Astrobiology
Origin and Evolution of Life
Astrobiologia
Asili na mabadiliko ya maisha

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Ufafanuzi wa astrobiology
Definition of Astrobiology

Astrobiology sio nidhamu, lakini shughuli ya interdisciplinary ambayo inahusu suala la asili na mageuzi ya maisha duniani na kuwepo kwake katika sehemu nyingine za ulimwengu.

Astrobiology is not a discipline but an interdisciplinary activity around the question of the origin and evolution of life on Earth and its possible presence in other parts of the Universe; It covers all fields interested in this issue, from astronomy to biology, including geology and chemistry, but also history and philosophy of science.

Etiolojia: Exogenesis na Astrobiology
Etimology: Exobiology and Astrobiology

Pamoja na mbio za nafasi na ujumbe wa kwanza kwa Mwezi na Mars, hatari ya uchafuzi wa kibiolojia hutokea.
With space race and the first lunar and martian exploration missions, the risk of biological contamination appears.

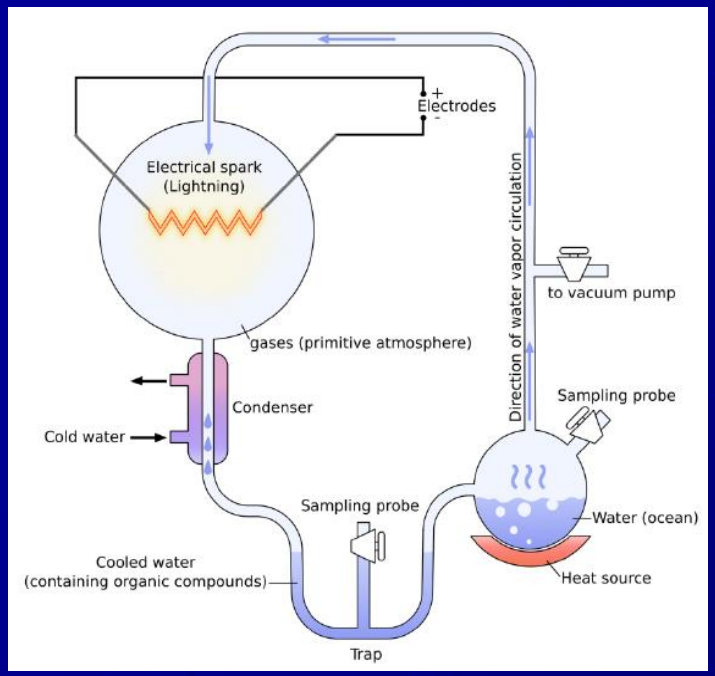
Kwanza kabisa, wanasayansi wanaamini
Microbes ni uwezekano wa kuishi mtihani wa nafasi.

Leo, tunajua kwamba hii sio kesi, kwa mfano, kwamba retards wanaweza kupinga hali kali, ikiwa ni pamoja na nafasi, na hii sio mfano wa pekee.

First, scientists assumed
that microbes were unlikely to withstand the conditions of space.
Today we know that this is not the case and, for example, tardigrades are capable of resisting extreme conditions, including those in space, and this is not an isolated case.

Water bear (tardigrade),
Hypsibius exemplaris
(Credit: B. Goldstein & V. Madden)

Etiolojia: Exogenesis na Astrobiology
Etimology: Exobiology and Astrobiology



Itifaki ya Miller-Yuri. (Elekezwa kutoka S. LaBar)
Scheme of the Miller-Urey experiment. (Credit: S. La Barre)

Pamoja na majaribio ya waanzilishi wa Miller-Urey, maabara ilianza utafiti wa kwanza wa kemikali juu ya awali ya molekuli za prebiotic

With the Miller-Urey's pioneering experiment began the chemical studies for the synthesis of the first prebiotic molecules in the laboratory

Nidhamu mpya muhimu katika utafutaji wa asili ya maisha kupitia uchunguzi wa nafasi iliibuka: exozoology, iliyoanzishwa na Joshua Lederberg mnamo 1960.

A new key discipline for the search for the origin of life through space exploration appears: Exobiology, term introduced by Joshua Lederberg in 1960.

Neno "astrobiology" lilipitishwa na IAU mwaka 2015.

The term “Astrobiology” was adopted in 2015 by the IAU.

Malengo ya Astrobiological
Astrobiology Objectives

- Fafanua maisha ni nini.
- Amua asili ya maisha.
- Tafuta nyayo zake za zamani.
- Jifunze kuhusu mfumo wa mageuzi yake duniani.
- Kutafuta maisha katika ulimwengu.

- Define what Life is.
- Determine the origin of life.
- Look for its oldest footprints.
- Understand its evolution mechanisms on Earth.
- Search for life in the universe.

Malengo ya Astrobiological

Define Life

Swali hili linahitaji kufafanuliwa kisayansi,
Lakini pia ni swali la falsafa.
This question requires scientific arguments,
but it is also a philosophical question.

Maisha ni tabia ya kiumbe hai, ikiitofautisha na ya mwisho kuwa kiumbe aliyekufa au kiumbe kisichotumika, hasa kutofautisha na hiyo

- **Kukua.**
- **Kimetaboliki.**
- **Kujibu kwa stimuli.**
- **Kukabiliana.**
- **Uzazi.**

Life is a characteristic of a living organism that distinguishes the latter from a dead organism or a non-living thing, as specifically distinguished by the capacity to

- **Grow.**
- **Metabolize.**
- **Respond to stimuli.**
- **Adapt.**
- **Reproduce.**

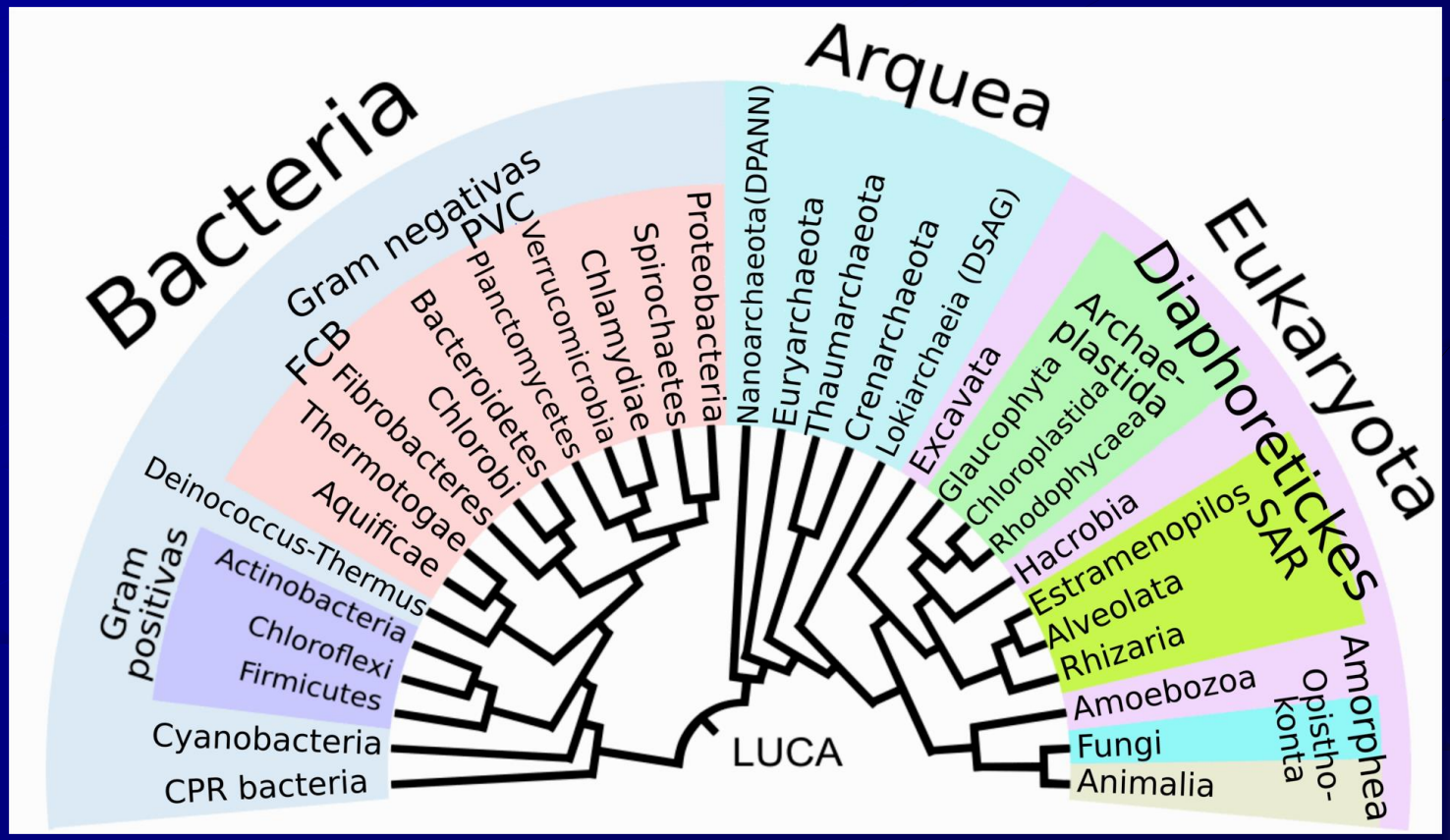
Utofauti wa maisha duniani
Diversity of Living Things on Earth

Mfano pekee wa maisha ni maisha ya dunia.
Astrobiology inalenga juhudi zake nyingi juu ya kujifunza maisha ya ardhi katika mazingira yote, hasa yale yaliyokithiri zaidi, kama vile chemchemi za moto za hydrothermal, maziwa ya chumvi, au maeneo yaliyohifadhiwa.
Aina hii ya mazingira inaweza kuwa mazingira mazuri kwa analogy na eneo la nje.

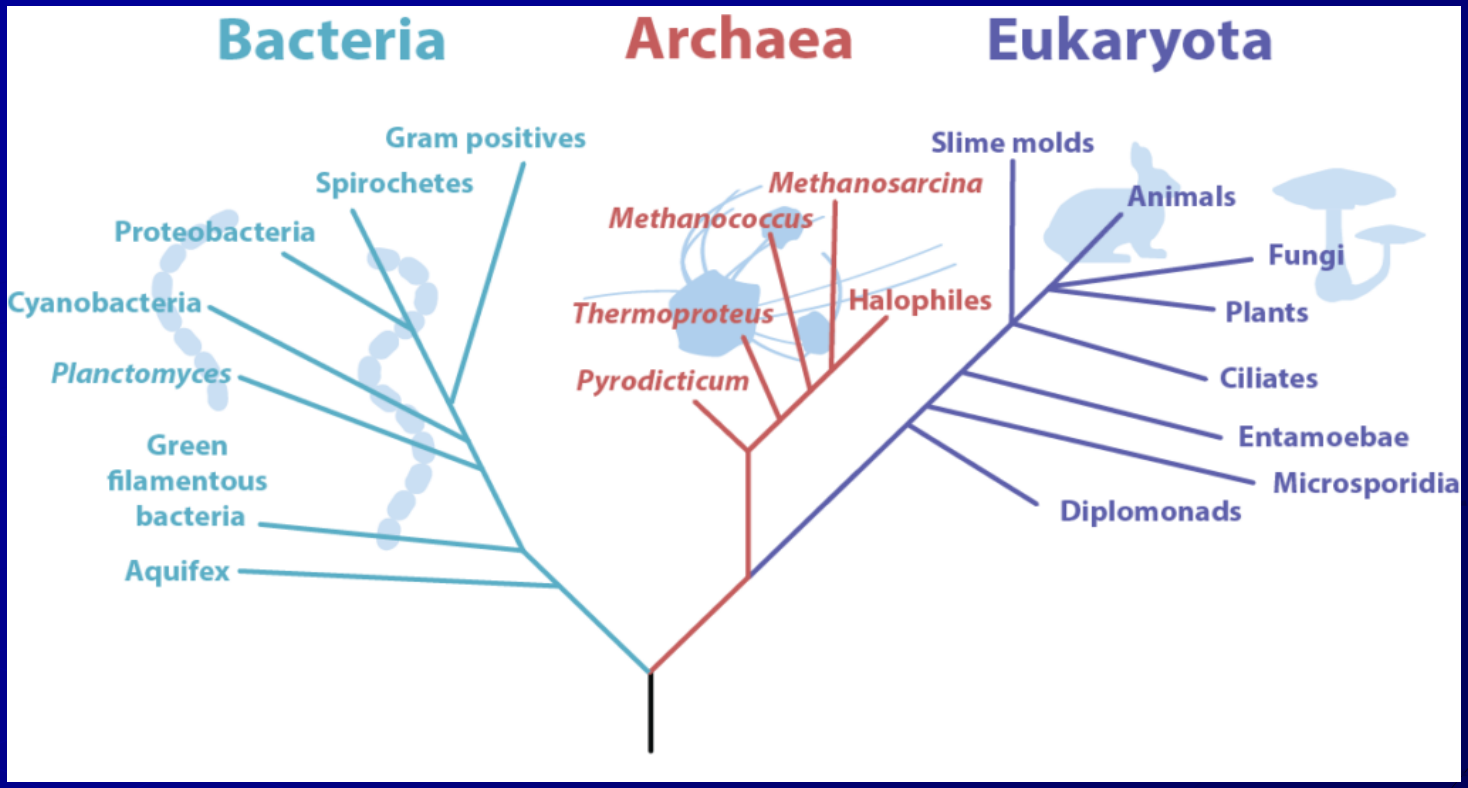
The only known example of life is terrestrial life.
Astrobiology concentrates much of its efforts on studying terrestrial life in all environments, especially in the most extreme ones, such as underwater hydrothermal springs, brine lakes or frozen places.
This type of environment can be a good analogue for extraterrestrial locatio

Ili kuelewa vizuri mipaka ya viumbe hai na utaratibu ambao wanafanya kazi katika mazingira mabaya, wanasayansi wamejaribu kuamua utofauti wa phylogenetic na kimetaboliki wa viumbe hai.

To better understand the limits of living organisms and the mechanisms at work in extreme environments, scientists seek to determine the phylogenetic and metabolic diversity of living organisms.



(Credit: Wikipedia)



(Credit: open.oregonstate.education)

Moja ya matawi ya maslahi fulani katika mti wa maisha ni archaea (au archaea), ambayo inatofautiana na bakteria prokaryotic kutokana na mlolongo wao wa ribosomal RNA na ni hasa ilichukuliwa na mazingira uliokithiri (kwa suala la shinikizo, joto, salinity, virutubisho, nk).

One of the branches of the tree of life that is of special interest are the archaebacteria (or archaea), different from prokaryotic bacteria due to their ribosomal RNA sequence and particularly adapted to extreme environments (in terms of pressure, temperature, salinity, nutrients , etc).

Kupata athari za zamani zaidi za maisha duniani: ngumu
Search for the oldest traces of life on Earth: Difficulties

1) Dunia ni sayari "hai" (tectonics, mmomonyoko) na kwa hivyo imepitia mageuzi makubwa tangu kuundwa kwake miaka bilioni 4.5 iliyopita. Kulingana na nasaba ya spishi, kiumbe cha kwanza hai hakika ni kiumbe cha seli moja sawa na bakteria.

2) Viumbe wa kale lazima wawe microscopic. Athari za zamani zaidi za maisha duniani zilianzia miaka bilioni 3.48 na zilipatikana nchini Australia.

3) Ni vigumu kutafsiri na kulinganisha mifumo ya abiotic, ambayo inaweza kuunda alama za vidole ambazo zinafanana na vipengele vya kibiolojia au morphology.

4) The Earth is a "living" planet (tectonics, erosion) and has therefore evolved greatly since its formation 4.5 billion years ago. Based on the genealogy of species, the first living organisms must have been single-celled beings similar to bacteria.

5) Primitive organisms had to be microscopic. The oldest proven traces of life on Earth date back 3.48 billion years and were discovered in Australia.

6) Difficulty in interpretation and comparison with abiotic systems, which could have formed fingerprints similar to biological signatures or morphologies.

Kemia ya prebiotic na mpito kutoka inanimate hadi animate

Prebiotic chemistry and the transition from non-living to living

Leo, kati ya aina zote za extant duniani, kuna vitalu vya msingi vilivyoundwa na C, H.N, na O

Today, in all living species on Earth, among all the existing diversity, there are elementary blocks made of C, H, N and O

Sehemu hizi ni pamoja na protini (msingi wa replication), DNA (deoxyribonucleic acid) (ambayo hubeba habari za maumbile), na amphiphiles (ambayo hufanya ukuta wa seli kwa kutengwa kwa seli).

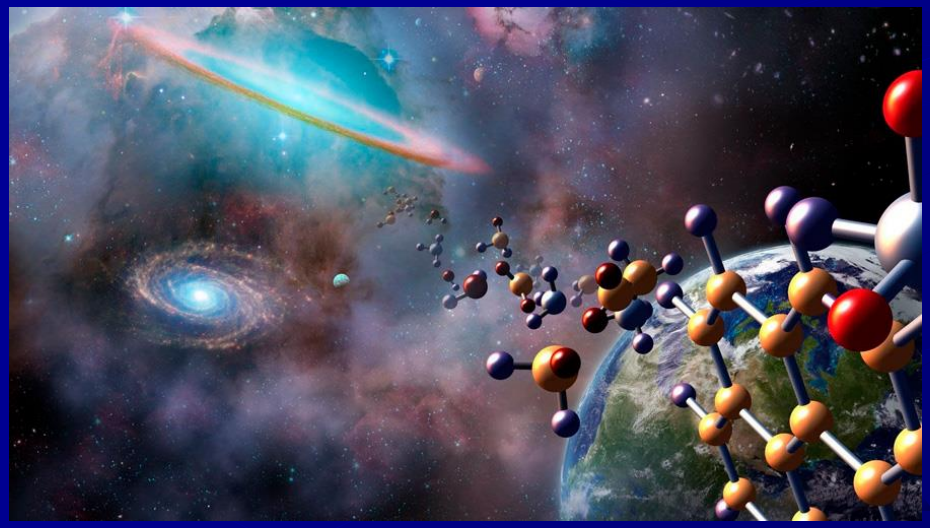
These blocks are proteins, the basis of replication, DNA (deoxyribonucleic acid), which carries genetic information, and amphiphiles, which constitute cell walls for compartmentalization.

Kwa hivyo, kila kitu kilicho hai duniani kina aina tano za molekuli (wakati mwingine huitwa matofali ya maisha), asidi ya amino, besi za nitrojeni, sukari, fosforasi, lipids (au asidi ya mafuta).

The elemental bricks that every living species on Earth has are, therefore, five types of molecules (sometimes called the bricks of life), amino acids, nitrogenous bases, sugars, phosphorus, lipids (or fatty acids).

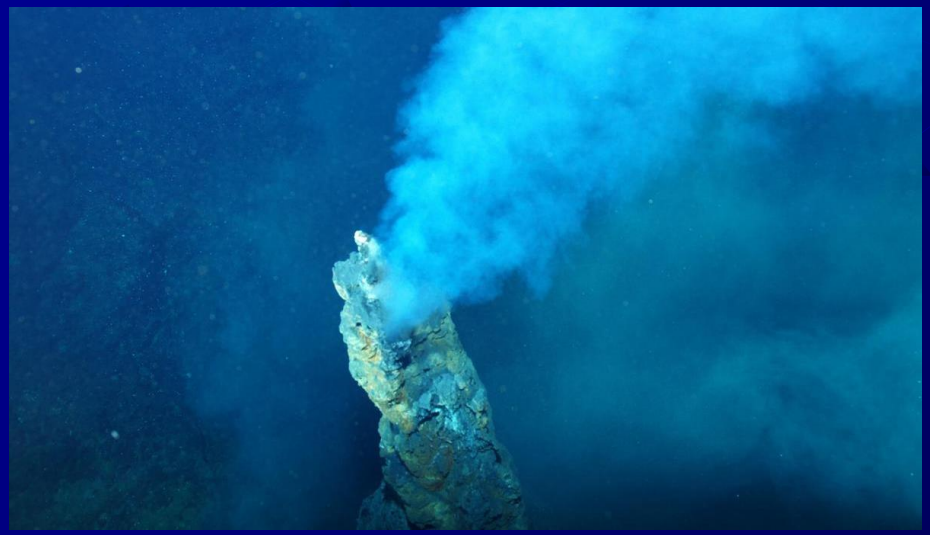
Kemia ya prebiotic na mpito kutoka inanimate hadi animate

Prebiotic chemistry and the transition from non-living to living



Vipengele hivi ni muhimu kwa maisha kwenye ardhi, na utafiti wa asili yao unaturuhusu kuweka vizuizi zaidi juu ya asili ya maisha yenyewe.

These elements are essential for terrestrial life and the study of their origin allows us to give more limitations to the origin of life itself.



Molekuli hizi ziko katika anga ya Dunia na zinaweza pia kuunda katika matundu ya hydrothermal.

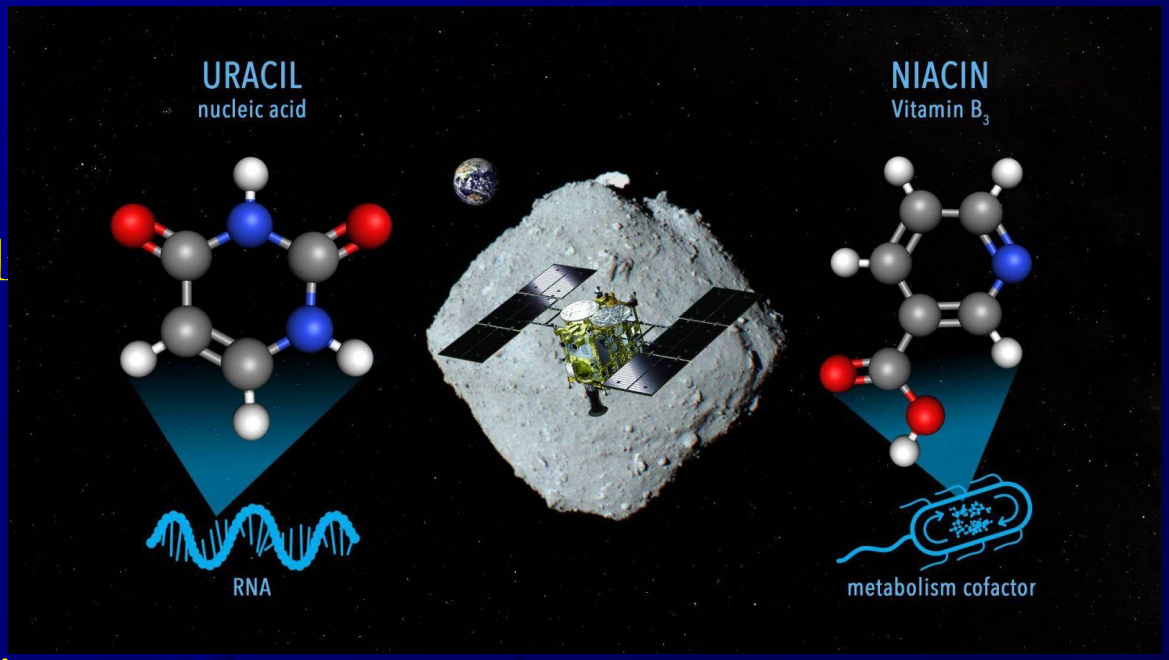
Abiotically, these molecules could have formed in the Earth's atmosphere, but also in hydrothermal vents.

Kemia ya prebiotic na mpito kutoka inanimate hadi animate

Prebiotic chemistry and the transition from non-living to living

Dhana nyingine ni kwamba molekuli hizi zinaweza kuletwa na miil ya selestia (meteorites) kutoka kwa asteroids na comets: meteorites iligeuka kuwa tajiri sana katika jambo la kikaboni.

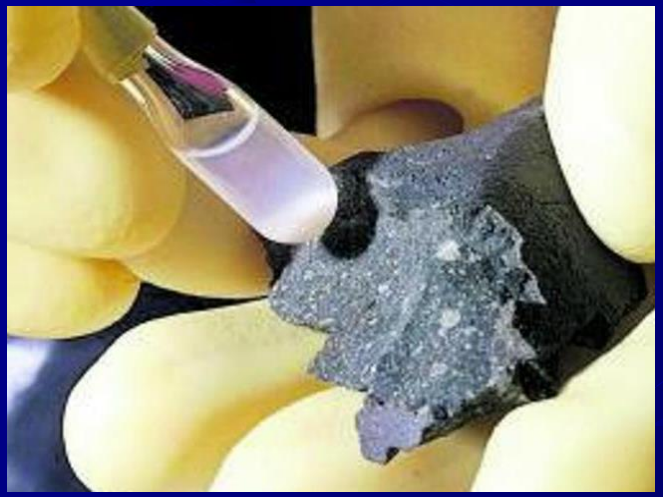
Another hypothesis proposes that these molecules could have been brought by celestial objects (meteorites), coming from asteroids and comets: meteorites have proven to have great organic richness.



Uwakilishi wa Ryugu ya asteroid(Mikopo: NASA Goddard/JAXA/Dan Gallagher

Kemia ya prebiotic na mpito kutoka inanimate hadi animate

Prebiotic chemistry and the transition from non-living to living



Wakati meteorite akaanguka duniani, inaweza kuwa kusafirishwa baadhi ya maji na ferrophilic mambo kupatikana juu ya uso wa tofauti miaka bilioni 4.5 iliyopita.

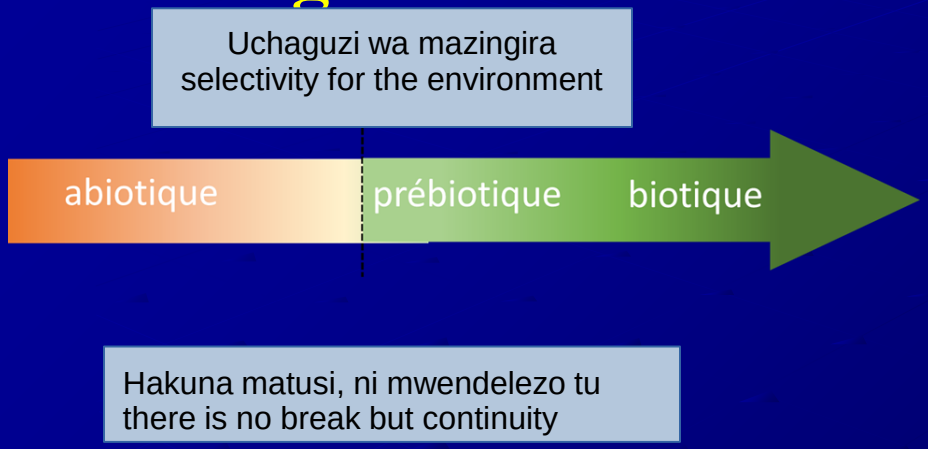
When falling to Earth, the meteorites could have transported part of the water and siderophile elements found on their surface after differentiation 4.5 billion years ago.

Aina za maisha bado hazijagunduliwa kwa miili hii ya selestia, lakini zina maelfu ya molekuli, utofauti na utofauti wa molekuli hizi, na zile muhimu kwa wasio wa biosynthesis.

No life form has yet been found in these objects, but they contain thousands of molecules as diverse and varied as those necessary in abiotic synthesis.

Kemia ya prebiotic na mpito kutoka inanimate hadi animate

Prebiotic chemistry and the transition from non-living to living



Hakuna utengano mkali kati ya mifumo ya abiotic na kibiolojia, lakini kupitia mwendelezo wa kabla ya biochemical.

There would not be a strict separation between an abiotic and a biotic system, but rather a continuity, passing through said prebiotic chemistry.

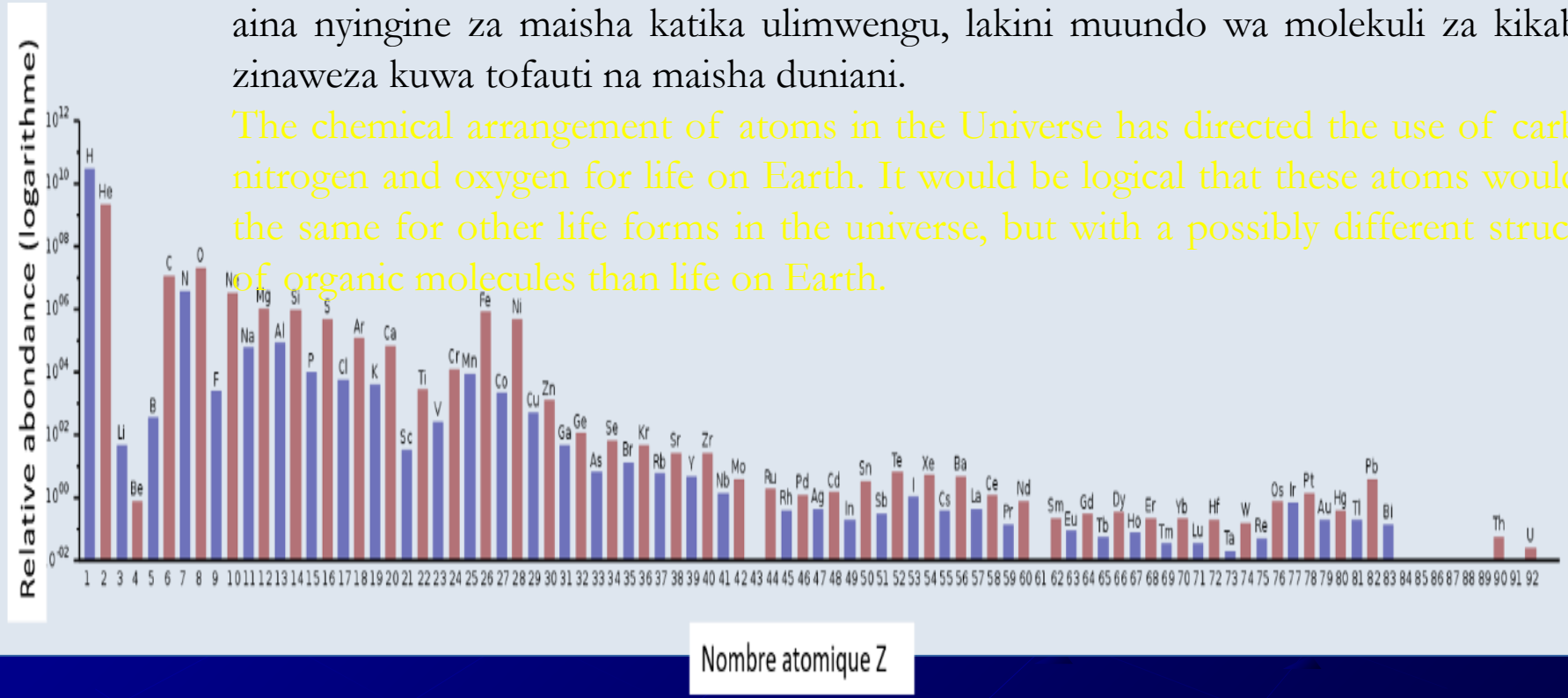
Jinsi na wapi maisha yalitoka duniani bado ni swali ngumu zaidi la kibiolojia, na njia za kemikali zinazowezekana ni nyingi sana hivi kwamba haijulikani kwamba jibu siku moja litapatikana.

How and where life arose on Earth remains the most complex exobiological question and the possible chemical pathways are so numerous that it is not obvious that the answer will one day be found.

Tafuta maisha kila mahali
Search for life everywhere

Mpangilio wa kemikali wa atomi katika ulimwengu unaongoza matumizi ya kaboni, nitrojeni, na oksijeni kwa maisha duniani. Ni mantiki kwamba atomi hizi ni sawa kwa aina nyingine za maisha katika ulimwengu, lakini muundo wa molekuli za kikaboni zinaweza kuwa tofauti na maisha duniani.

The chemical arrangement of atoms in the Universe has directed the use of carbon, nitrogen and oxygen for life on Earth. It would be logical that these atoms would be the same for other life forms in the universe, but with a possibly different structure of organic molecules than life on Earth.

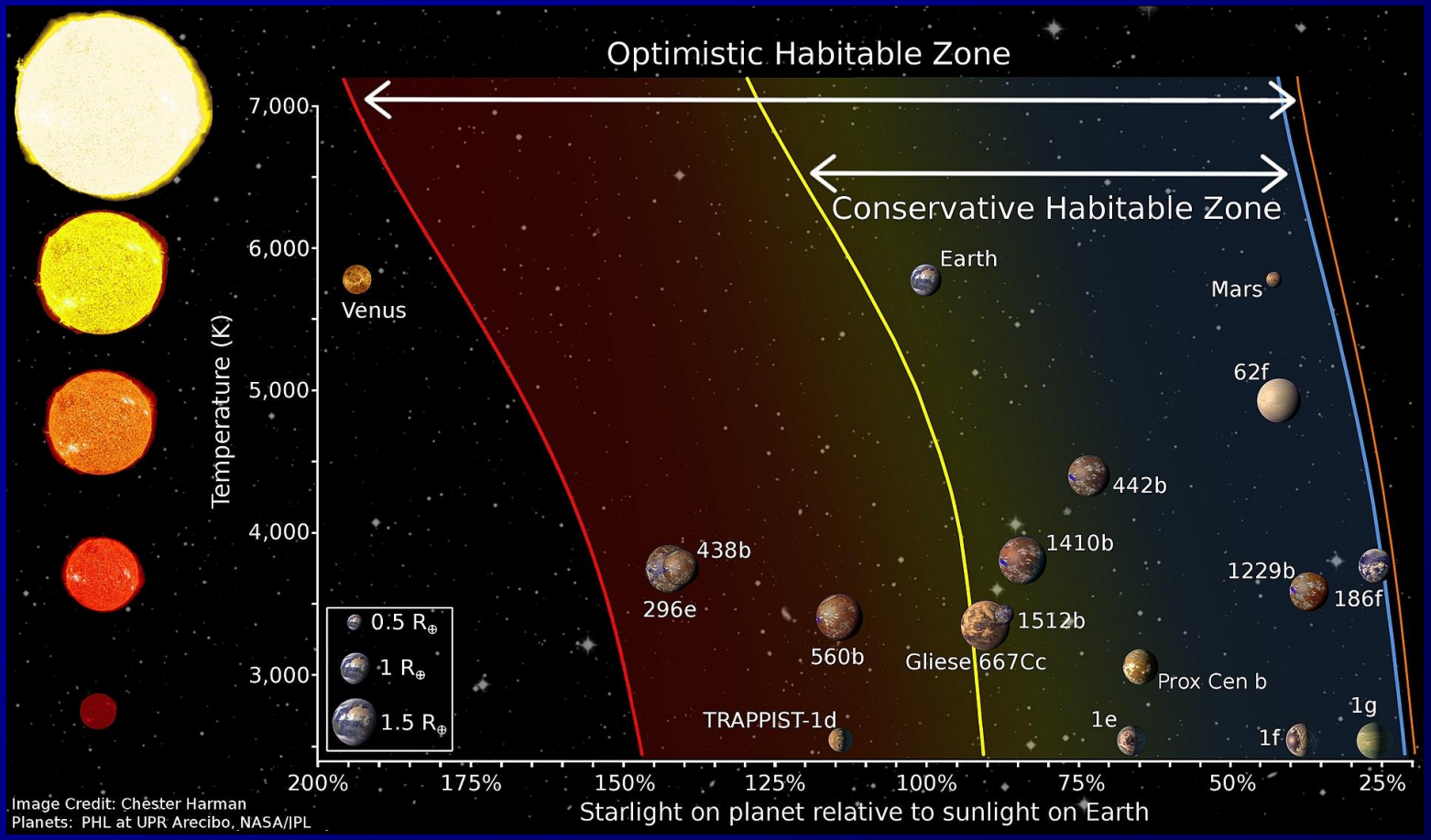


Katika kutafuta maisha mahali pengine una kujua nini cha kuangalia, moja ya misingi ya astrobiolojia, na udhaifu wake, ni kutafuta maisha ambayo ni sawa na yetu.

To look for life in other places you have to know what to look for and one of the bases of Astrobiology, but also its weakness, is the search for life biologically similar to ours.

Tafuta maisha kila mahali

Search for life everywhere



Dhana ya kuishi ni mada ya mjadala, na ufafanuzi wake unahusiana na hali zinazoruhusu kuibuka na mageuzi ya maisha pekee (ya dunia). Kundi B

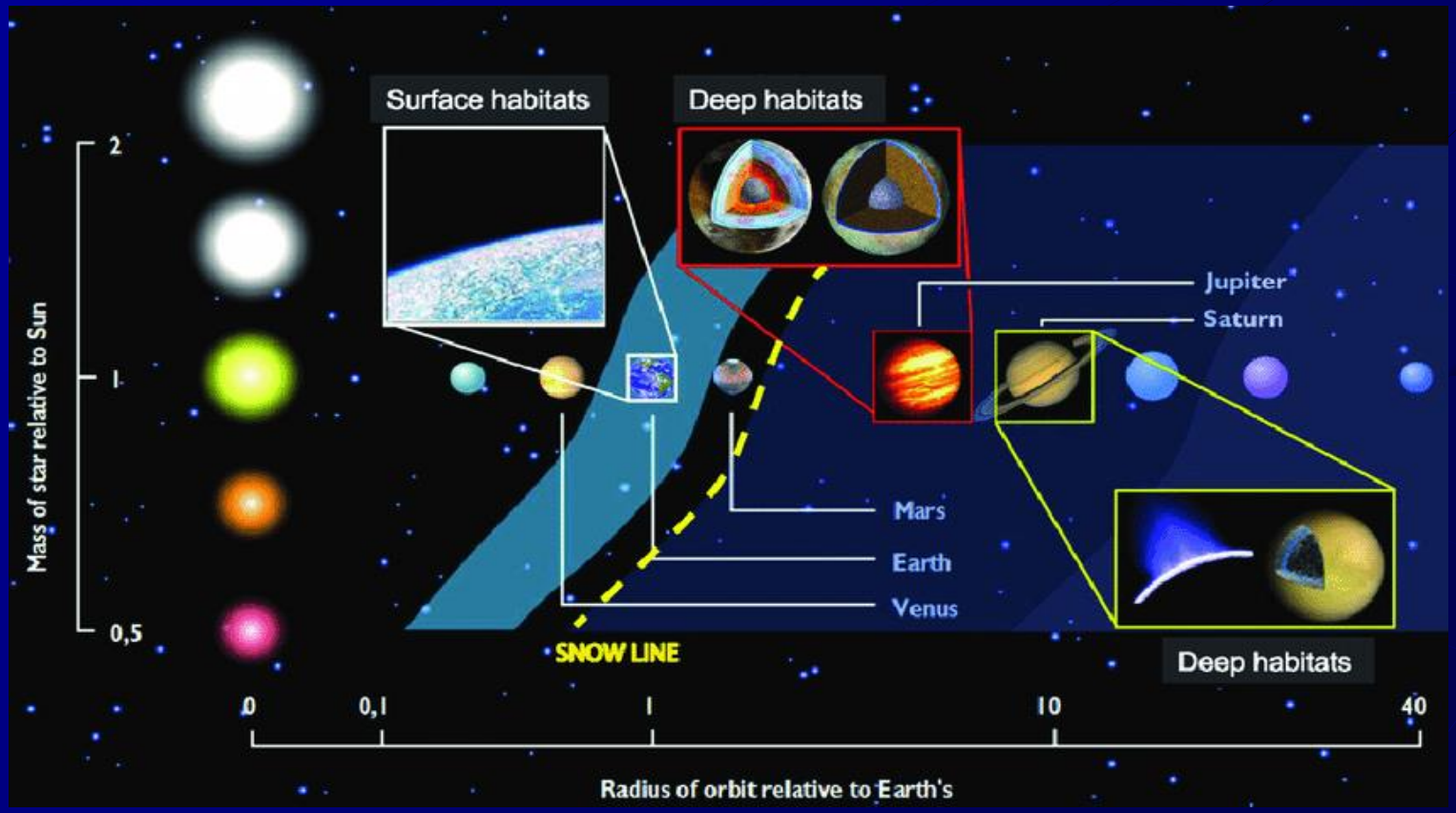
The notion of habitability is a debated topic , its definition is linked to the cond that allowed the emergence and evolution of the only (terrestrial) life we know.

Tafuta maisha kila mahali

Search for life everywhere

Upanuzi wa eneo la kuishi katika mazingira ya chini ya ardhi ni mfano wa utafiti wa uwezekano wa maisha katika mazingira haya ya mfumo wa jua.

The extension of the habitable zone to underground environments is an example of research into the possibility of life in these environments of the solar system.



Miili ya Celestial katika mfumo wa jua na maslahi yao ya astrobiological

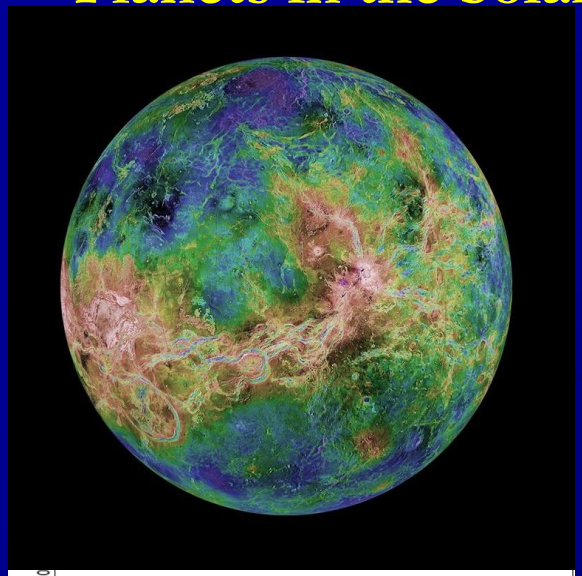
Bodies in the Solar System and their astrobiological interest

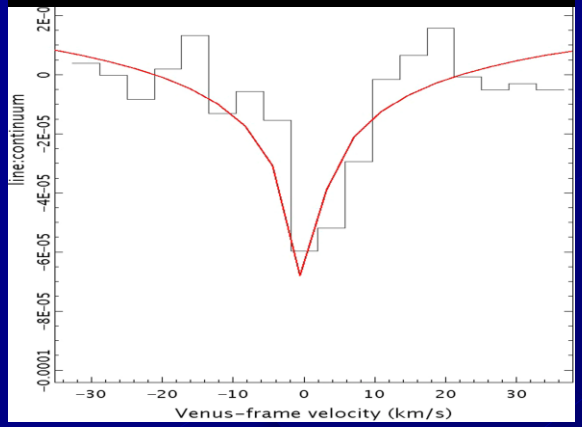
Utafiti wa Astrobiology unazingatia uwezekano wa maisha katika mazingira haya yaliyofafanuliwa (zaidi ya Dunia).

Astrobiology studies are then interested in the possible emergence of life in these environments, beyond Earth, which have been defined as habitable

Sayari katika mfumo wa jua na maslahi yao ya astrobiological: Venus

Planets in the Solar System and their astrobiological interest: VENUS





"Seli yetu ya dada" ina kemia ngumu ya kikaboni, na molekuli za sulfuri na phosphorus zilizopo katika anga yenye mnene sana inayojumuisha zaidi ya 96% dioksidi kaboni.

Haipatikani katika eneo la kawaida la mfumo wa jua na haina kiungo muhimu: maji juu ya uso wake.

Our "sister planet" has relatively complex organic chemistry, with sulfur and phosphorus molecules in an extremely dense atmosphere composed of more than 96% CO_2.

It is not found in the habitable zone of the solar system and it lacks an essential component: water on its surface.

Maji yaliyosafishwa (HDO) (Credit: Greaves, J.S., Richards, A.M.S., Bains, W. et al.)

Sayari katika mfumo wa jua na maslahi yao ya astrobiological: Venus

Planets in the Solar System and their astrobiological interest: VENUS

Venus ilifaidika na vifaa vya kigeni kama vile Dunia baada ya kuundwa kwake, na kunaweza kuwa na maji ya kioevu juu ya uso wake, na kulikuwa na wakati ambapo anga ilikuwa na maji mengi miaka bilioni 4.5 iliyopita.

Kwa sasa ina volkeno hai tu juu ya uso wake na ina joto la karibu 460 ° C.

Ikiwa maisha yanaendelea kwa wakati mzuri zaidi, inashauriwa kuwa inaishi katika mawingu yake kwa njia ya microorganisms kwa joto la ~ 75 ° C

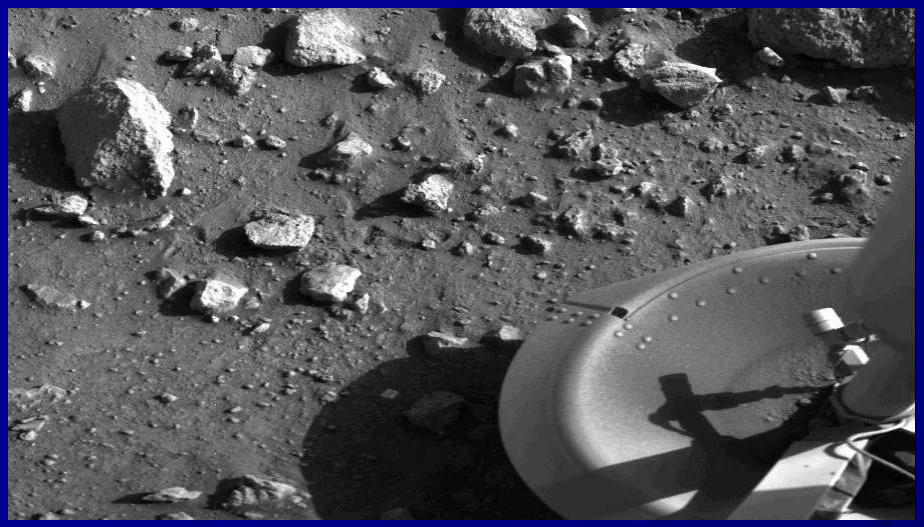
Venus benefited from exogenous inputs like Earth after its formation, it may have had liquid water on its surface and a water-rich atmosphere 4.5 billion years ago and for some time.

Currently its surface is only active volcanism with temperatures of around 460°C.

If life developed at the most favorable time, it is proposed that it survived in the form of microorganisms in the clouds of its atmosphere, with a temperature of ~75°C

Sayari katika mfumo wa jua na maslahi yao ya astrobiological: Mars

Planets in the Solar System and their astrobiological interest: MARS



Sayari hii mara nyingi huchukuliwa kuwa mahali pazuri katika mfumo wa jua kuwa na au bado kuwa na hali ya maisha.

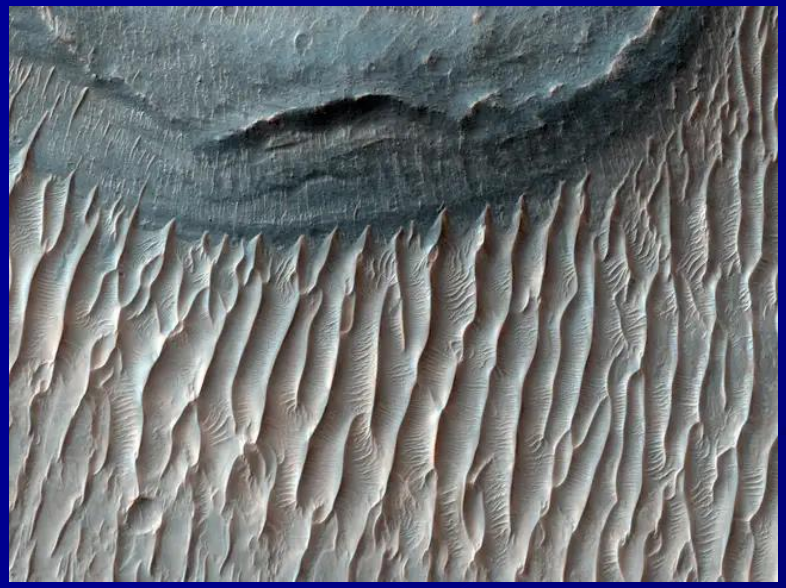
This planet has often been proposed as the best place in the solar system to have had, or still have, conditions for life.

Wakati wa maandalizi ya ujumbe wa Pirate katika miaka ya 70, uwepo wa maisha ya microbial tayari ulizingatiwa: lander ilikuwa na vifaa ambavyo vinaweza kufanya majaribio yenye lengo la kuonyesha maisha kwenye Mars, kugundua shughuli za kibiolojia za photosynthetic au kutoa virutubisho kwa bakteria ya Martian, lakini majibu yalikuwa hasi.

The existence of microbial life was already considered in the 70s during the preparation of the Viking mission: the landers were equipped with instruments capable of carrying experiments aimed at highlighting Martian life, detecting photosynthetic biological activity, providing nutrients to Martian bacteria, with negative responses.

Sayari katika mfumo wa jua na maslahi yao ya astrobiological: Mars

Planets in the Solar System and their astrobiological interest: MARS



Credit: (Curiosity, NASA/JPL)

Vikings alithibitisha uwepo wa maji ya kioevu kwenye Mars katika siku za nyuma, kuchunguza njia za maji, mito ya wadi na mabonde ya dendritic.

The Vikings confirmed the presence of liquid water in the past of Mars, observing channels, dry rivers and dendritic valleys.

Maji yanaweza kuwa yamekaa juu ya uso wake kwa angalau miaka bilioni 1 na bado yapo katika madini ambayo kwa sasa yanafunika uso wake.

The water could have remained on its surface for at least a billion years and is still present in the minerals that currently cover the surface .

Kuna barafu ya maji katika taji la polar, na inashukiwa kuwa kuna kiasi kikubwa cha maji katika crust ya Martian

At the poles there is water ice in the polar caps and it is suspected that water is present in greater quantities in the Martian crust

Sayari katika mfumo wa jua na maslahi yao ya astrobiological: Mars

Planets in the Solar System and their astrobiological interest: MARS

Maisha kwenye Mars yanaweza kuwa yameendelea wakati huo huo kama maisha duniani na yanaweza kuendelea chini ya uso.
Ugunduzi wa maisha kwenye Mars utatoa majibu mengi kwa kuibuka kwa maisha kwenye sayari yetu.
Ikiwa maisha yapo kwenye Mars, hata katika mfumo wa microorganisms, na kwa sababu Mars haifanyi kazi tena kijiolojia, basi inawezekana kupata maisha juu ya uso wa Mars kwa njia ya mabaki ya kufuatilia, na hata matumaini kwamba maisha yapo na kubaki chini ya ardhi.

Life could have developed on Mars at the same time as on Earth and perhaps persisted underground.
Finding life on Mars would provide many answers about the emergence of life on our planet.
If life existed on Mars, even in the form of microorganisms, and since the planet is no longer geologically active, it should be possible to discover it in the form of trace fossils on the surface or even hope that it exists and has survived underground.

Miili ya Celestial katika mfumo wa jua na maslahi yao ya astrobiological: satelaiti

Bodies in the Solar System and their astrobiological interest: SATELLITES

Katika miongo ya hivi karibuni, viumbe vingine vya mbinguni vilivyovutiwa vimegunduliwa zaidi ya kizuizi cha asteroidi: miezi ya sayari kubwa za gesi.
Sayari kubwa zina maslahi kidogo katika astrobiology kwa sababu hazina uso na kwa hivyo hakuna miamba.
Mwezi wao pia ni muhimu kwa kuelewa asili na mageuzi ya mfumo wa jua.

In recent decades, other habitable bodies of astrobiological interest have been discovered beyond the asteroid barrier: the satellites of giant gaseous planets.
Giant planets are of limited interest to astrobiology because they have no surfaces and therefore no rocks.
Their satellites are also important for understanding the origin and evolution of the Solar System.

Satelaiti za mfumo wa jua na maslahi yao ya astrobiological

Satellites in the Solar System and their astrobiological interest

Karibu na Jupita: Ganymede, Callisto, na Europa.
Saturn: Titan na Titan.
Tangu uchunguzi wa Cassini-Huygens (1997-2017) ulitembelea ulimwengu huu kwa miaka 15, miezi ya barafu ya Saturn ilishangazwa na utofauti wao na wingi wa maji ya kioevu yaliyomo.

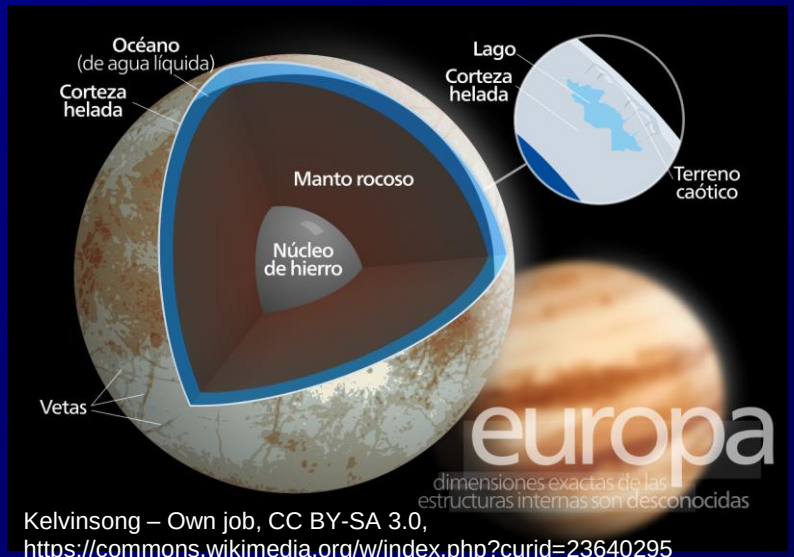
Around Jupiter: Ganymede, Callisto and Europa.
Around Saturn: Enceladus and Titan.
Revealed thanks to the Cassini-Huygens probe (1997-2017), which visited these worlds for 15 years, the icy satellites of Saturn surprise with their diversity and the abundance of liquid water they contain.

Satelaiti za mfumo wa jua na maslahi yao ya astrobiological

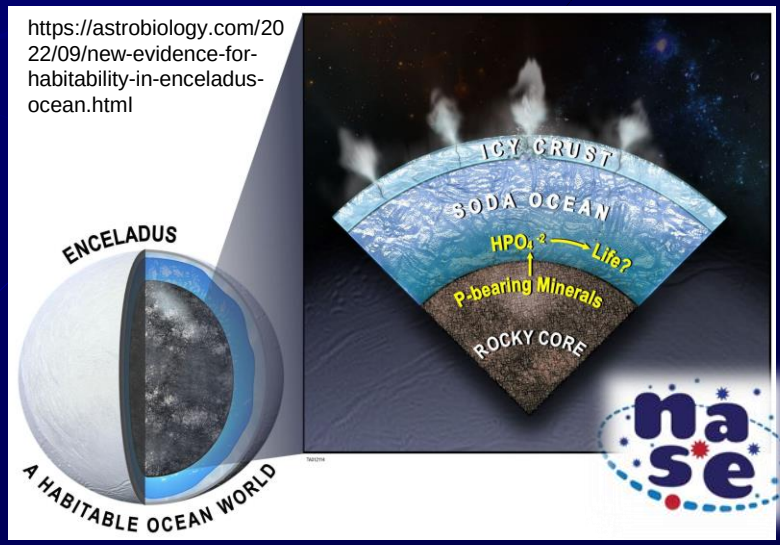
Satellites in the Solar System and their astrobiological interest

Europa itakuwa na bahari mara 10 kubwa kuliko Dunia, na mara 3 ndogo kuliko sayari yetu.
Enceladus aligundua geyser ya maji juu ya uso wake katika 2014, kupanua mita 100 juu ya uso wake.
Uchunguzi huu ulifunua bahari chini ya karatasi ya barafu.

Europa would contain an ocean ten times larger than Earth's, while being three times smaller than our planet.
Enceladus In 2014 water geysers on its surface, which extend up to 100 km above its surface, were discovered.
This observation has revealed the presence of an ocean under the ice sheet.



Kelvinsong – Own job, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=23640295



Satelaiti za Mfumo wa jua na Maslahi Yao ya Astrobiological: TITAN

Satellites in the Solar System and their astrobiological interest: TITAN

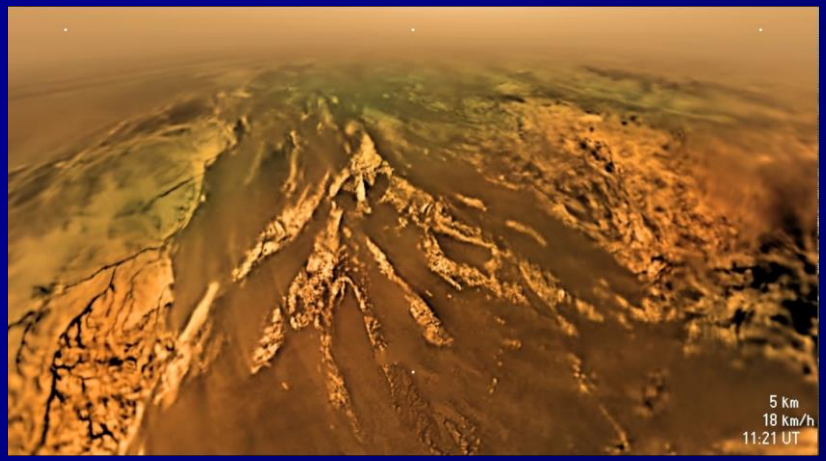
Mwezi mkubwa zaidi wa Saturn, Titan, huunda kiasi kikubwa cha vitu vya kikaboni katika anga.
Katika miaka ya 1980 na 1981, uchunguzi wa Voyager 1 na 2 uligundua anga nene sana iliyojumuisha nitrojeni na methane.
Kemia katika anga ya Titan imeonekana kuwa ngumu sana, na kusababisha kuundwa kwa aerosols za kikaboni na amana yao juu ya uso.

Saturn's largest satellite, Titan, presents a large amount of organic matter that forms in its atmosphere.
In 1980 and 1981, the Voyager 1 and 2 probes revealed an extremely dense atmosphere composed primarily of nitrogen and methane.
The chemistry in Titan's atmosphere has proven to be extremely complex, resulting in the formation of organic aerosols that settle on the surface.

Ujumbe wa Cassini-Huygens (1997-2017) ulithibitisha kemia ngumu ya kikaboni ya anga ya Titan.

The Cassini-Huygens mission (1997-2017) confirmed complex organic chemistry in the atmosphere of Titan.

Cassini/Huygens Mission (Credit: NASA)



Titan (Credit: Cassini/Huygens, NASA)

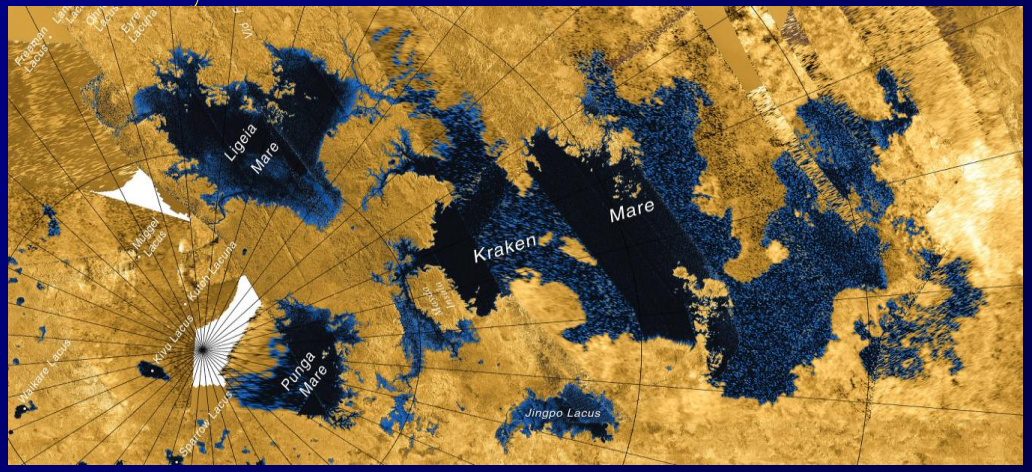
Picha za kuvutia zilipatikana juu ya uso uliofunikwa na chembe za kikaboni, dunes za mchanga na maziwa ya hydrocarbon. Mifano ya Astrophysical zinaonyesha kwamba Titan inaweza kuwa na kiasi kikubwa cha maji ya kioevu chini ya uso wake na kutoa vipengele vyote muhimu kwa kuibuka kwa kemikali nyingi za kabla ya maisha na aina za maisha.

Impressive images were obtained of the surface covered with organic grains, dunes and hydrocarbon lakes.
Astrophysical models have proposed that Titan may harbor an ocean of liquid water beneath its surface and presents all the necessary ingredients for the emergence of rich prebiotic chemistry and a possible form of life.

Mifano ya geochemical ya mageuzi inaonyesha kwamba kutoka mwaka wa milioni baada ya kuundwa kwa Titan, bahari hii ya subterranean iliwasiliana na anga, na kuzalisha molekuli ya kwanza ngumu.
Sawa na Dunia, matundu ya hydrothermal yanatarajiwa katika bahari hii ya Titan, ambayo ni chanzo cha nishati kwa molekuli za kikaboni na mazingira ya uwezekano wa mifumo ya prebiotic.

Evolutionary geochemical models suggest that from the first million years after the formation of Titan, this underground ocean was in contact with the atmosphere, in which the first complex molecules would have been produced.

By analogy with Earth, the presence of hydrothermal vents is expected in this Titan ocean, which constitute a source of energy for organic molecules and a potential environment for prebiotic systems.



Nje ya mfumo wa jua
Beyond the Solar System

5,500 exoplanets (kama ya 2024) imegunduliwa na kuthibitishwa katika galaxy yetu. Inatusaidia kuelewa malezi ya mfumo wa jua, ambayo inaweza kuwa ya kipekee.

Maarifa ya sasa na maendeleo katika uwanja wa astrobiology hufanya iwe vigumu kudhani sayari inayokaliwa na kuthibitika maisha katika Njia ya Milky na zaidi.

Inaonekana kuna maeneo zaidi na zaidi ya uwezekano wa maendeleo ya maisha, lakini vipi kuhusu maendeleo halisi ya maisha?

5500 exoplanets (up to now 2024) have being discovered and confirmed in our galaxy. It helps us to understand the formation of our Solar System and that islikely unique.

With the current state of knowledge and advances in the field of Astrobiology, it is very difficult to hypothesize an inhabited planet and the proven presence of life in our galaxy or beyond.

There seem to be more and more potential sites for the development of life, but about the actual development of life?

Hitimisho
Conclusions

Astrobiology inajaribu kuamua kama maisha yanaweza kuwepo katika sehemu nyingine za ulimwengu na, ikiwa ni hivyo, kwa namna gani, kujaribu kujibu swali la kuwepo: Je, sisi peke yetu katika ulimwengu? Kwa miongo kadhaa, kuelewa jinsi maisha duniani yalivyoonekana kuwa muhimu katika kuamua kama ilikuwa ni bahati mbaya au jambo linaloweza kuzalishwa katika hali maalum na mazingira.

Astrobiology attempts to determine whether life could exist in other parts of the universe and, if so, in what form, to try to answer an existential question: are we alone in the universe?

For several decades, understanding the appearance of life on Earth has been crucial to determine whether it is a coincidence or a reproducible phenomenon under specific conditions and environments.

Hitimisho
Conclusions

Uelewa huu ni muhimu ili kutoa hitimisho juu ya uwezekano wa maisha mahali pengine katika ulimwengu.
Licha ya juhudi nzuri, hakuna hitimisho kama hilo bado limefikiwa.

Kundi B

This understanding is necessary to draw conclusions about the possibility of life elsewhere in the universe.
Despite active efforts, no such conclusions have yet been reached.

Shukrani kwa ajili
ya maslahi yako!

**Thank you for
your attention!**