



clay-colored thrush

Gravity in life and physical sciences

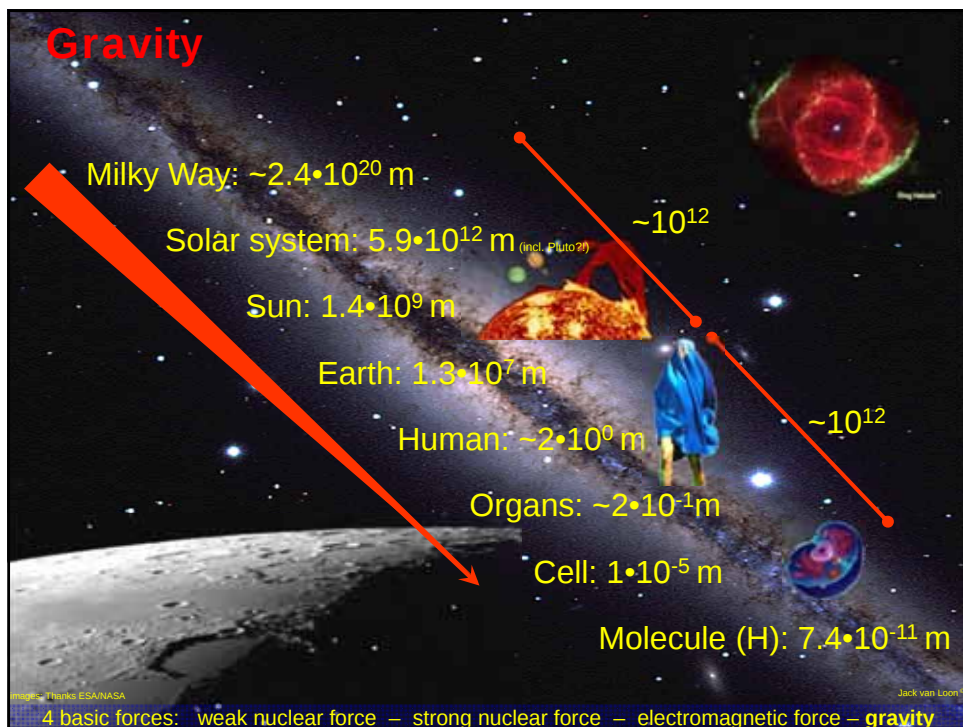
Dr.ing. Jack J.W.A. van Loon
(j.vanloon@vumc.nl)

Dutch Experiment Support Center & 3D InnovationLab
Dept. Oral and Maxillofacial Surgery / Oral Pathology
VU University Medical Center (VUmc) &
Academic Centre for Dentistry Amsterdam (ACTA)
Amsterdam, NL

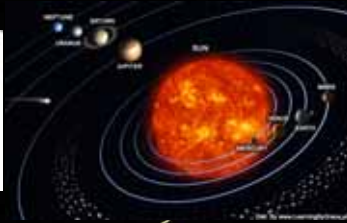
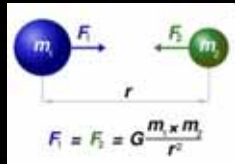
Collaborating Scientist at:
TEC-MMG, Life- and Physical Science
Instrumentation Laboratory (LIS)
ESA-ESTEC, Noordwijk, The Netherlands

United Nations/Costa Rica Workshop on Human Space Technology
San José, Costa Rica, 7 March – 11 March 2015

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Gravity and Mass



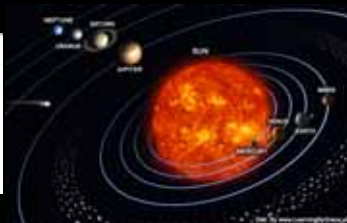
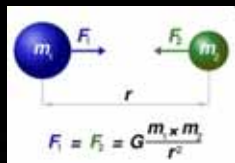
$$F = m \times a$$

i.e.

$$F = m \times g$$

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Gravity and Mass



regular balloons ~15 cm



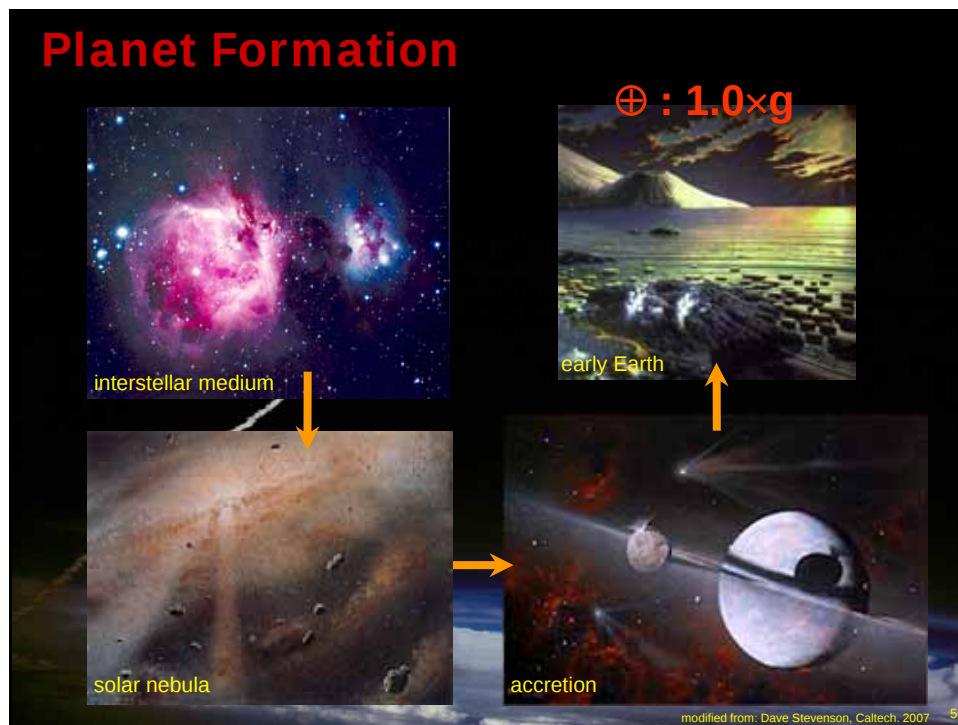
Large Diameter Centrifuge, LDC
ESA-ESTEC Noordwijk, NL



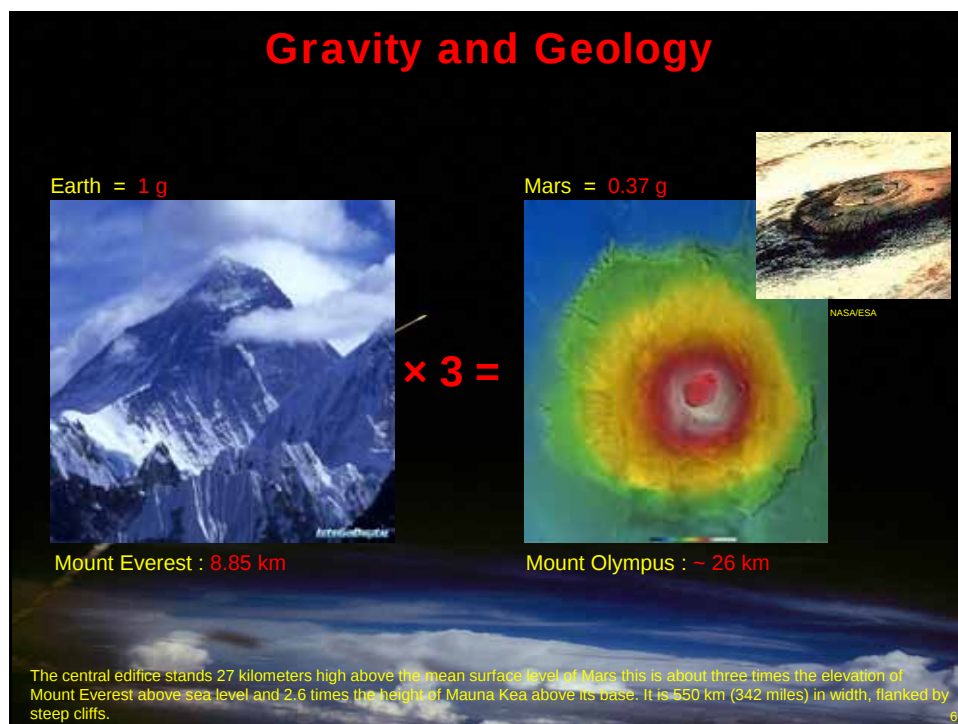
air (light) vs water (heavy) balloon

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Planet Formation



Gravity and Geology



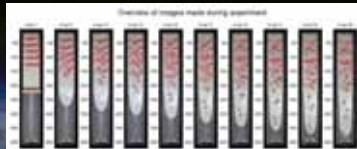
LDC for Glacier / Geological Research



SYT-2014: Glacier: Darko Radakovic,
Rachael Chambers, Univ. of Amsterdam



ESA=LDC
Centrifuge

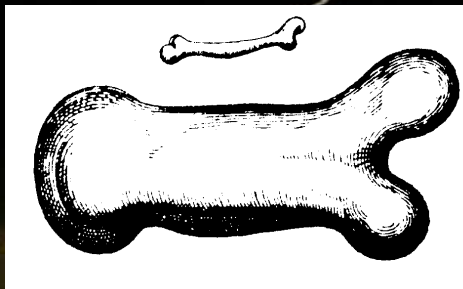


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Gravity (Weight) and Living Systems



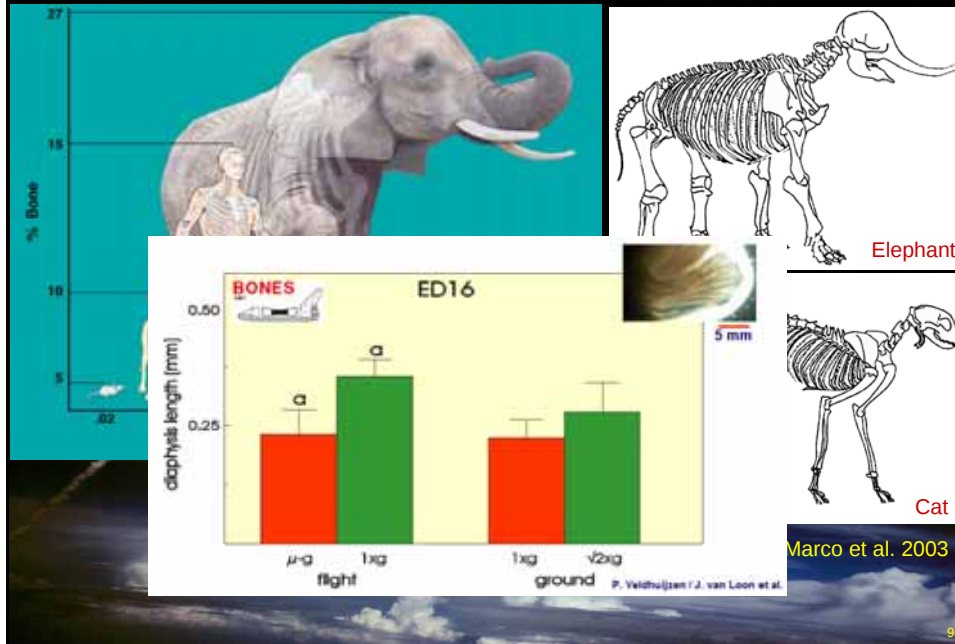
Galileo Galilei
1564 - 1642



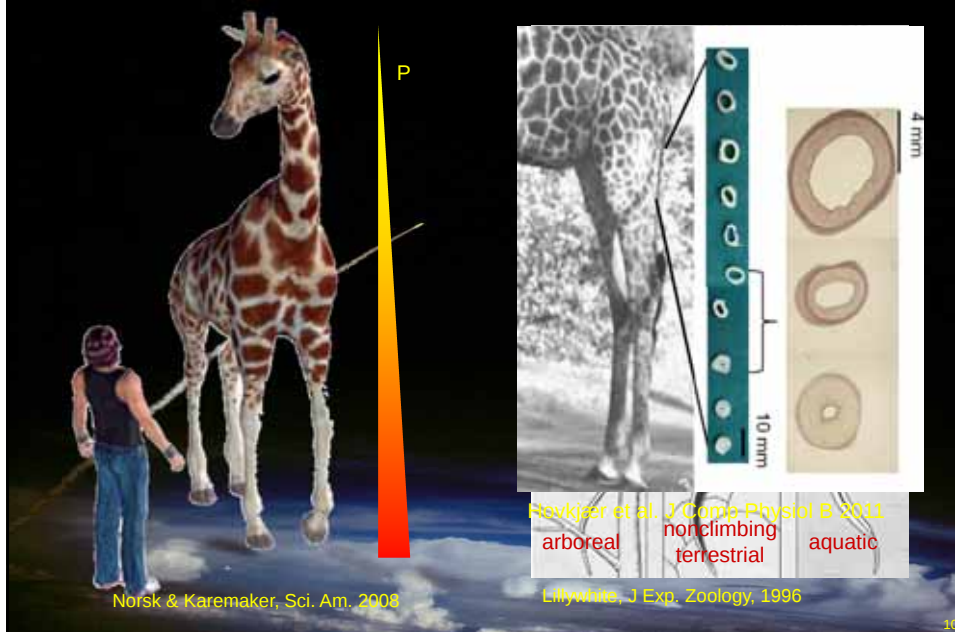
**Galileo: "Man cannot
build a house, nor nature
can construct an animal
beyond a certain size
without altering the
design or material"**

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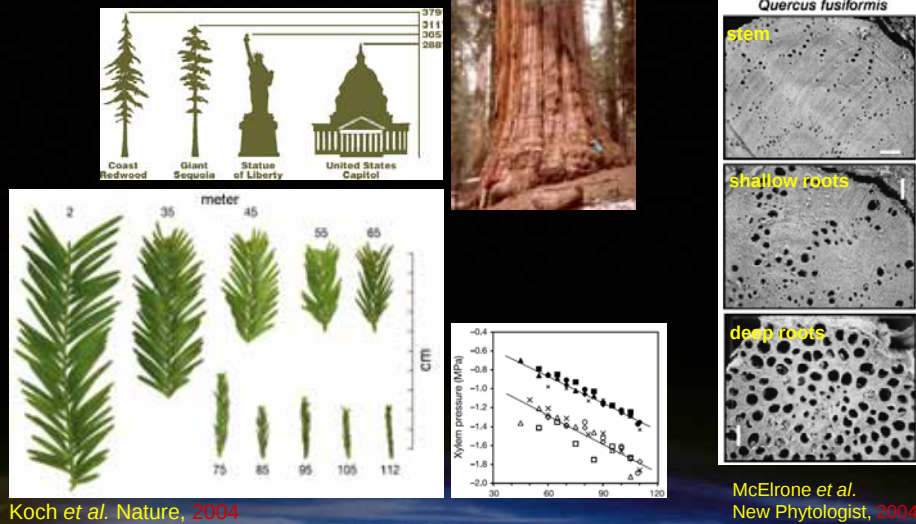
Gravity and Terrestrial Life



Gravity and Hydrostatic Pressure



Hydrostatic pressure : trees



The universal influence of gravity on water potential gradients in tall trees underlies structural changes in photosynthetic tissues that, along with increased stomatal regulation, reduce photosynthesis and carbohydrate availability for height growth.

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Gravity and Terrestrial Life

375 million years ago



Fossil fish bridges evolutionary gap between animals of land and sea. (Zina Deretsky, National Science Foundation, 2006)

"The skeleton of *Tiktaalik* indicates that it could support its body under the force of gravity whether in very shallow water or on land." (Farish Jenkins, Harvard Univ.)

Shubin *et al.*, Nature, 2006

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Gravity and Buoyancy Examples

Two phase flow in 'horizontal' tube

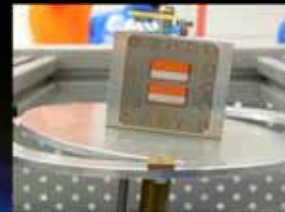
1g



μ g



Fluid / air bubbles
(NASA, ISS, Don Petit)



Fluid different viscosity
(ESA/ULB, parabolic flight, Belgium)¹

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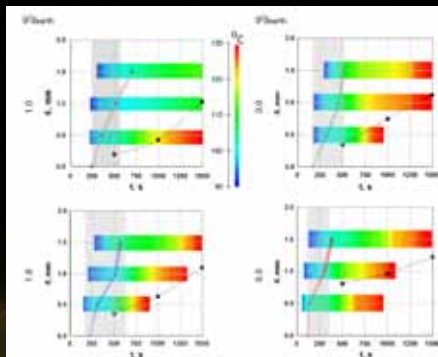
Mass & Heat Transfer @ altered Gravity



T. Karapantsios, Univ. Thessaloniki, Greece



Set-up in LDC



comparisons of crust thickness

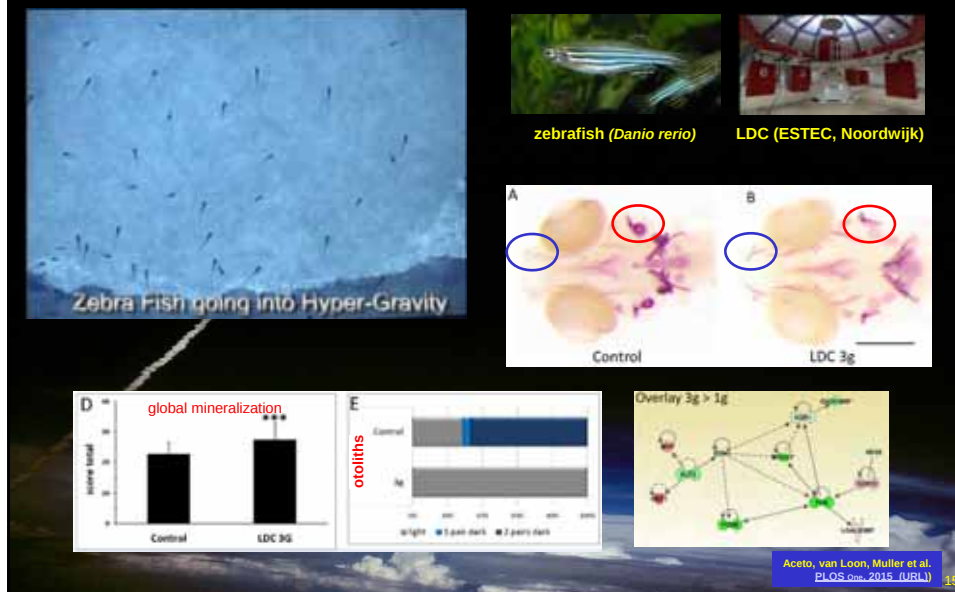
Lioumbas et al Food Research International 2014

Education:
Children's TV show
on cooking
Best Fries @ Jupiter !

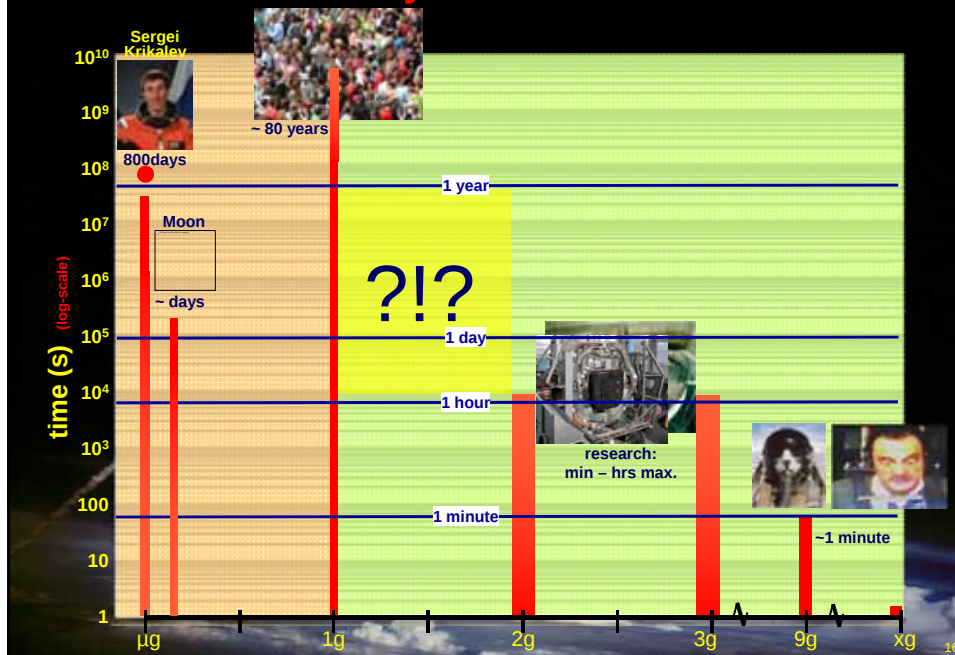


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Use of High g in Animal research Gravity otoliths & cranial bone development



Gravity and Humans



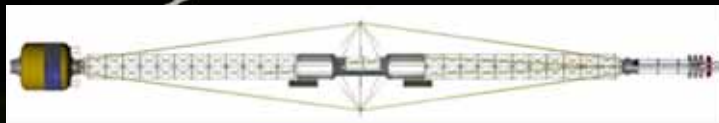
Gravity and Angular Velocity



Ø ~12 m



Nautilus study (NASA 2011)



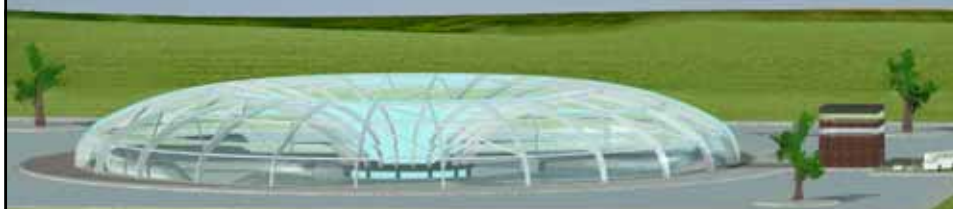
Ø ~125 m

Fire Baton concept (NASA)

H³ in preparation for large in-flight rotating systems

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The Human Hypergravity Habitat, H³ An Altered Gravity Platform



~ 175 m

✓ BERTE pva
✓ BETAQUA
✓ QinetiQ
✓ IFB GmbH

see also: *Annales Kinesiologiae*, 3.1, p. 107-121, 2012. UDC: 001.891:612:629.78 (URL)

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Poster #14: *"The ESA Large Diameter Centrifuge (LDC) Facility Cooperating with the United Nation's - Human Space Technology Initiative (UN-HSTI)"*



ESA Large Diameter Centrifuge (LDC)

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Acknowledgements

*to all who have provided information and data for
this presentation . . . !!*

Gracias !

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