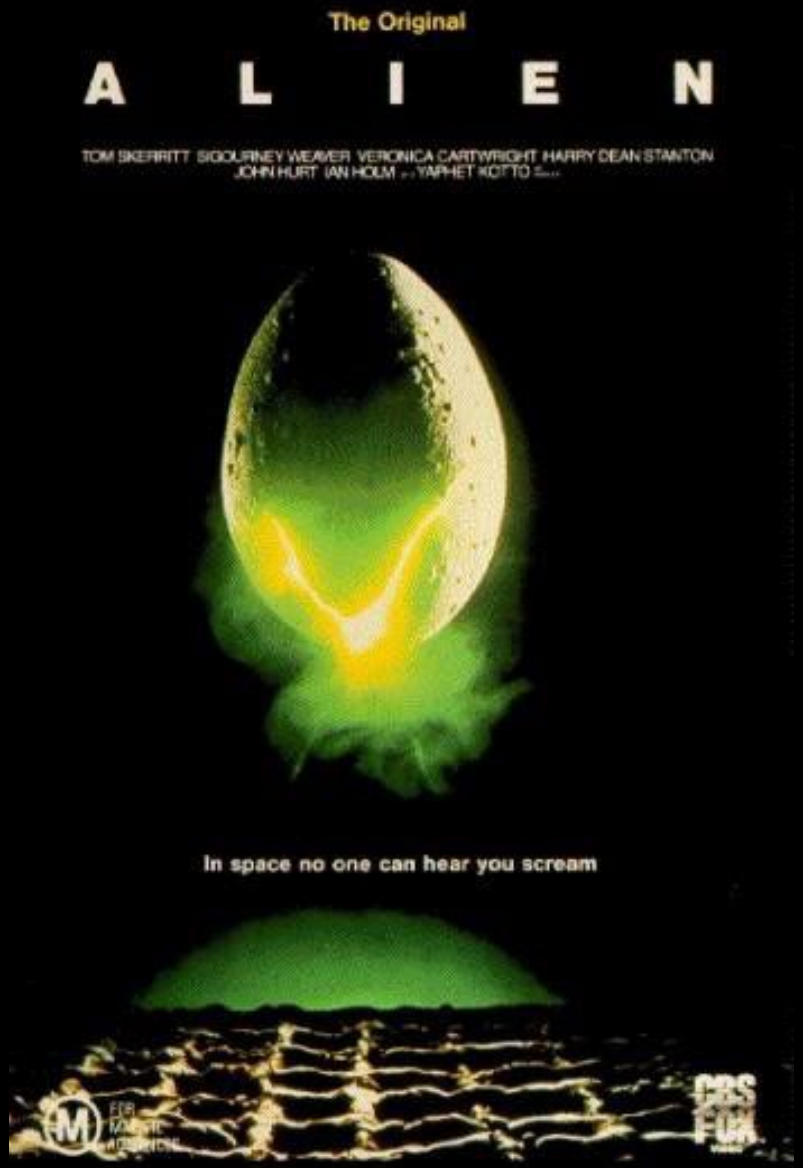
The New Science of Astrobiology, and the Search for Life in the Universe

NASA

What astrobiology is not ....



At least not yet .....

What is astrobiology?

" The study of the astronomical and planetary context within which life on Earth has evolved, and the implications for the nature and prevalence of life elsewhere in the Universe." - **Crawford**

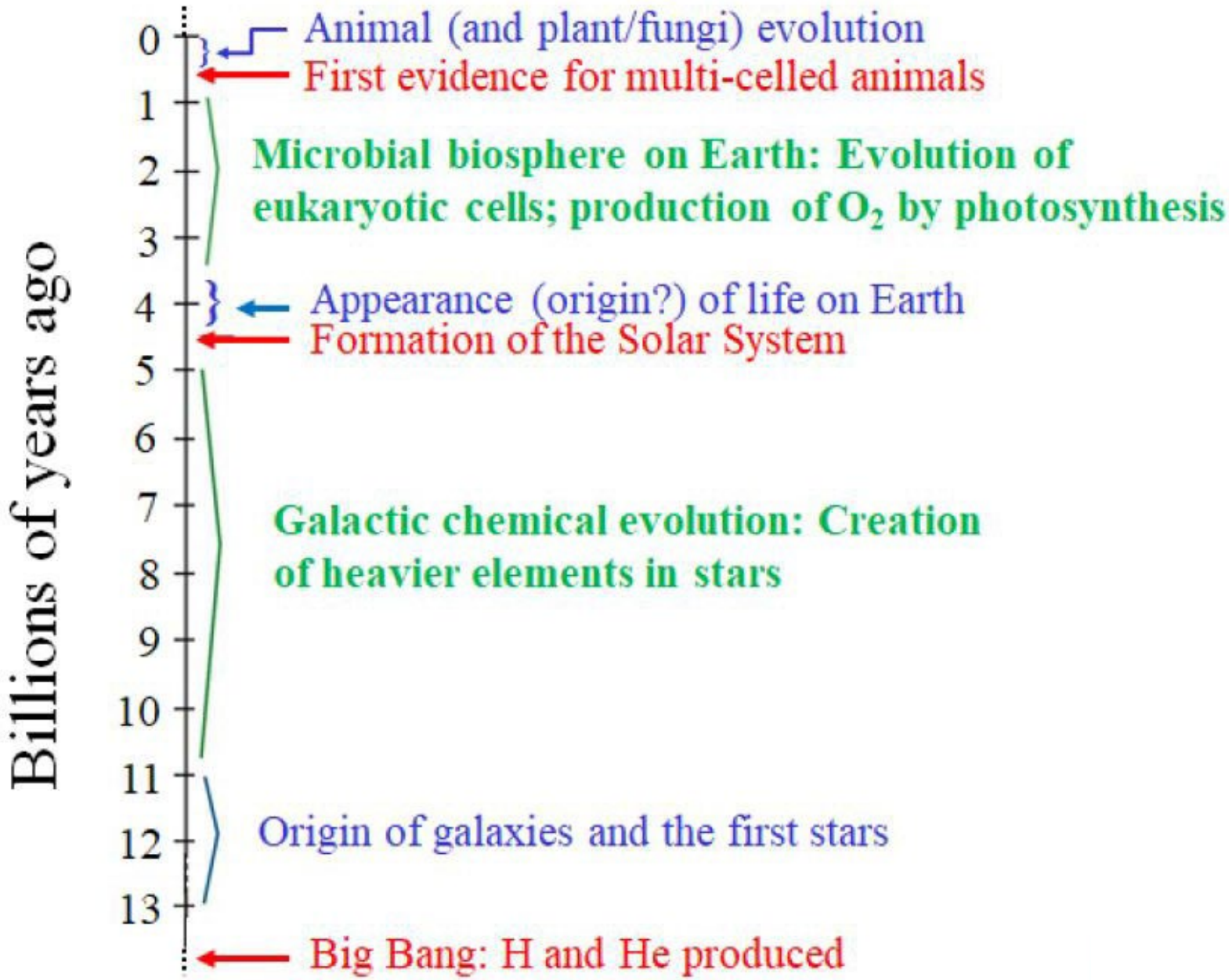
NASA

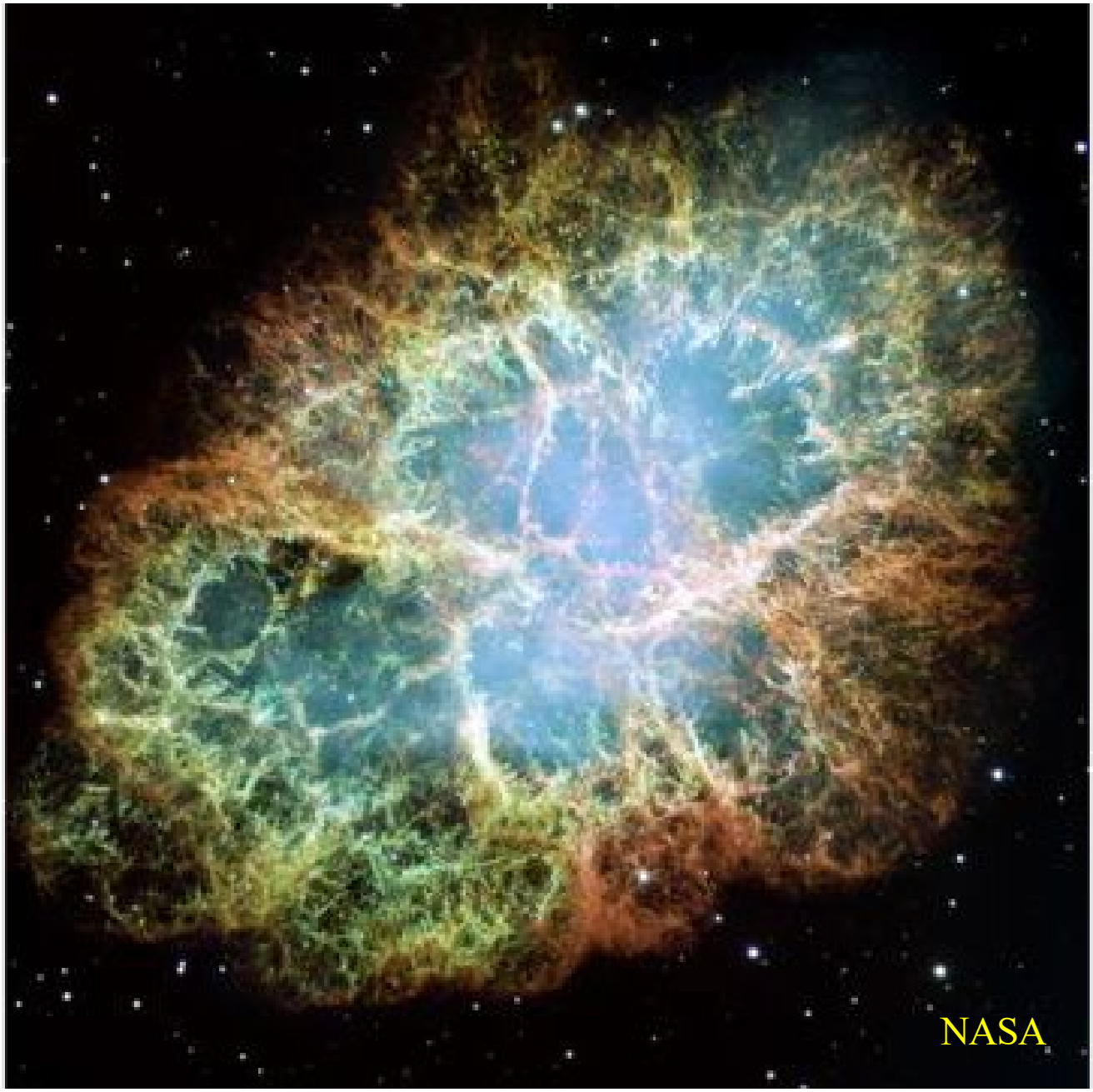
What is astrobiology?

"The study of the distribution of habitable environments in the Universe." **- Rushby**

NASA

A historical perspective ....



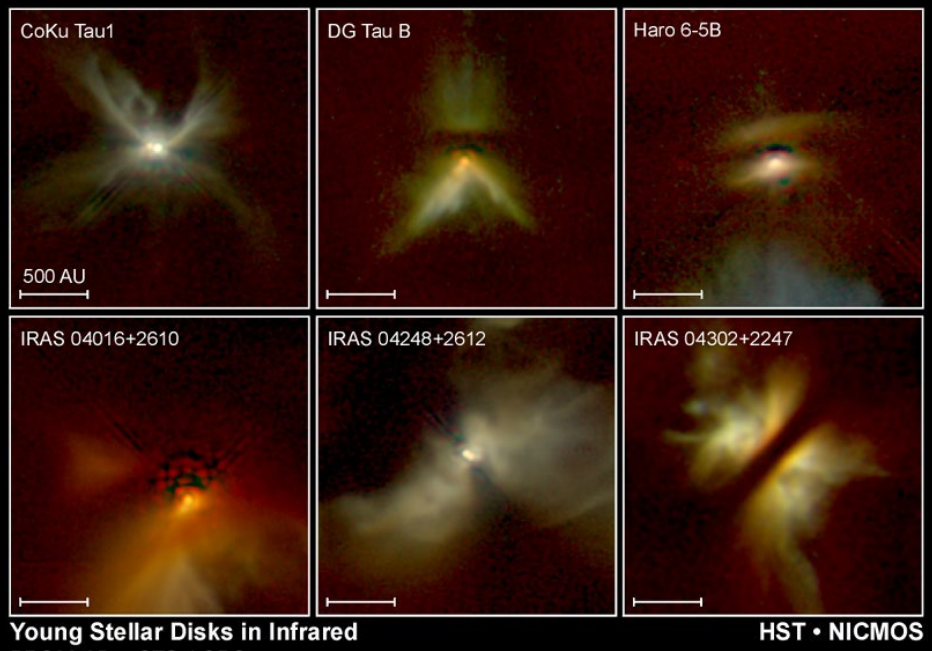

NASA


Lynette Cook/NASA

Circumstellar/ Protoplanetary Disks

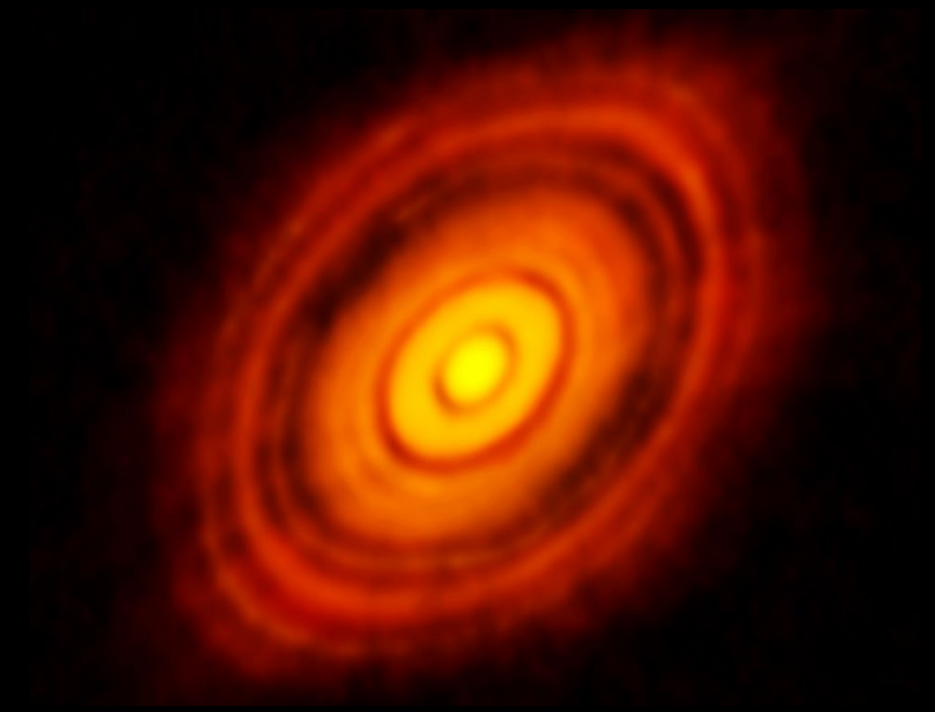
Edge-On Protoplanetary Disk
Orion Nebula
PRC95-45c · ST ScI OPO · November 20, 1995
M. J. McCaughrean (MPIA), C. R. O'Dell (Rice University), NASA

HST · WFPC2



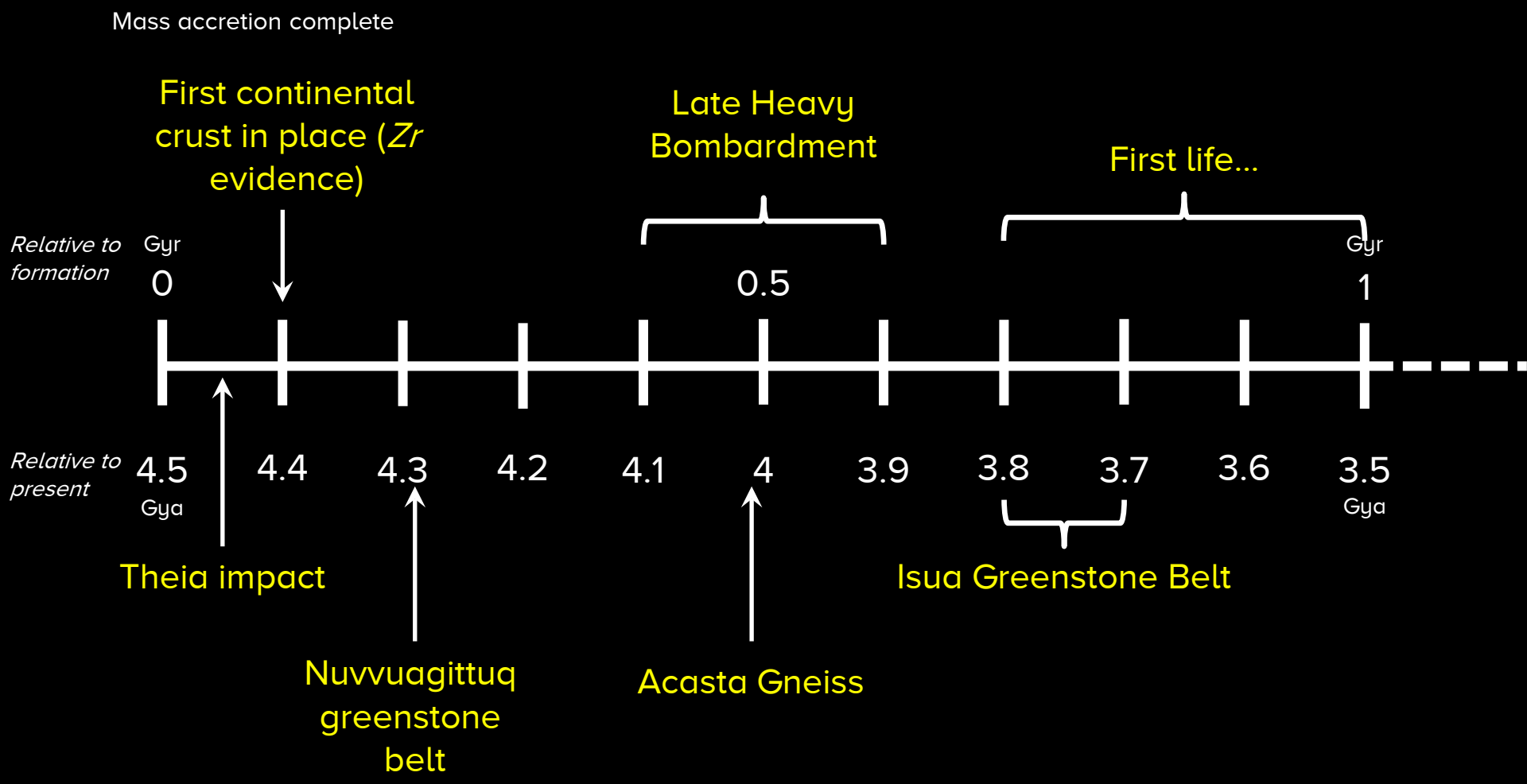
Young Stellar Disks in Infrared
PRC99-05a • STScI OPO
D. Padgett (IPAC/Caltech), W. Brandner (IPAC), K. Stapelfeldt (JPL) and NASA

HST • NICMOS

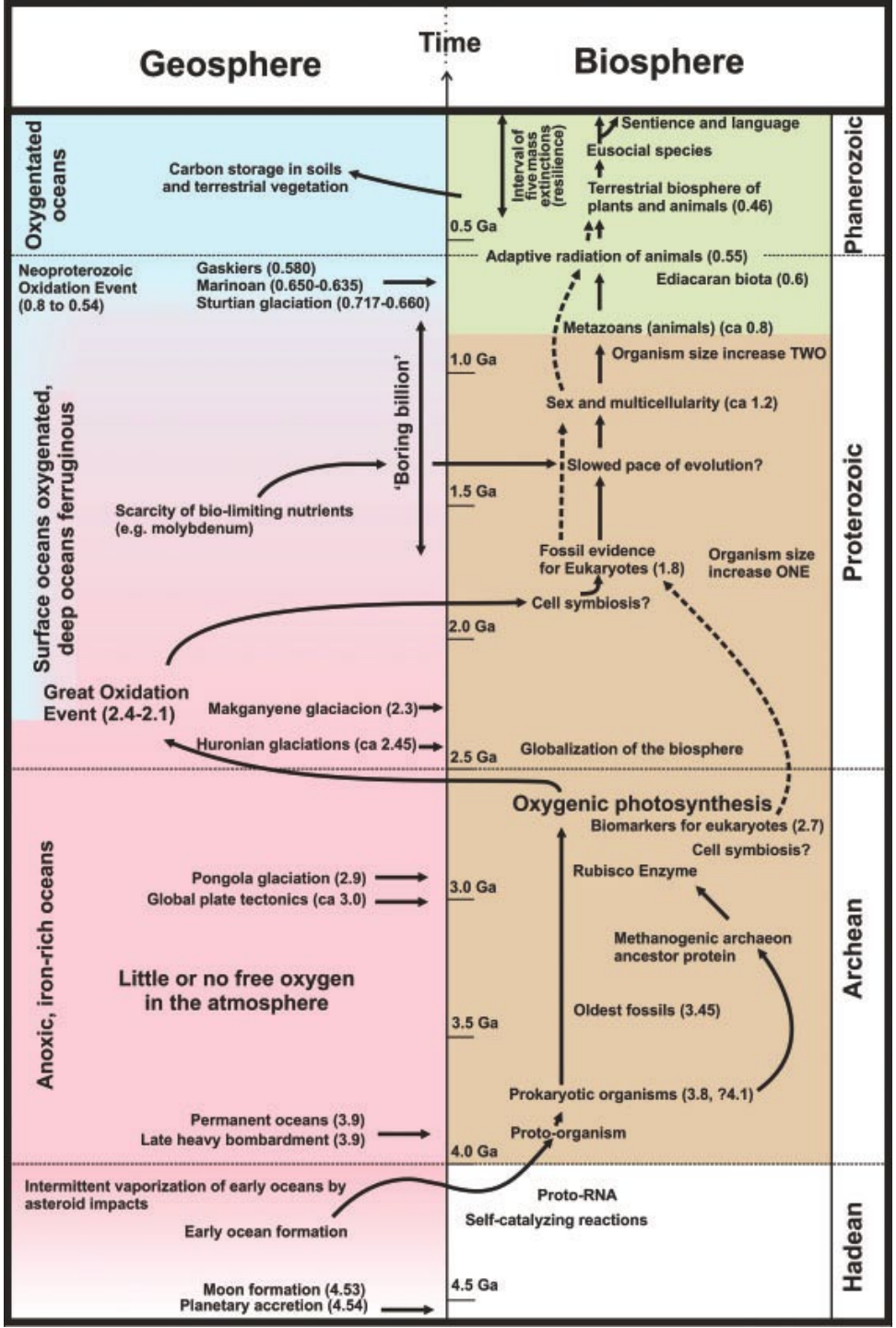


Protoplanetary Disk of HL Tauri from ALMA
(ALMA/ESO/NAOJ/NRAO/NSF)

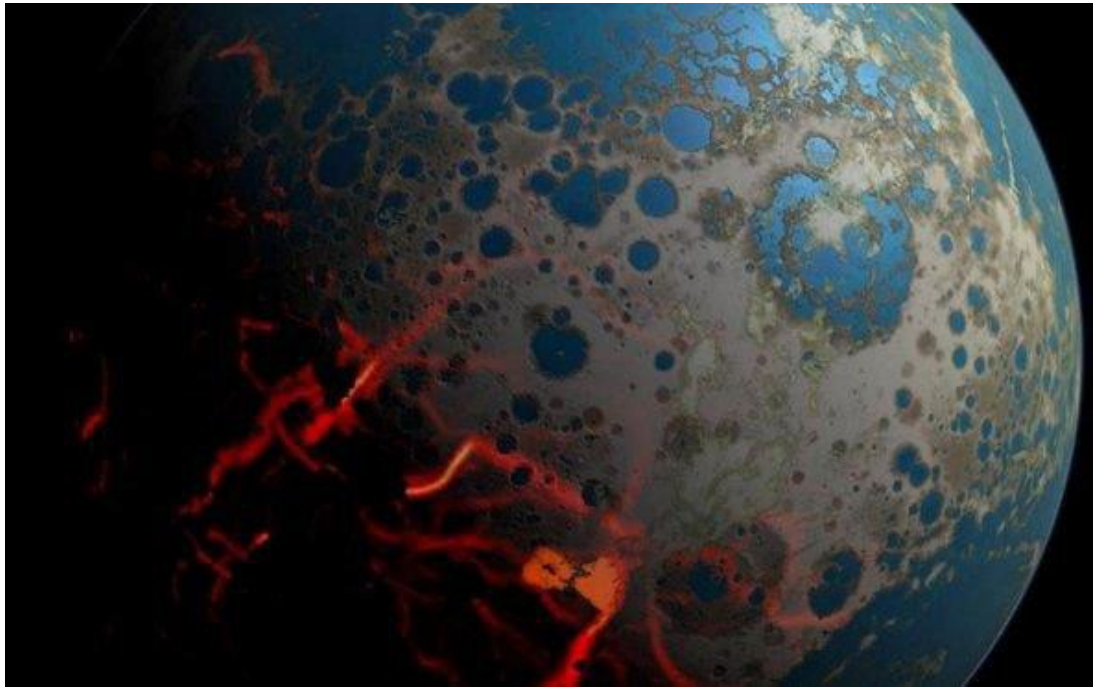
Timeline of the early Earth



Co-evolution of life and the planet



Based on Lenton (2004)



4.5 – 4 billion years ago

Heavy bombardment; Origin of life?

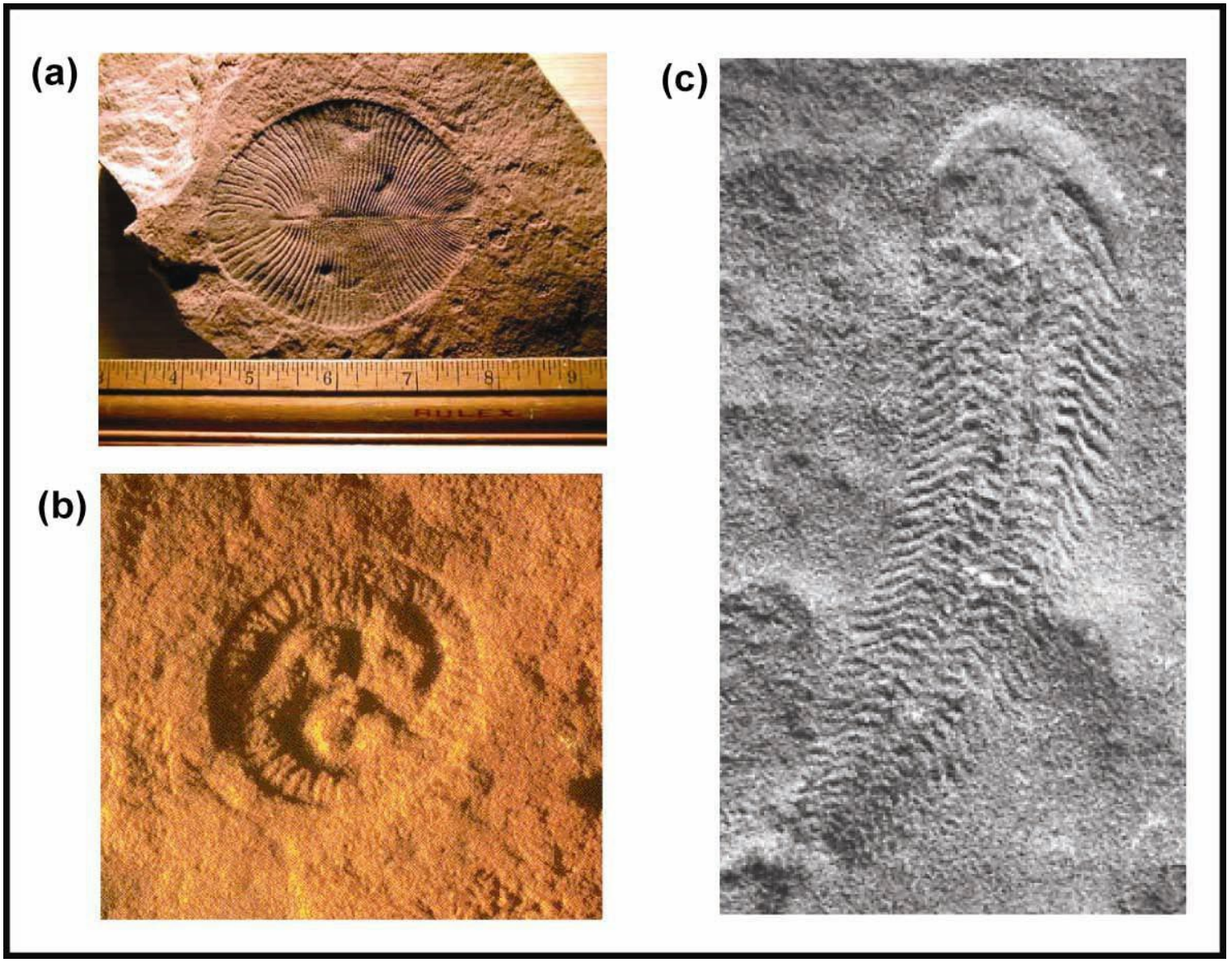
3.8 – 3.0 billion years ago:

Microbial life established; CO_2 – rich atmosphere

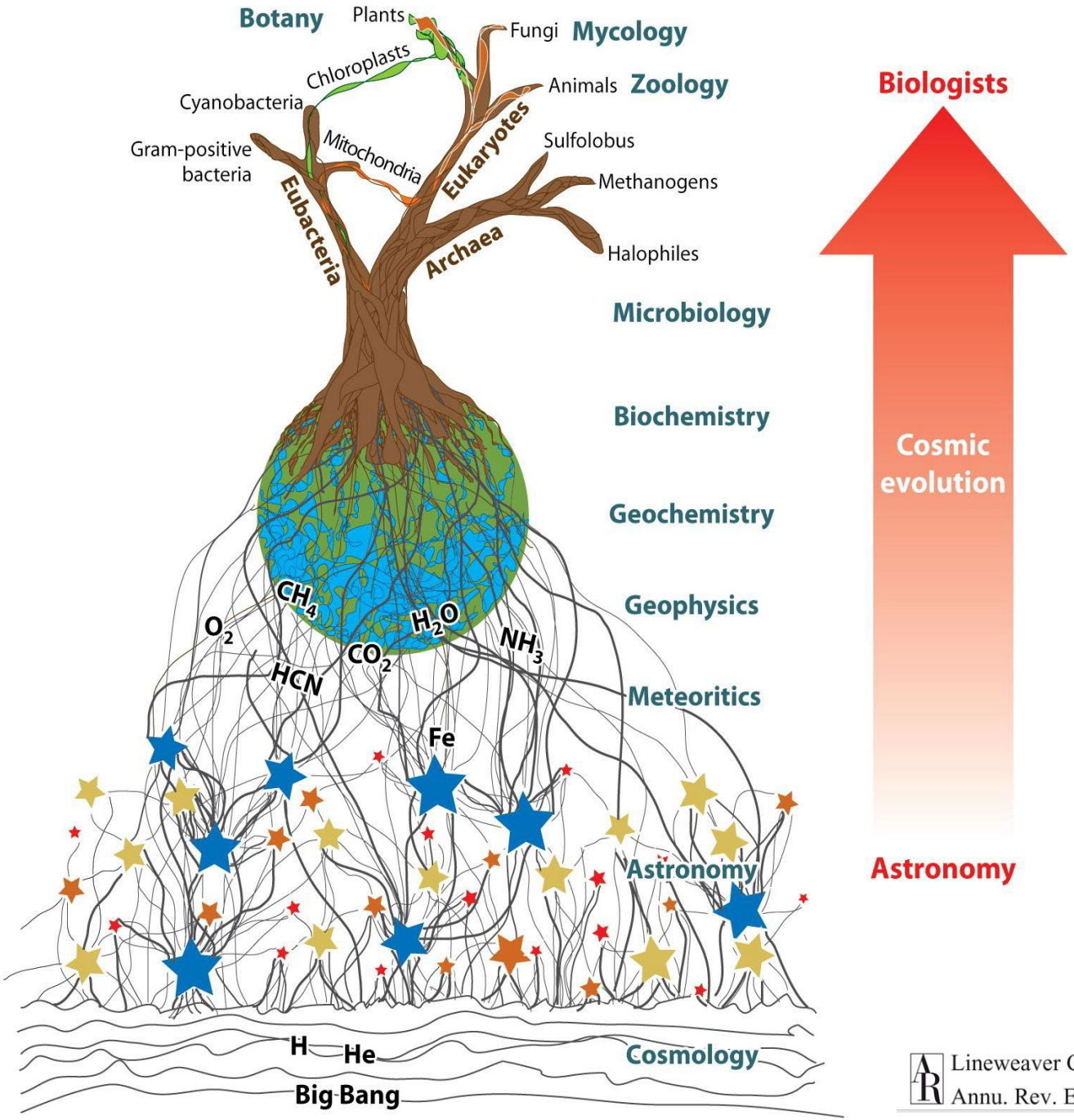
Images: Simone Marchi/SwRI/NASA). Bottom: Peter Sawyer/Smithsonian Institution

3.4 Gyr-old stromatolite, Strelley Pool Chert, Australia (Image: IAC, 2015)

Earliest evidence for multi-celled animals: 600 million years ago



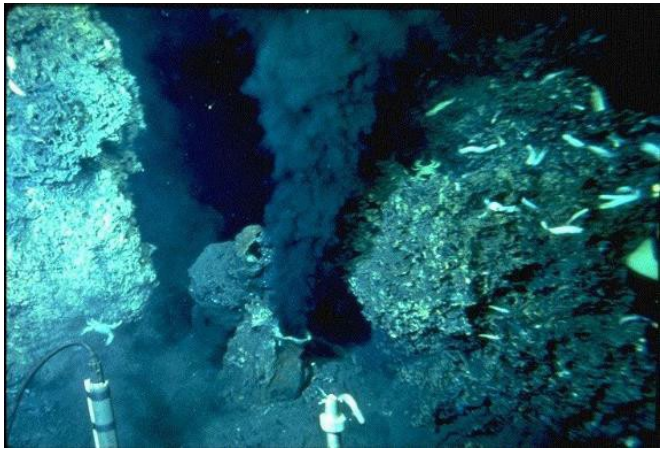
Images: https://ucmp.berkeley.edu/vendian/vendian.html



Lineweaver CH, Chopra A. 2012.
Annu. Rev. Earth Planet. Sci. 40:597–623

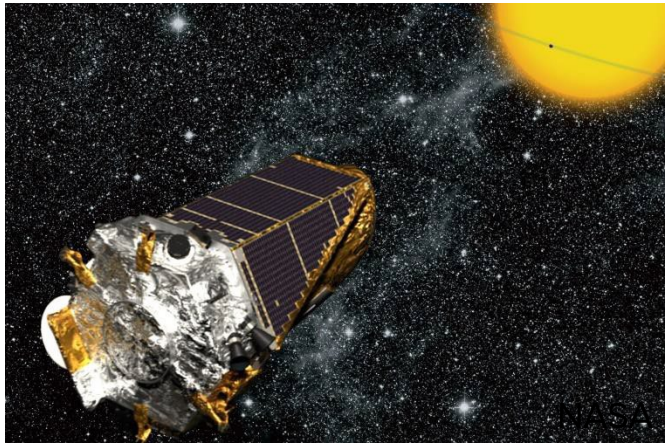
Key drivers for astrobiology

- Discovery of ‘extremophiles’ on Earth

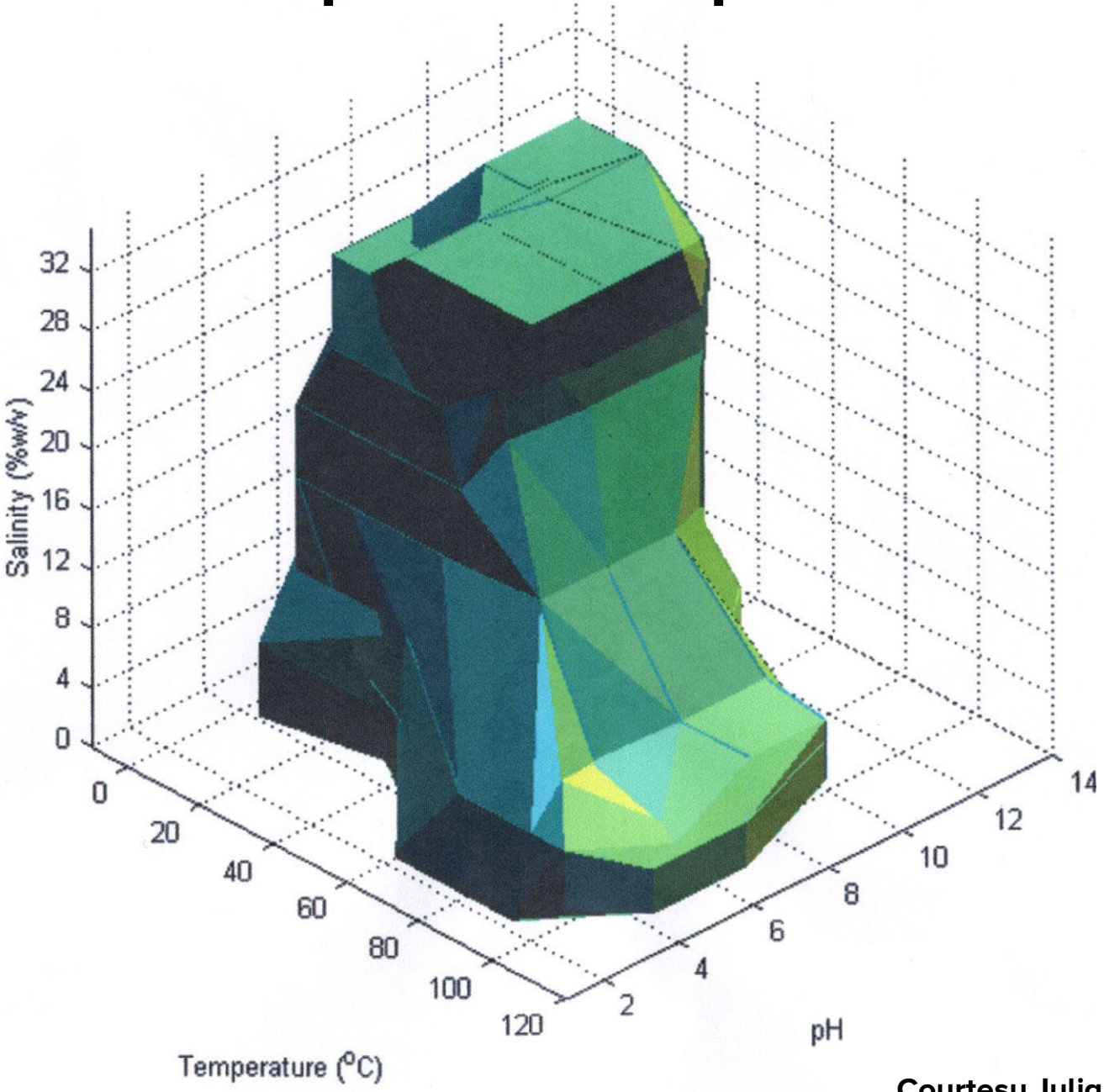


- Renewed interest in life elsewhere in the Solar System

- Detection of planets around other stars

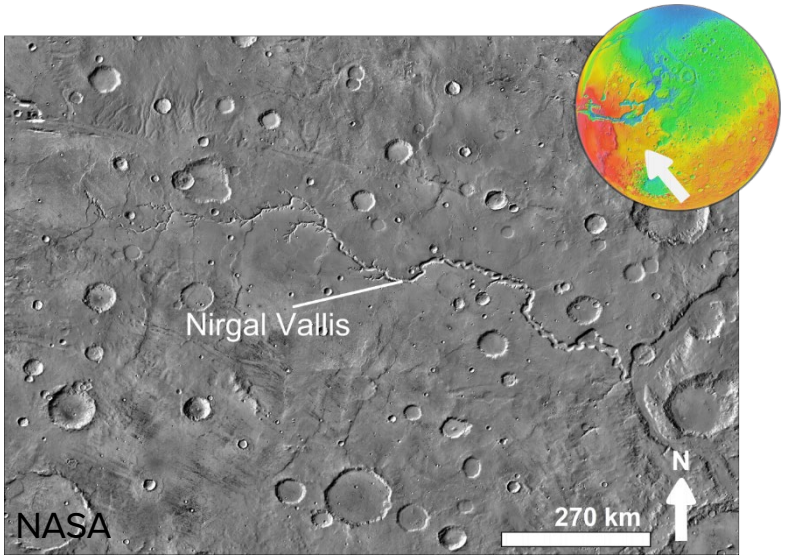


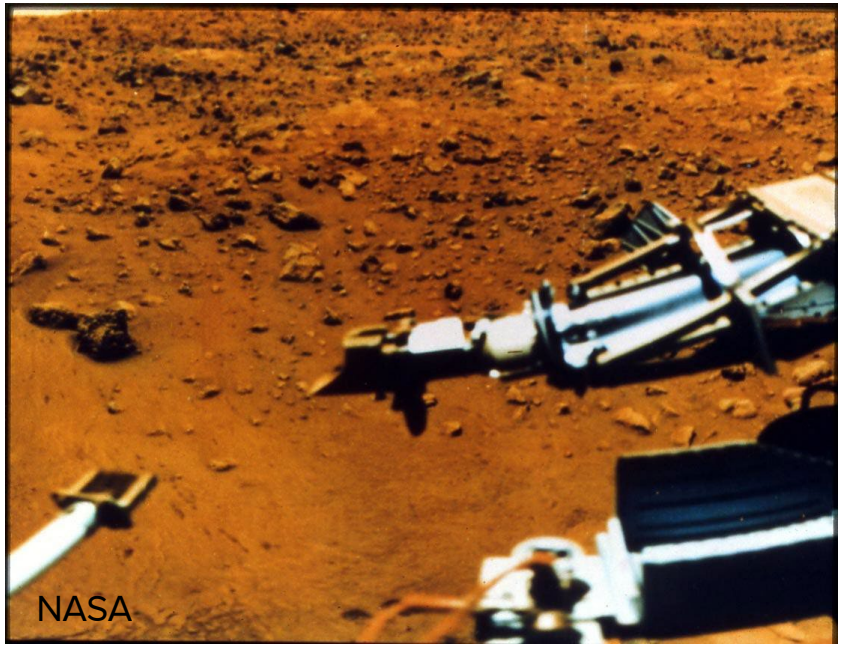
Terrestrial life's parameter space

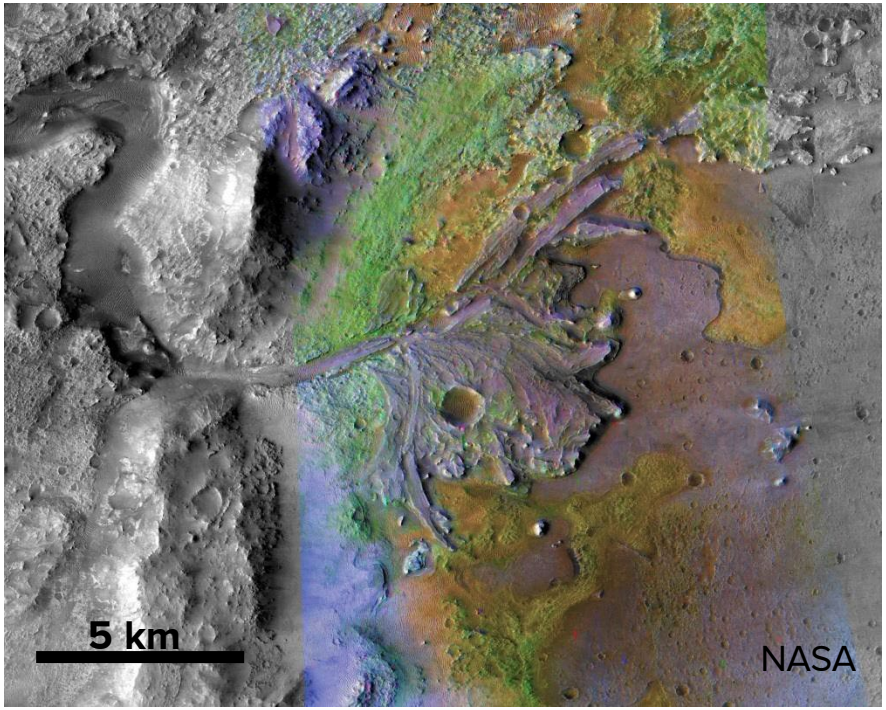


Courtesy Julian Wimpenny

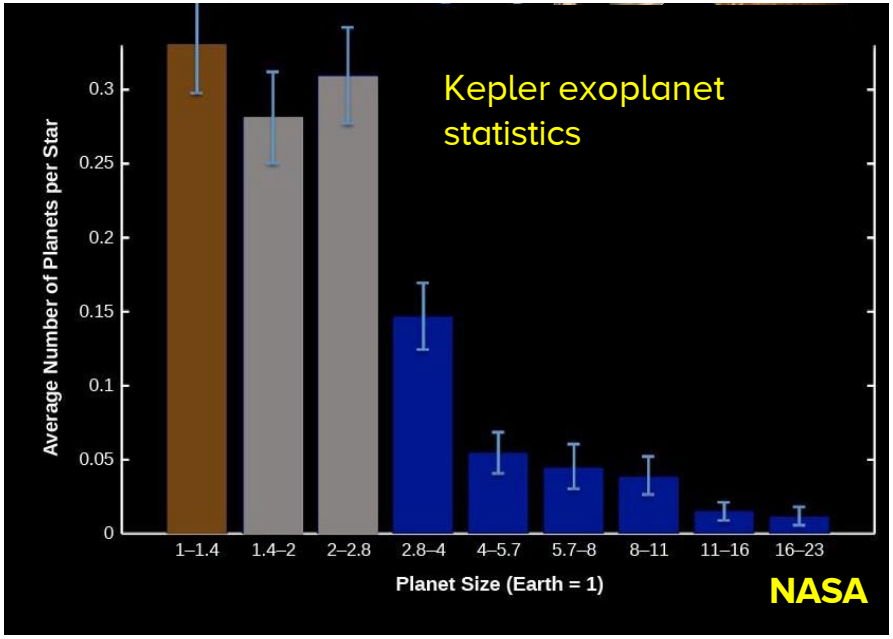
Extant or extinct life on Mars …

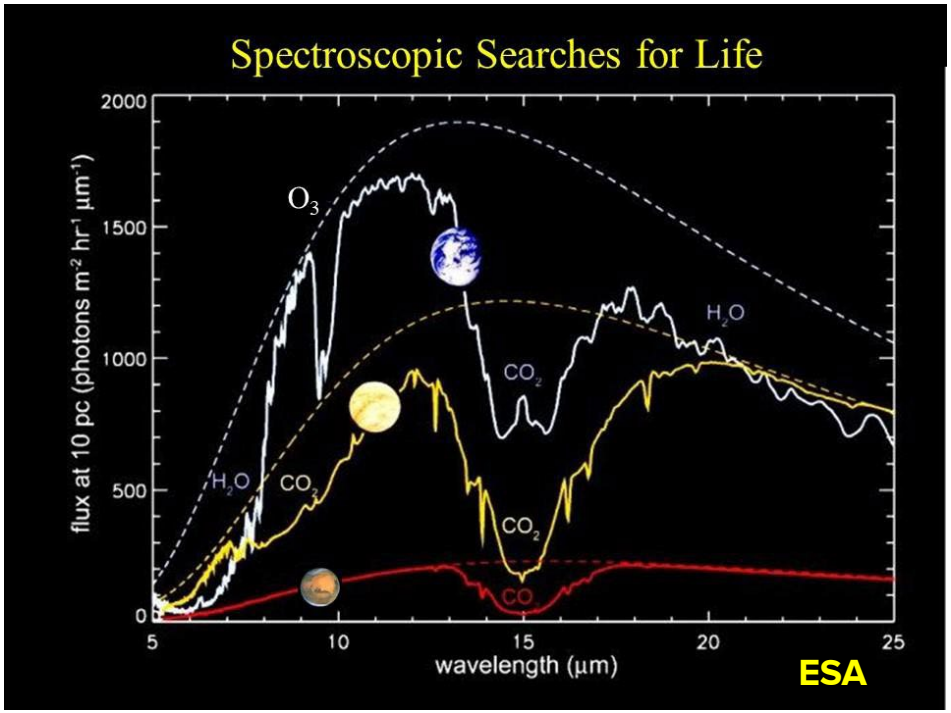


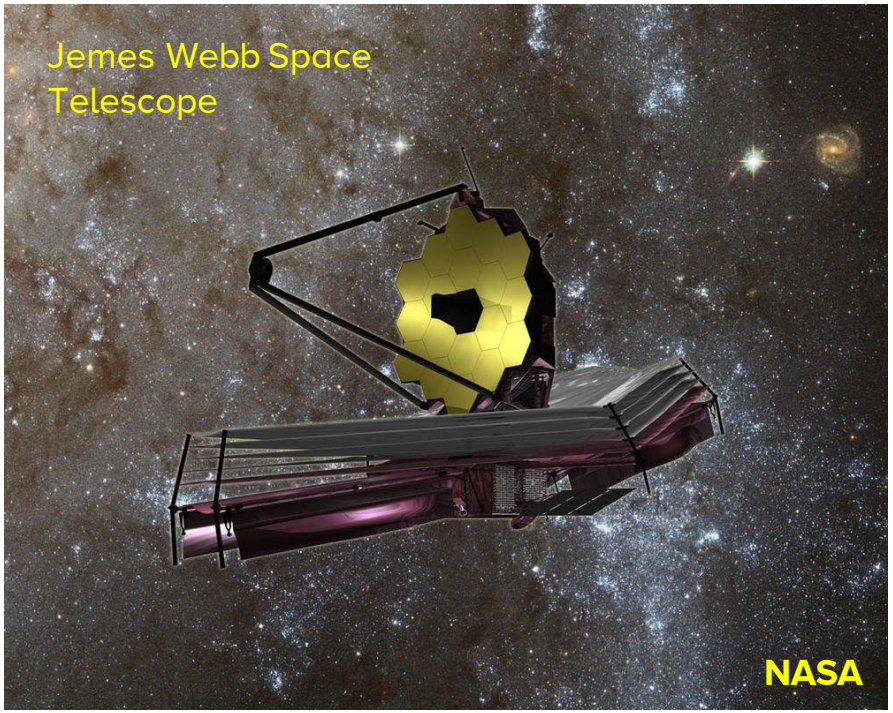




And/or the icy moons …


Kepler exoplanet statistics
Average Number of Planets per Star
0.3
0.25
0.2
0.15
0.1
0.05
0
1–1.4
1.4–2
2–2.8
2.8–4
4–5.7
5.7–8
8–11
11–16
16–23
Planet Size (Earth = 1)
NASA


Spectroscopic Searches for Life
flux at 10 pc (photons m-2 hr-1 µm-1)
2000
1500
1000
500
0
O3
H2O
CO2
H2O
CO2
CO2
CO
5
10
15
20
25
wavelength (µm)
ESA


Jemes Webb Space Telescope
NASA

The Search for Extraterrestrial Intelligence (SETI)

CENTRE FOR PLANETARY SCIENCES AT UCL/BIRKBECK

Institute of Earth and Planetary Sciences

UCL Birkbeck UNIVERSITY OF LONDON

Astrobiology and Planetary Exploration (APEX) Meeting Programme

All APEX meetings this term will be held on-line using Zoom at 13:00 on Thursdays. Contact details will be advertised in advance of each meeting. Please contact joanna.fabbri at ucl.ac.uk for joining instructions if you have not received these prior to the day of each session.

20 January	Dr Andrew Rushby (BBK)	Effects of land and ice albedo feedbacks on the climate and habitability of terrestrial exoplanets orbiting M-dwarf stars
27 January	Dr Manasvi Lingam (Florida Tech)	Avenues for the regulation of planetary habitability by stellar processes
03 February	Dr Frances Westall (CNRS)	Looking for biosignatures: Lessons from the ALH84001 meteorite
10 February	Dr Nisha Ramkissoon (OU)	Exploring the habitability of martian impact craters
17 February	UCL Reading Week	No APEX

New programme announced soon

www.ucl.ac.uk/~ucfbiac/APEX.htm