



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

CSmicro *g* lab
Computer Science & Microgravity LAB

Effects of microgravity in human health. What do we know?

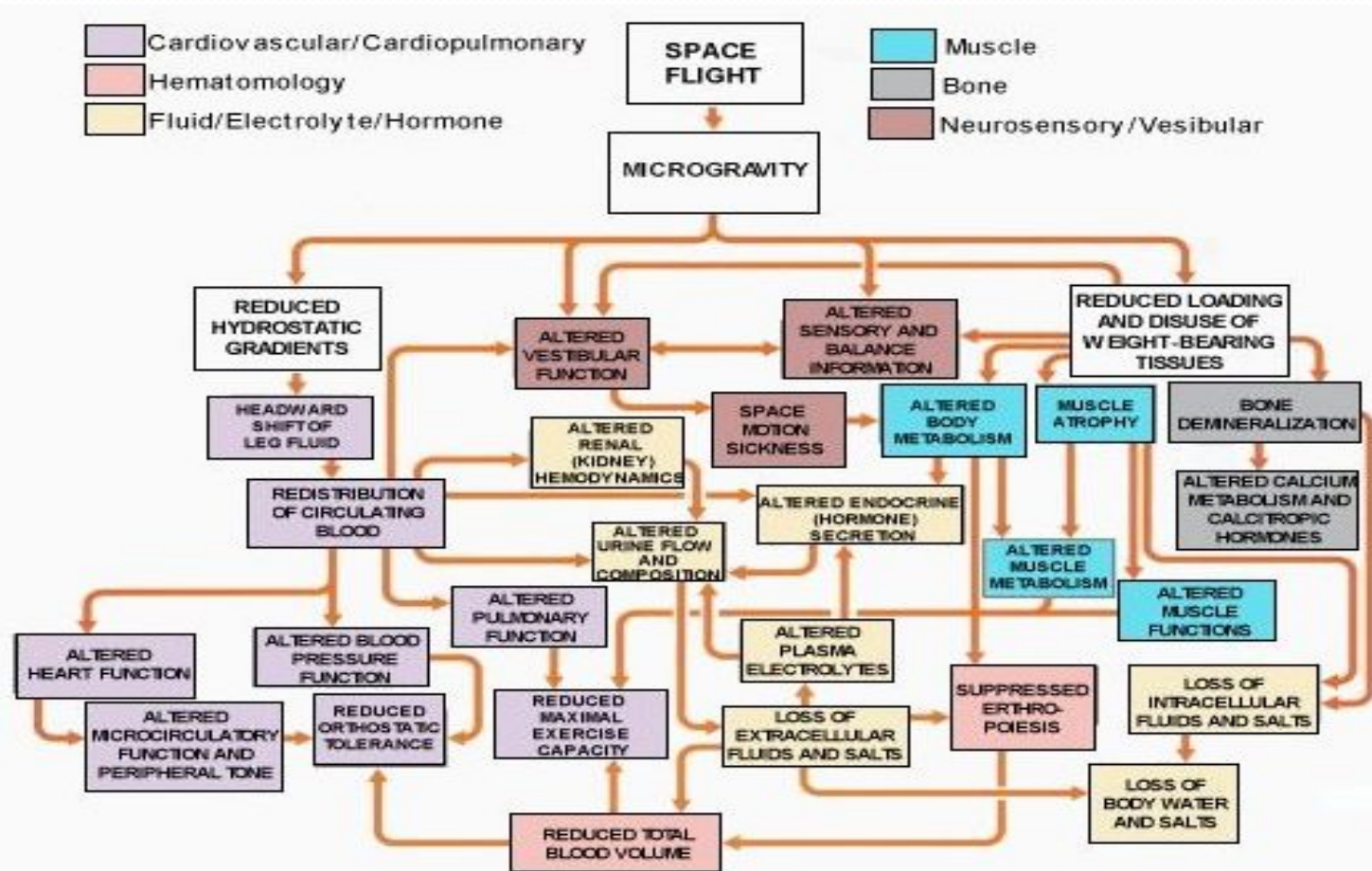
Trobades Científiques de la Mediterrània, 2023

Antoni Perez-Poch

UPC- Universitat Politècnica de Catalunya – BarcelonaTech

IEEC- Institut d'Estudis Espacials de Catalunya





Whole-body algorithm SLS-1

Cardiovascular
system

Osteoporosis

Space Radiation

Muscular distress

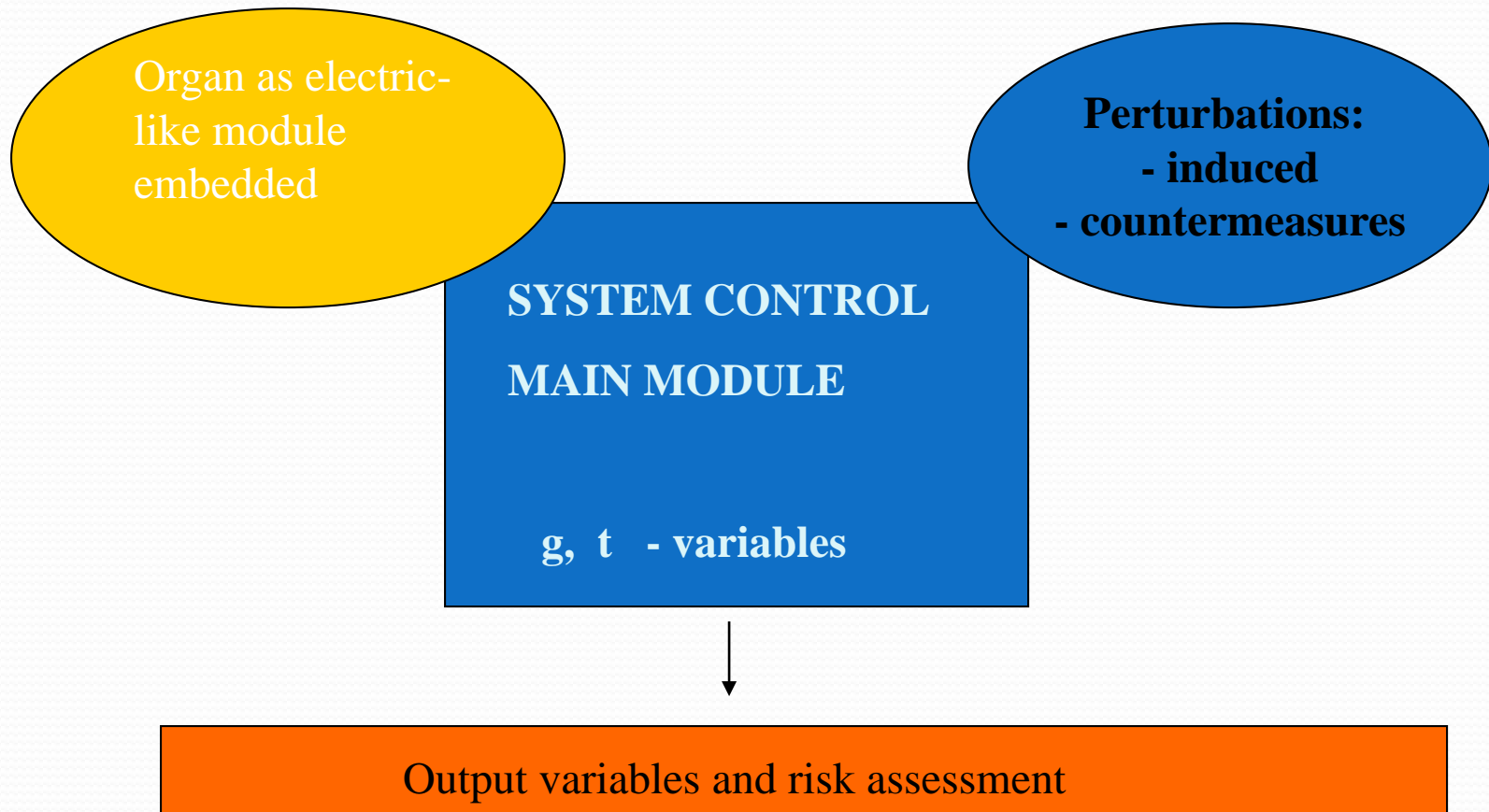
Psychology

Immuno system



Spaceflight effects on human body– Beau and Alan Daniels

NELME- Numerical Evaluation of Long-Term Effects

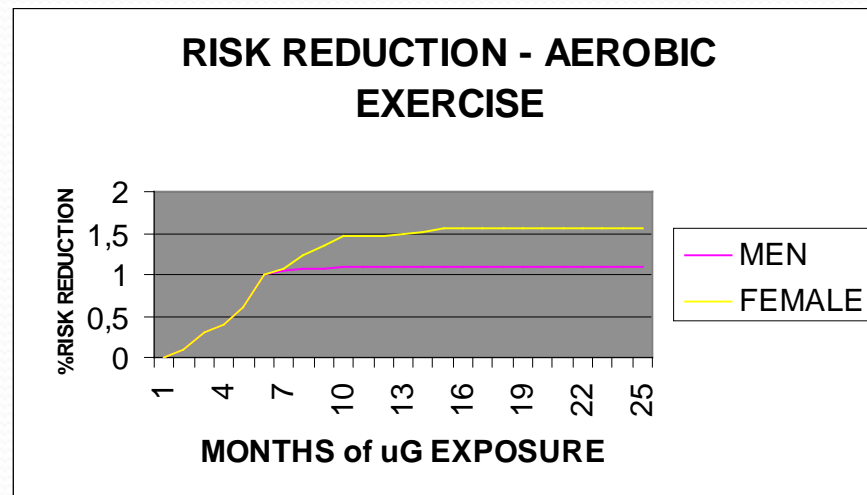


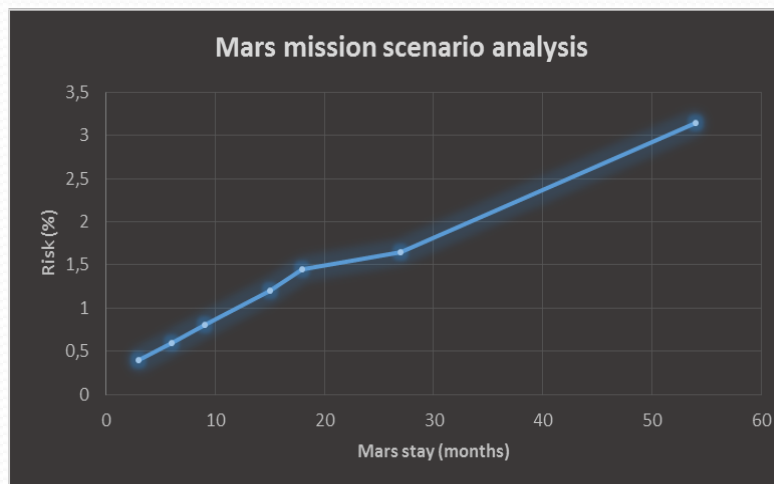
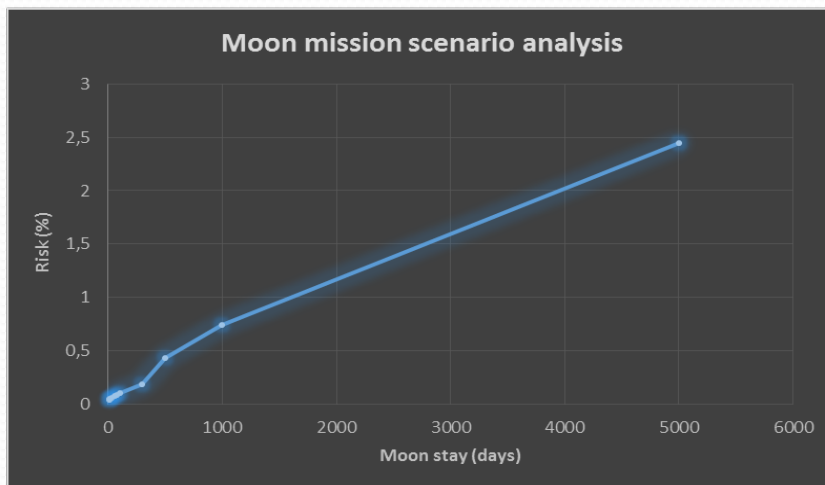
NELME - Numerical Evaluation of Long-Term Effects

VALIDATION :Assess accuracy of model at zero-g ---compared to published data.

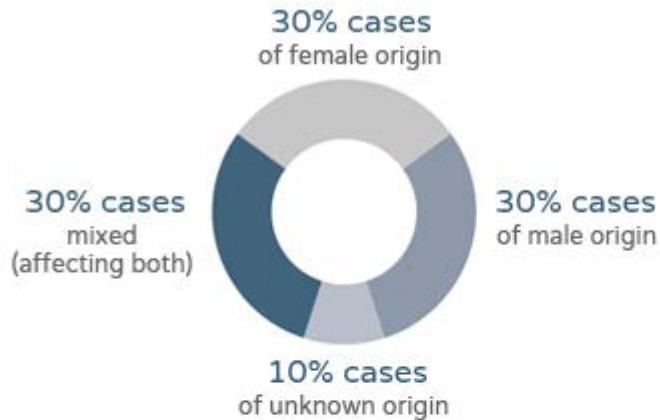
Orthostatic intolerance assessment compared to experimental data

Diaz-Artiles A., Heldt T., Young L.R., “Computational model of cardiovascular response to centrifugation and lower-body cycling exercise”. J. Appl. Physiol. (2019).





Human Reproduction: Assisted Reproduction Techniques



- In-Vitro Fertilization
- Criopreservation of gamets and embryos

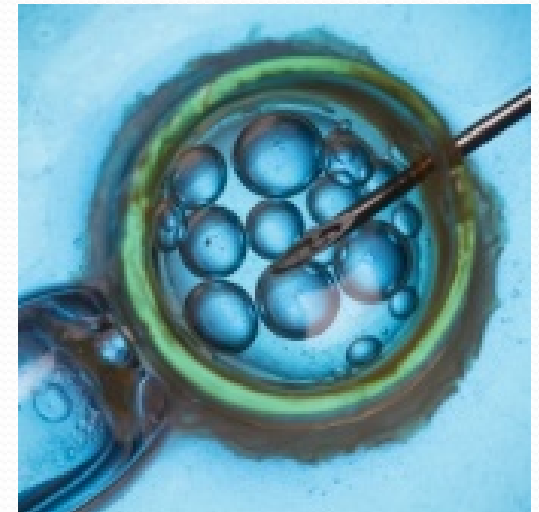
More common than you think

Fertility disorders affect **15% of couples wanting to have children.**

15% of the population is affected by lowered fertility

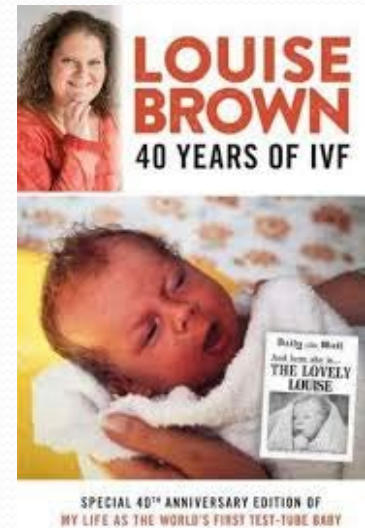


90% of this percentage can be diagnosed





Assisted
Reproduction
Techniques
on Earth



...and in Space? ... in microgravity?

Model animal:

Journal of Andrology, Vol. 24, No. 6, November/December 2003
Copyright © American Society of Andrology

Effect of Simulated Microgravity on Testosterone and Sperm Motility in Mice

HIROYUKI KAMIYA,* SHOICHI SASAKI,* TAKAHITO IKEUCHI,* YUKIHIRO UMEMOTO,*
HIROYUKI TATSURA,* YUTARO HAYASHI,*, SHIGEO KANEKO,† AND KENJIRO KOHRI*

From the *Department of Nephro-urology, Nagoya City University Graduate School of Medical Science, Nagoya, Japan; and the †Department of Urology, Asahikawa Medical College, Asahikawa, Japan.

OPEN ACCESS Freely available online



Detrimental Effects of Microgravity on Mouse Preimplantation Development In Vitro

Sayaka Wakayama¹, Yumi Kawahara², Chong Li^{1,3}, Kazuo Yamagata¹, Louis Yuge², Teruhiko Wakayama^{1,3*}

¹Laboratory for Genomic Reprogramming, RIKEN, Center for Developmental Biology, Kobe, Japan, ²Division of Bio-Environment Adaptation Sciences, Graduate School of Health Sciences, and Space Bio-Laboratories, Hiroshima University, Hiroshima, Japan, ³Department of Bioscience, Graduate School of Science and Technology, Kwansai Gakuin University, Sanda, Japan

Humans (exp. Micro-11):

NASA Sends Human Sperm to the International Space Station

Astronauts will study how microgravity affects the motility of the little swimmers



By Jason Daley
SMITHSONIAN.COM
APRIL 10, 2018

www.smithsonianmag.com

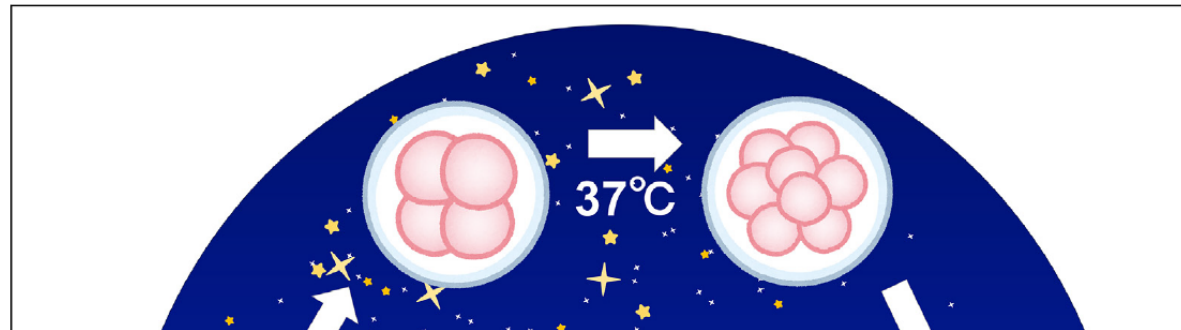
BREAKING

iScience

CellPress
OPEN ACCESS

Article

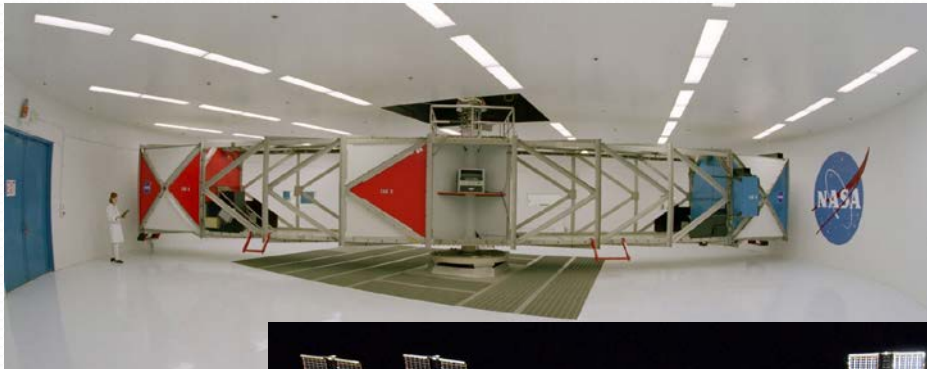
Effect of microgravity on mammalian embryo development evaluated at the International Space Station



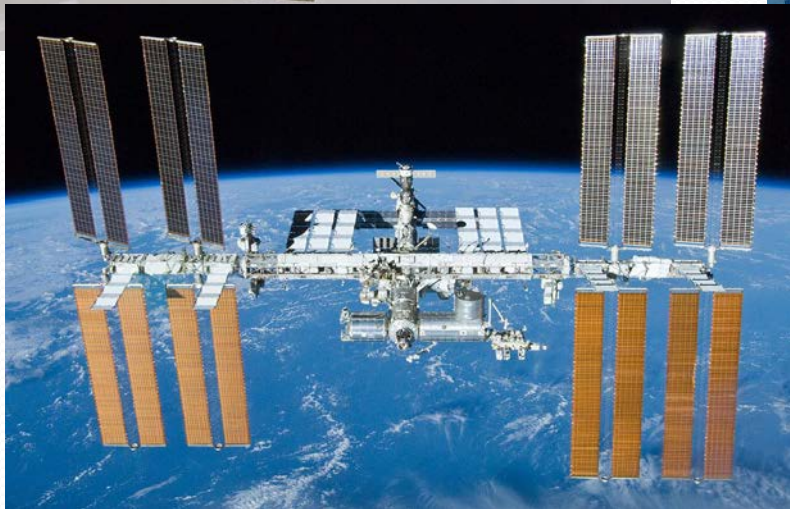
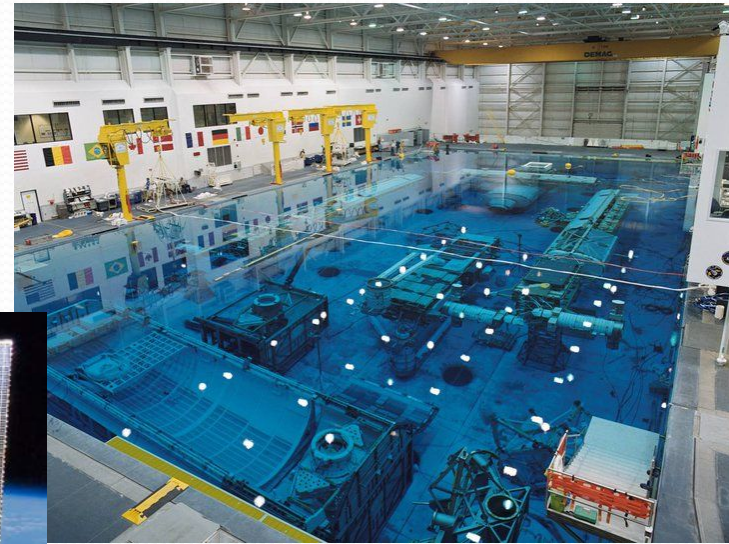
Sayaka Wakayama,
Yasuyuki Kikuchi,
Mariko Soejima, ...,
Atsuo Ogura,
Takashi Kohda,
Teruhiko
Wakayama

Space Exploration: gravity levels

Hypergravity



Hypogravity, reduced gravity



Microgravity

Microgravity research

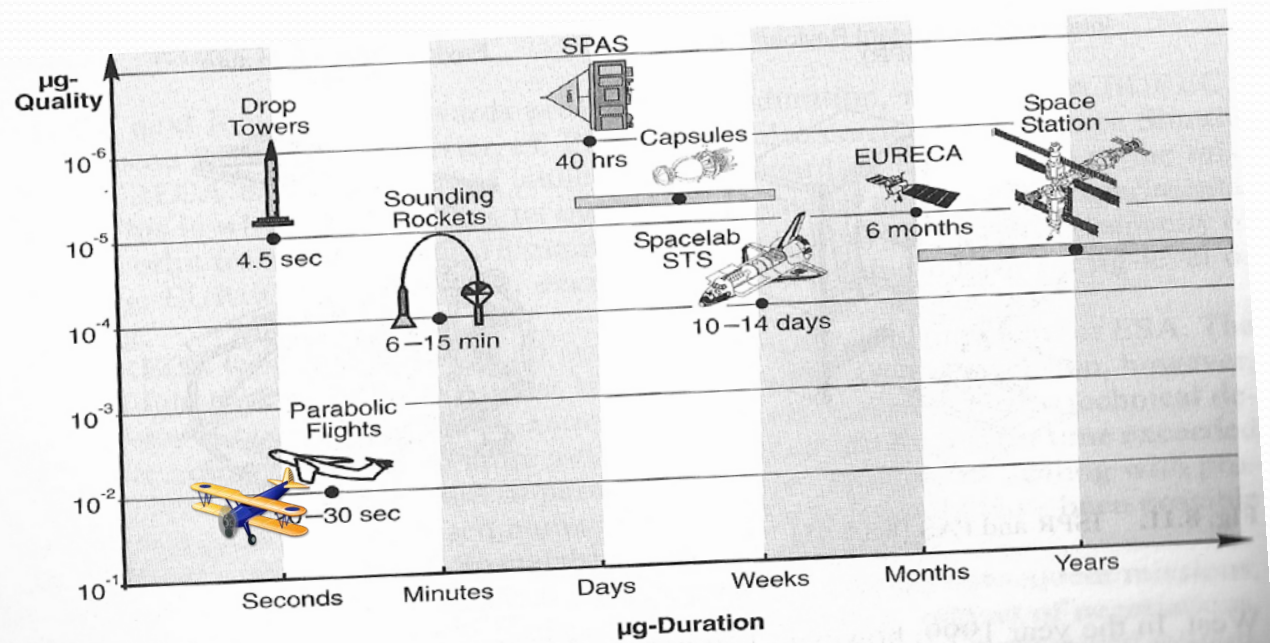


Fig. 8.12. Microgravity Duration and Quality for Different Flight Opportunities

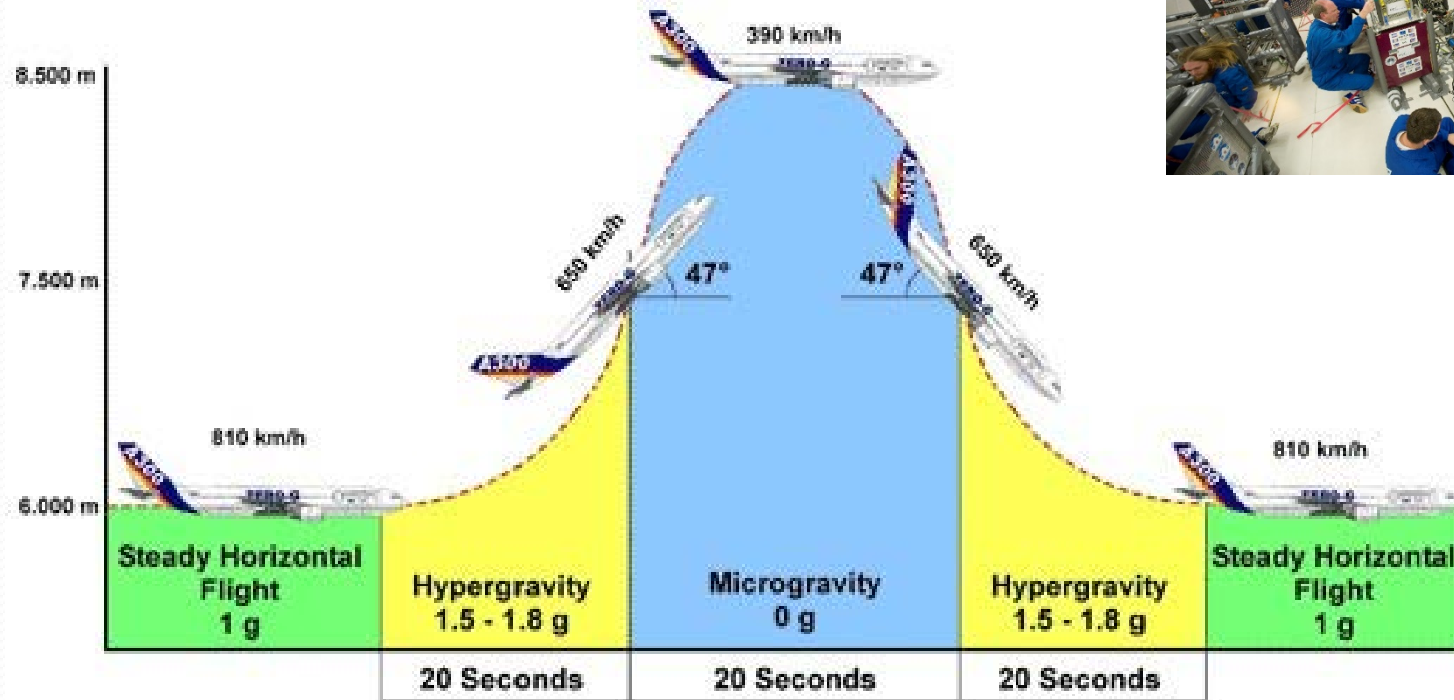
After "Space Stations. Systems and utilisations"
E.Messerschmid, R.Bertrand. Springer (2002)



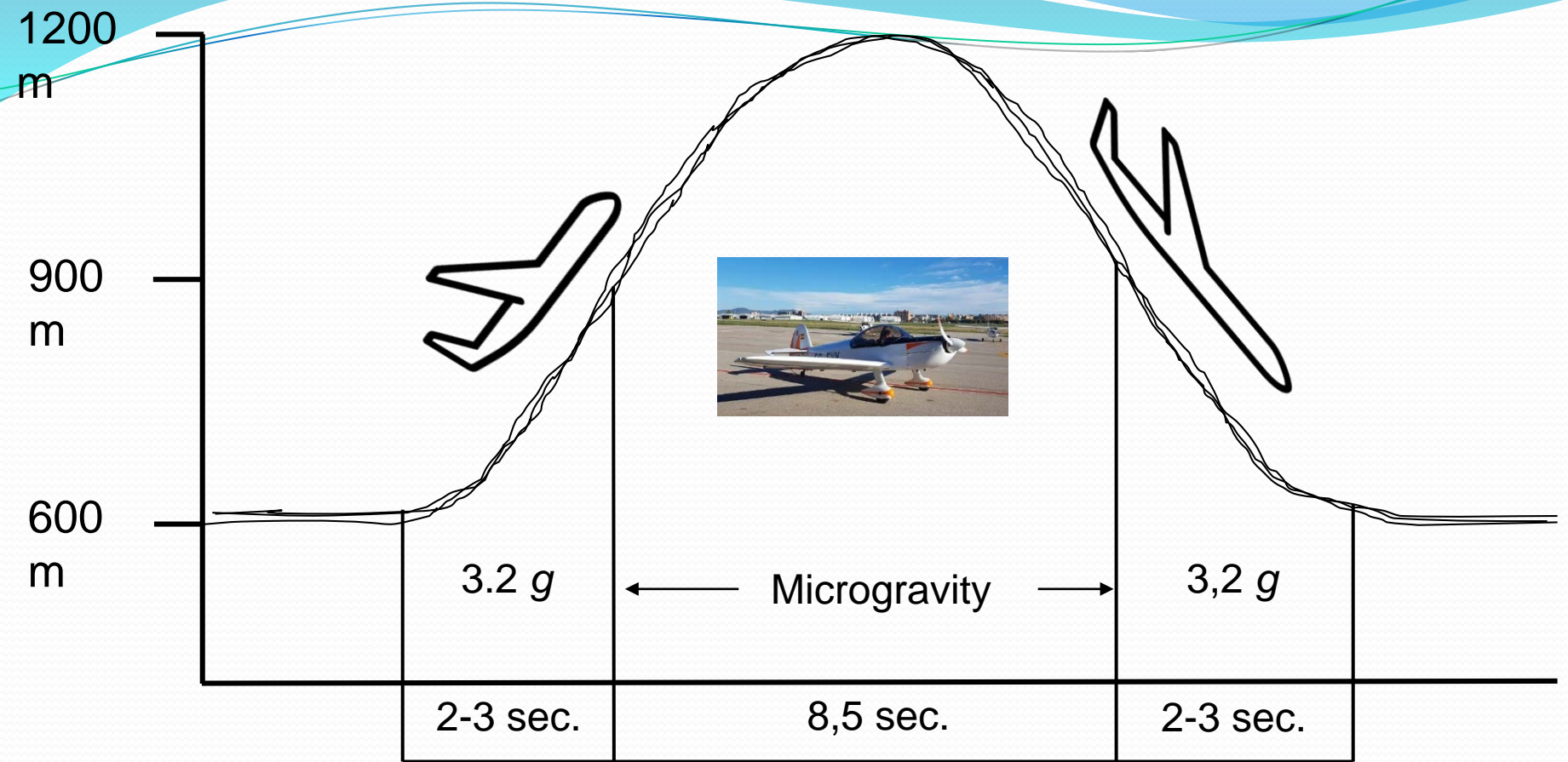


Parabolic flights

ESA – Novespace Airbus 310



Credit: Novespace

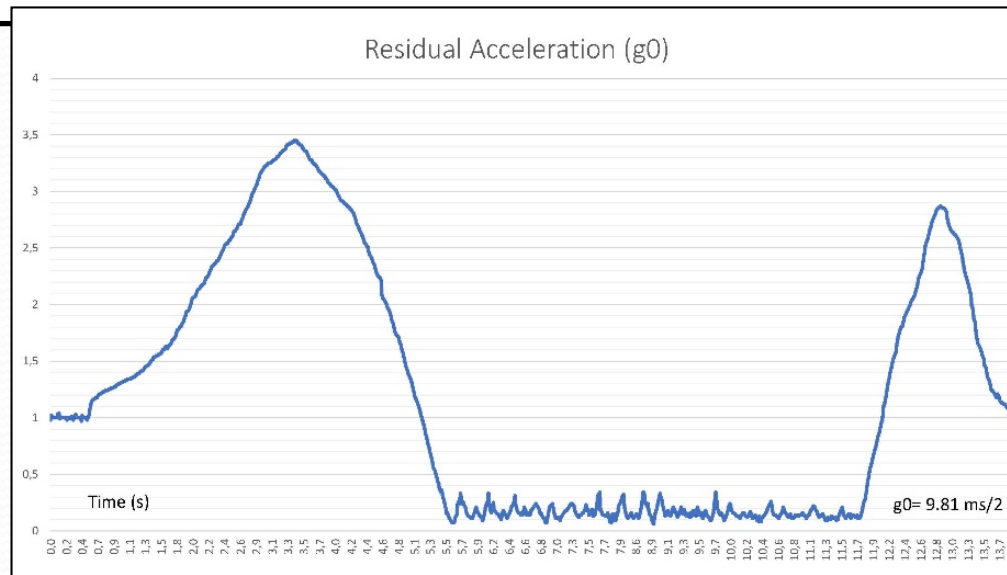


Perez-Poch A., González D.V., López D., "Hypogravity research and educational activities in Barcelona: a new hub of innovation in Europe", *Microgravity Science and Technology* (2016). doi:10.1007/s12217-016-9516-7

Fast gravity load changes

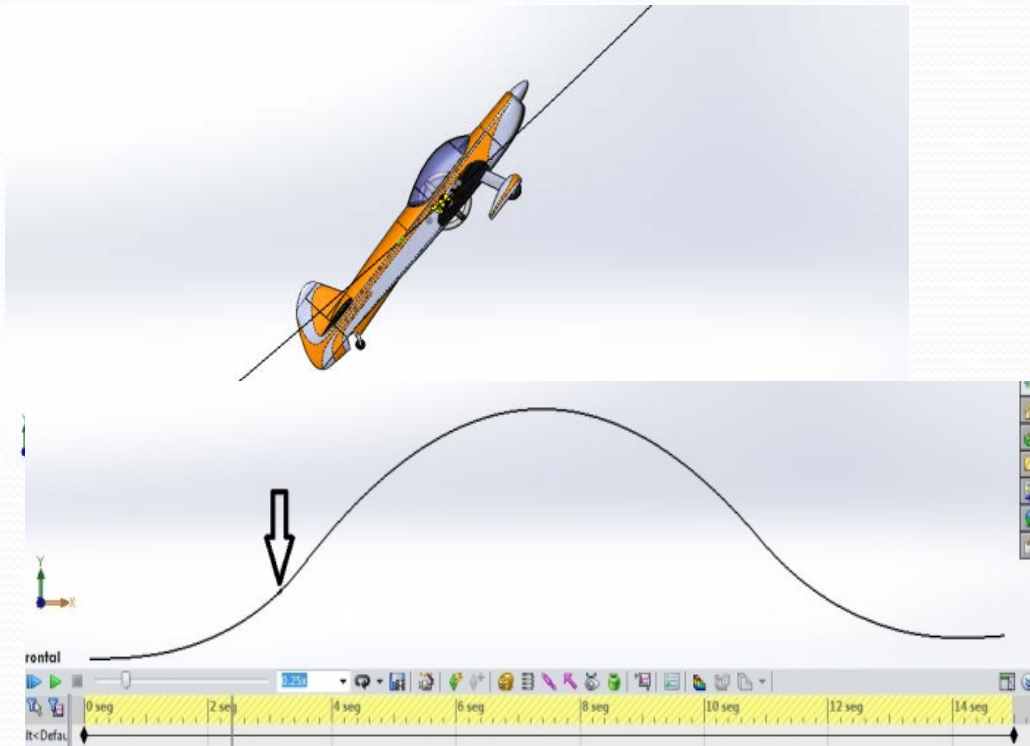
Single-engine aerobatic aircraft (Sabadell Airport)

- Up to 8.5 seconds of microgravity at 0.005 g0



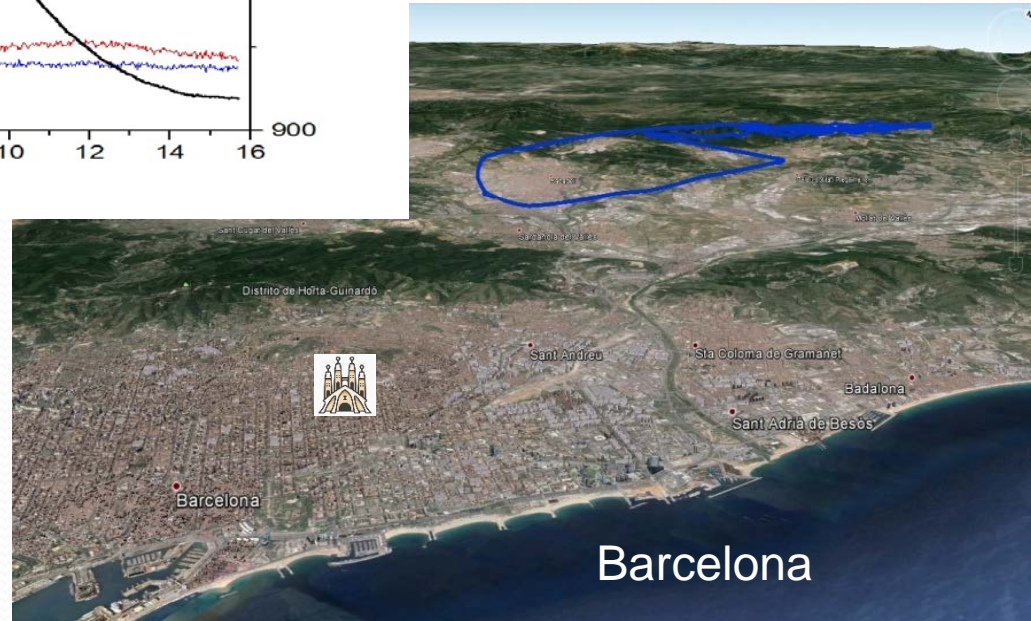
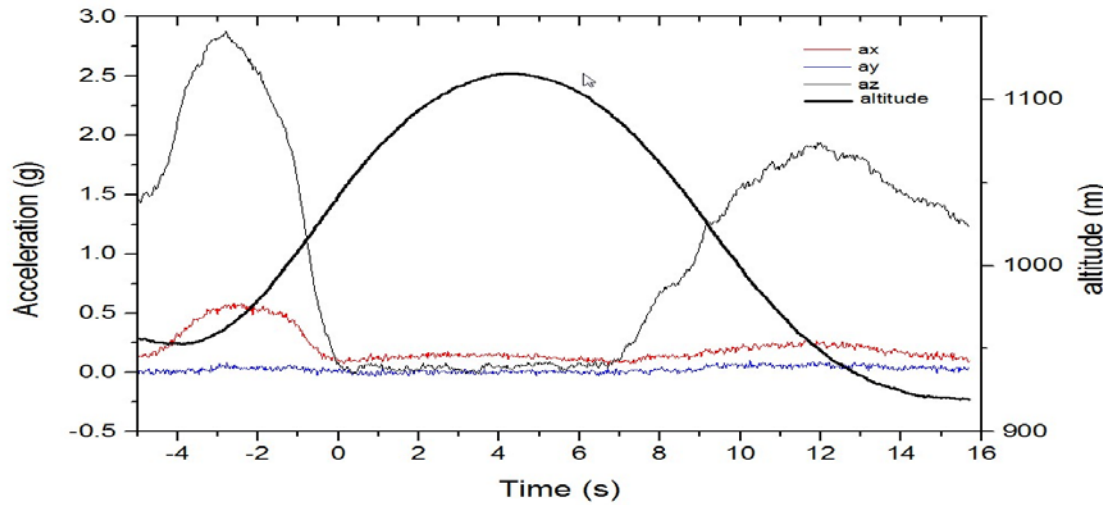
Torner J.; Brigos, M.; Perez-Poch, A.; Alpiste, F. **Dispositive for achieving absence of gravity in a light aircraft.**
Registration number: **P201431164. Invention patent.** Date of registration: 31/07/2014, Spain. Property-holding institution:
Universitat Politècnica de Catalunya. Company: Aeroclub Barcelona-Sabadell.

Optimization: ad-hoc flight simulator(Solidworks)



Brigos M., Perez-Poch A. et al. "Parabolic flights with single-engine aerobatic aircraft: flight profile and a computer simulation for its optimization. " *Microgravity Science and Technology*. 4 **26** pp. 229-239 (2014).

Flight operations



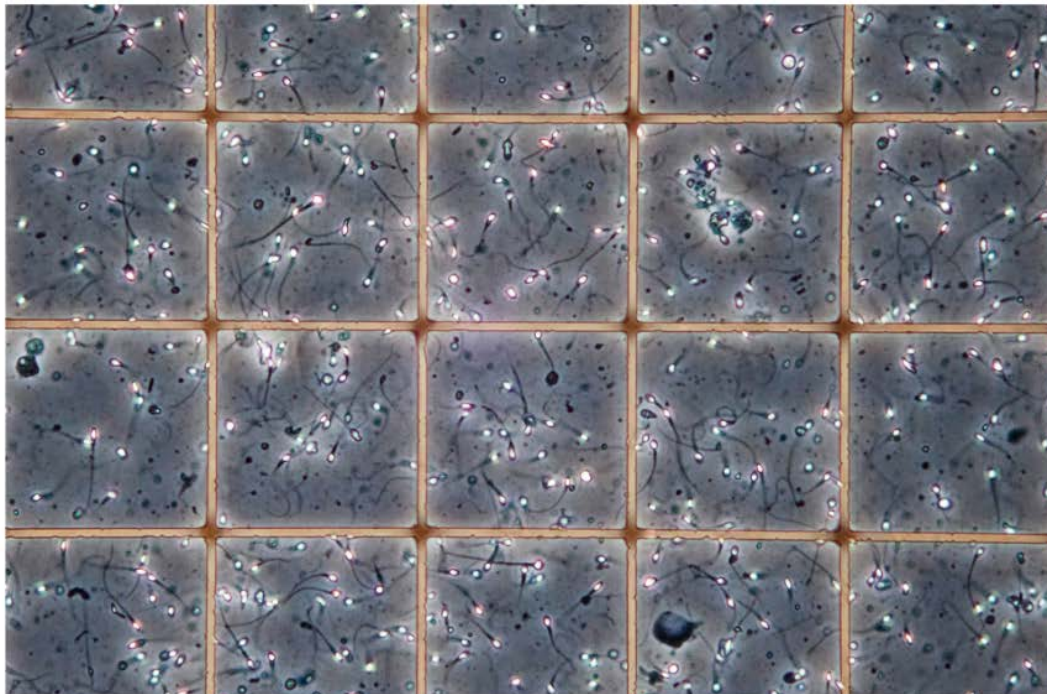
Considering using a sperm bank on space

WIRED

BUSINESS CULTURE GEAR IDEAS SCIENCE SECURITY TRANSPORTATION

Scientists Take Baby Steps Toward Extraterrestrial Babies

Can sperm survive microgravity? Do eggs hold up to radiation? The new science of off-planet procreation is now getting underway.





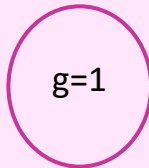
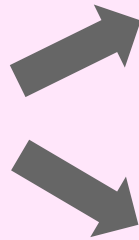
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Material and Methods



15 Sperm Samples



Sperm
analysis

Sperm
analysis



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Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Acta Astronautica

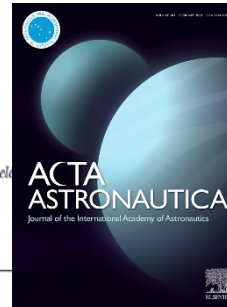
journal homepage: www.elsevier.com/locate/actaastro



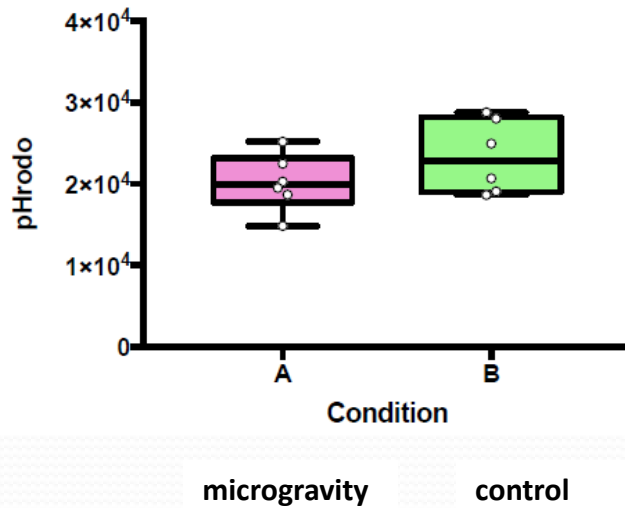
Effects of rapid gravity load changes on immunophenotyping and leukocyte function of human peripheral blood after parabolic flight

Abril Gorgori-González^{a,*}, Antoni Perez-Poch^b, Daniel V. González^c, Roser Salvia^d, Laura G. Rico^d, Michael D. Ward^e, Jolene A. Bradford^e, Jordi Petriz^d, Ginés Viscor^a

^a Department of Cell Biology, Physiology and Immunology, Universitat de Barcelona, Av. Diagonal, 643, Barcelona, Spain
^b Universitat Politècnica de Catalunya, Institut d'Estudis Espacials de Catalunya (IEEC), EEBC Campus Diagonal-Besòs, c. E. Maristany 16, E08019, Barcelon
^c Barcelona-Sabadell Aviation Club, Sabadell Airport, ctra. Bellaterra s/n, E080205, Sabadell, Barcelona, Spain
^d Germans Trias i Pujol Research Institute (IGTP), Ctra de Can Ruti, Camí de les Escoles s/n, 08916, Badalona, Barcelona, Spain
^e ThermoFisher Scientific, Eugene, OR, USA



Single cells (Phagocytes)



+ The Barcelona ZeroG Challenge

BARCELONA ZEROG CHALLENGE

Win an Aerobatic Zero-G Flight for your experiment along
with a 2.500 euro-grant for your microgravity research team



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SPACE GENERATION
ADVISORY COUNCIL



L'AEROCUB
BARCELONA SABADELL

Twitter: @BarcelonaZeroG Facebook group: Barcelona ZeroG Challenge

Informació: <http://window2theuniverse.org> <https://bit.ly/2NrdWp4>



Por quinto año consecutivo, la antoqueña Lina Hernández se coronó campeona nacional de contrarreloj. Esta ciclista más completa del país brilla en la ruta y en la pista. / Deportes p. 20

#Fuerza

Indicadores económicos

INDICADORES ECONÓMICOS	VALORAS
INDICADOR	VALOR
SOLAR EN CASAS DE CAMBIO	10.000
COMPRA	10.000
VENTA	10.000
OT	10.000

135 EL ESPECTADOR

BOGOTÁ COLOMBIA FUNDADO EN 1887 N° 39.356 11 DE FEBRERO DE 2022 24 PÁGINAS www.espectador.com ISSN 0022-856 \$1.900



Al infinito y más allá

Vera Gravitats está conformado por cuatro ingenieras aeroespaciales y mecánicas, cuyo objetivo es visibilizar a la mujer como parte de varios proyectos de investigación científica. Recientemente ganaron el Barcelona ZeroG Challenge, un concurso que reta a los estudiantes de todo el mundo a diseñar un experimento para volar en gravedad cero. / Tema del día p. 2

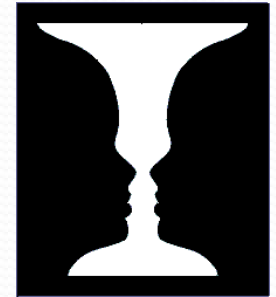
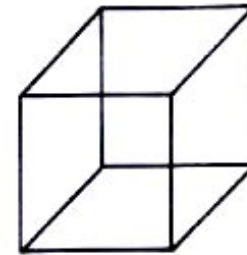


UdeA El equipo Vera Gravitats de la UdeA ganó el concurso Barcelona ZeroG

+ The Barcelona ZeroG Challenge



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IRIS Experiment
Prof. Gilles Clément (ISU)

