocimientos básicos de fundamentos tecnológicos, concentración, percepción, memoria visual…
  - Quedaron **200** a los que se realizan **pruebas psicológicas** destinadas a apreciar su comportamiento y personalidad en condiciones reales, con especial interés por cómo trabajan en grupo.
  - Quedaron **80**, a los que se someterá a un **chequeo intenso**: pruebas cardiovasculares, electroencefalogramas, hematología, neurología, obstetricia, salud dental...
  - Los **40 o 50** más idóneos son oficialmente los candidatos seleccionados, pero el orden en que aparezca cada uno lo decidirá una decisiva entrevista personal.

ESA, 2008


esa
esoc
SPACECRAFT
ISEE 2
MET 1
IUE
OTS 2
GEOS 2
MET 2-APPL
MARECS A
EXOSAT
ECS 1
ECS 2-TLC 1
LAUNCHER
SCOUT
THOR D
11:38
esa

2021

Último proceso de selección de astronautas en 2008…

¿Quién pudo aplicar?

All aspiring astronauts must fulfil requirements described in the vacancy notice. These include, but are not limited to:

- [ ] Citizen of an ESA Member or Associate Member State.
- [ ] Master's degree (or higher) in: natural sciences (including physical sciences, Earth, atmosphere or ocean sciences, biological sciences, medicine), engineering, mathematics, computer sciences; or an experimental test pilot degree.
- [ ] Three years' relevant professional post-graduate experience, showing progressive increase in responsibilities.
- [ ] Fluent in English (minimum CEFR C1). Knowledge of additional languages (minimum CEFR B1-B2) is an asset.
- [ ] Strong motivation and ability to cope with irregular working hours, frequent travel, and long absences from home, family and regular social life.
- [ ] Flexible with regards to place of work (inside or outside Europe).
- [ ] Calm under pressure.
- [ ] Willing to participate in life science experiments.

Fases del proceso de selección

Resultados 2021

Selection 2008		
Total number of candidates	8413	100,0%
Women	1287	15,3%
Men	7043	83,7%

Country	Male	Female	Total
Austria	349	115	**464**
Belgium	785	234	**1019**
Czech Republic	165	37	**202**
Denmark	110	36	**146**
Estonia	35	22	**57**
Finland	248	59	**307**
France	5475	1662	**7137**
Germany	2663	1037	**3700**
Greece	220	60	**280**
Hungary	116	34	**150**
Ireland	194	76	**270**
Italy	1507	353	**1860**
Latvia	60	21	**81**
Lithuania	62	18	**80**
Luxembourg	53	12	**65**
Netherlands	698	300	**998**
Norway	258	55	**313**
Poland	421	128	**549**
Portugal	256	61	**317**
Romania	199	56	**255**
Slovenia	49	13	**62**
Spain	1045	299	**1344**
Sweden	232	52	**284**
Switzerland	551	119	**670**
United Kingdom	1419	560	**1979**
Total	**17170**	**5419**	**22589**

Astronaut (with disabilty)

Candidates per country and gender for eligible countries			
Country	**Male**	**Female**	**Total**
Austria	2		2
Belgium	8	2	10
Denmark	1		1
Estonia	1		1
Finland	1		1
France	50	17	67
Germany	23	9	32
Greece	4		4
Hungary	3		3
Ireland	4		4
Italy	24	7	31
Latvia	2	1	3
Luxembourg	1		1
Netherlands	13		13
Norway	2	1	3
Poland	8	4	12
Portugal	4		4
Romania	8	2	10
Slovenia	1	1	2
Spain	10	3	13
Sweden	2		2
Switzerland	5	2	7
United Kingdom	20	11	31
Total	**197**	**60**	**257**

23 de noviembre de 2022

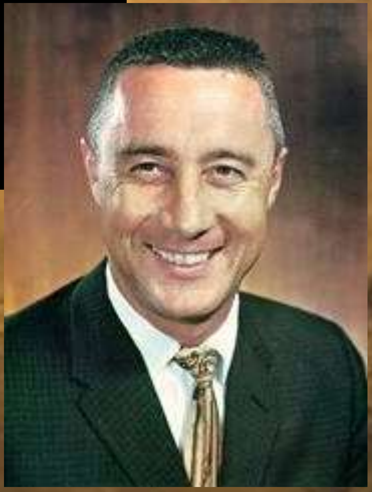
1992

2022

"Gus" Grissom fue el segundo astronauta EEUU durante los vuelos del Proyecto Mercury, y una de las tres primeras víctimas de la carrera espacial EEUU, junto a Edward White y Roger Chaffee en el incendio del Apolo 1.
Fue el primer astronauta en volar dos misiones, y el primer hombre que voló dos veces más allá del límite aceptado del espacio en una cápsula espacial.

"If we die we want people to accept it. We are in a risky business, and we hope that if anything happens to us, it will not delay the program. The conquest of space is worth the risk of life."

- Virgil I. "Gus" Grissom 1927 - 1967



Valter de J. Sabater, 2004

¡Muchas gracias por su atención!

Cor. Médico Beatriz Puente Espada

bpueesp@oc.mde.es