Зародження життя: коли, як і чому

Олег Стасик

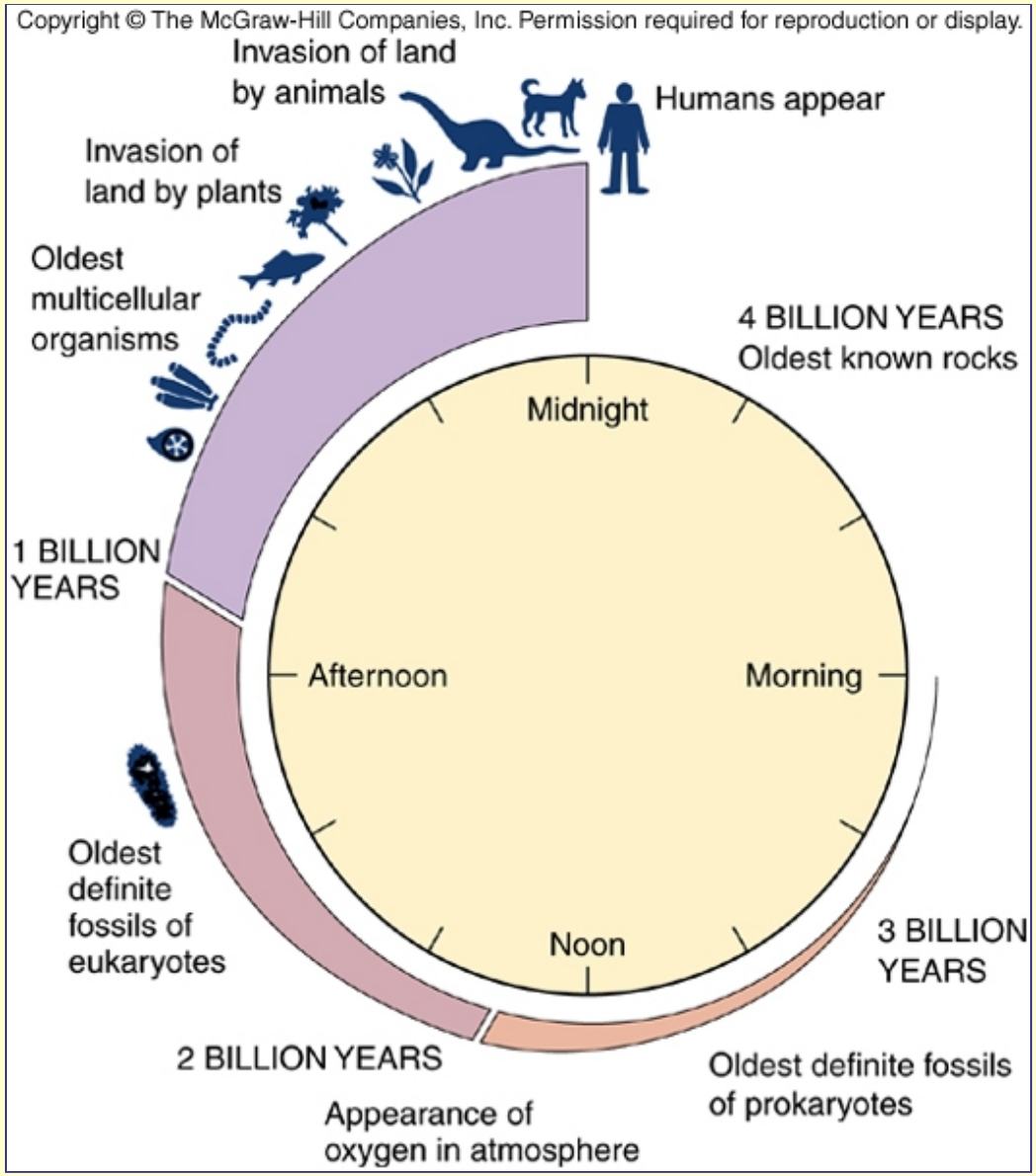
- **Зародження життя залишається не менш складною загадкою для сучасної науки, ніж створення Всесвіту.**
- **Ми знаємо коли з”явилось життя (на Землі) – приблизно 3,5 млрд. років тому, через мільярд років її існування як космічного тіла.**
- **Знайти вірну (чи найбільш імовірну) відповідь на питання «Як і чому?» можуть лише спільні зусилля космологів, хіміків, біологів, інформатиків і … філософів.**

Що таке життя???

Зародження життя:
Де і коли?

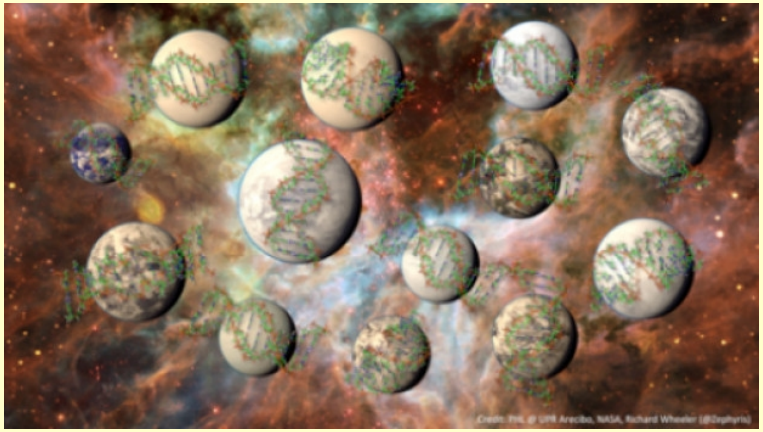
Планета Земля

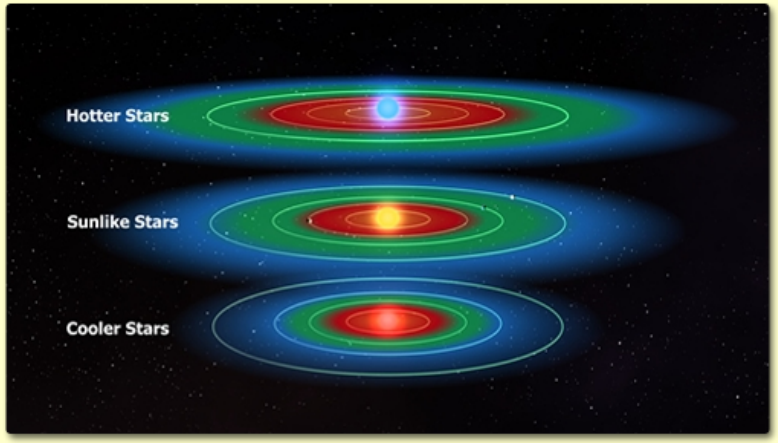
Життя є “раннім” феноменом



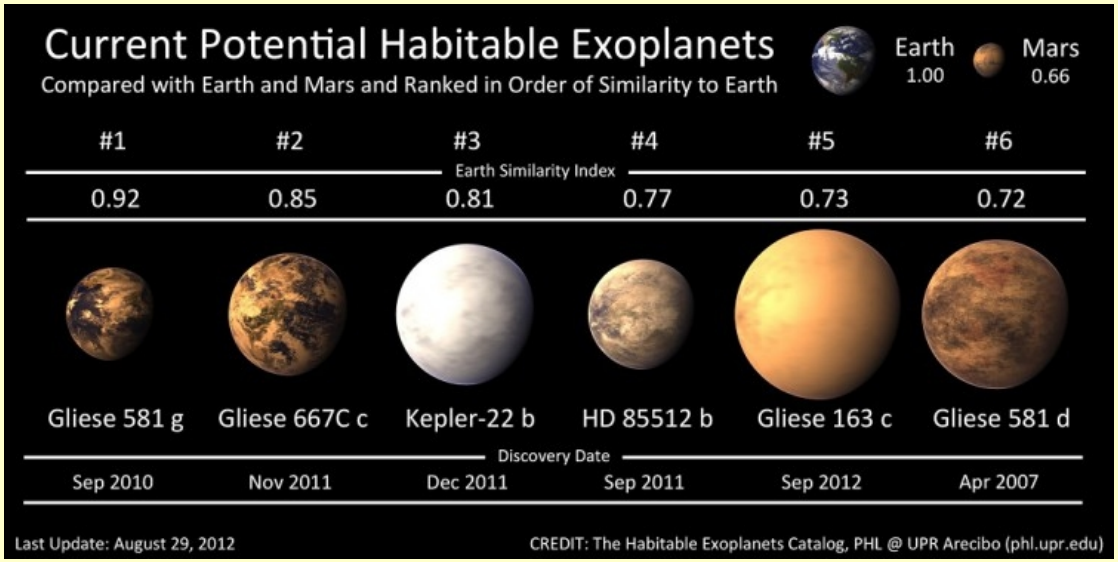
A new computation method to examine planets orbiting other stars suggests the Milky Way galaxy may house 100 million other places that could support complex life.

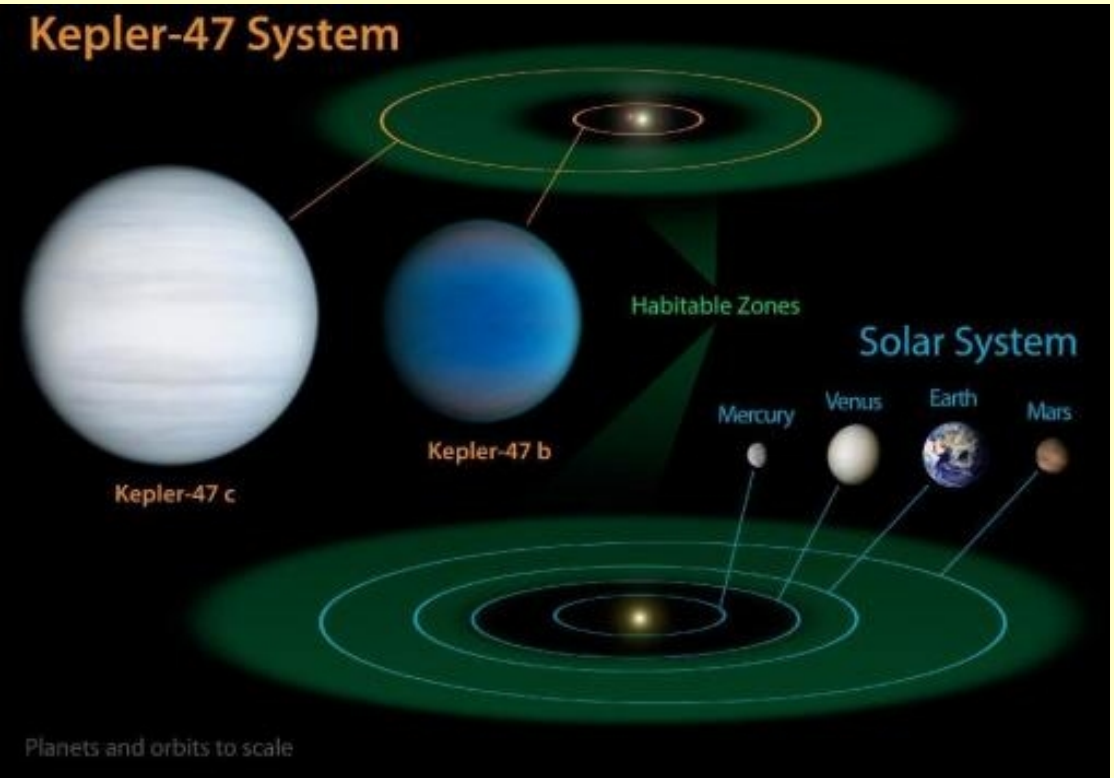
Credit: Courtesy of Planetary Habitability Laboratory, University of Puerto Rico at Arecibo





1.Louis Irwin, Abel Méndez, Alberto Fairén, Dirk Schulze-Makuch. Assessing the Possibility of Biological Complexity on Other Worlds, with an Estimate of the Occurrence of Complex Life in the Milky Way Galaxy. *Challenges*, 2014; 5 (1): 159
DOI: 10.3390/challe5010159



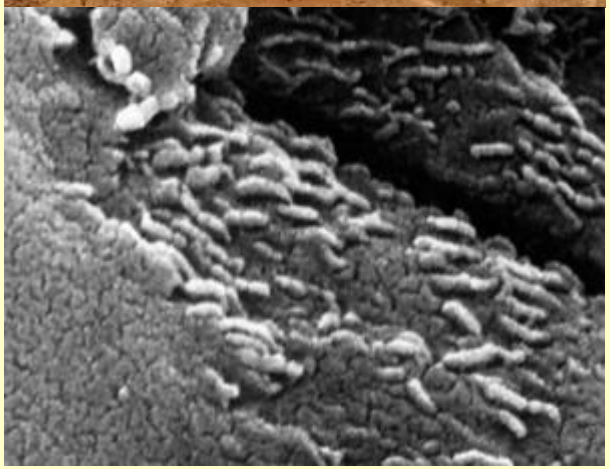


With about 10 billion stars in the Milky Way galaxy, the BCI yields 100 million plausible planets.

Despite the large number of planets that could harbor complex life, the Milky Way is so vast that planets with high BCI values are very far apart, according to the scientists. One of the closest and most promising extrasolar systems, called Gliese 581, has two planets with the apparent, possible capacity to host complex biospheres. The distance from Earth to Gliese 581 is about 20 light years.

"It seems highly unlikely that we are alone," say the researchers. "We are likely so far away from life at our level of complexity that a meeting with such alien forms might be improbable for the foreseeable future."

Марс



Is there, or was there once, life on Mars?

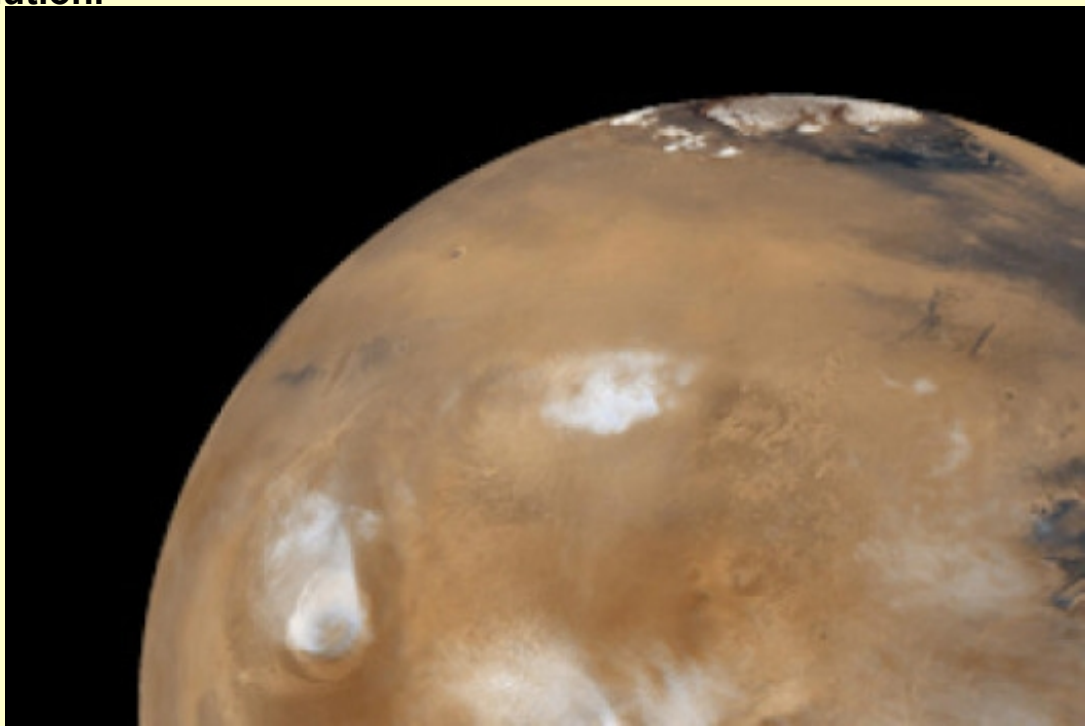
Elias Chatzitheodoridis, Sarah Haigh, Ian Lyon. A Conspicuous Clay Ovoid in Nakhla: Evidence for Subsurface Hydrothermal Alteration on Mars with Implications for Astrobiology. *Astrobiology*, 2014; 14 (8): 651 DOI: 10.1089/ast.2013.1069

A tiny fragment of Martian meteorite 1.3 billion years old is helping to make the case for the possibility of life on Mars, say scientists.

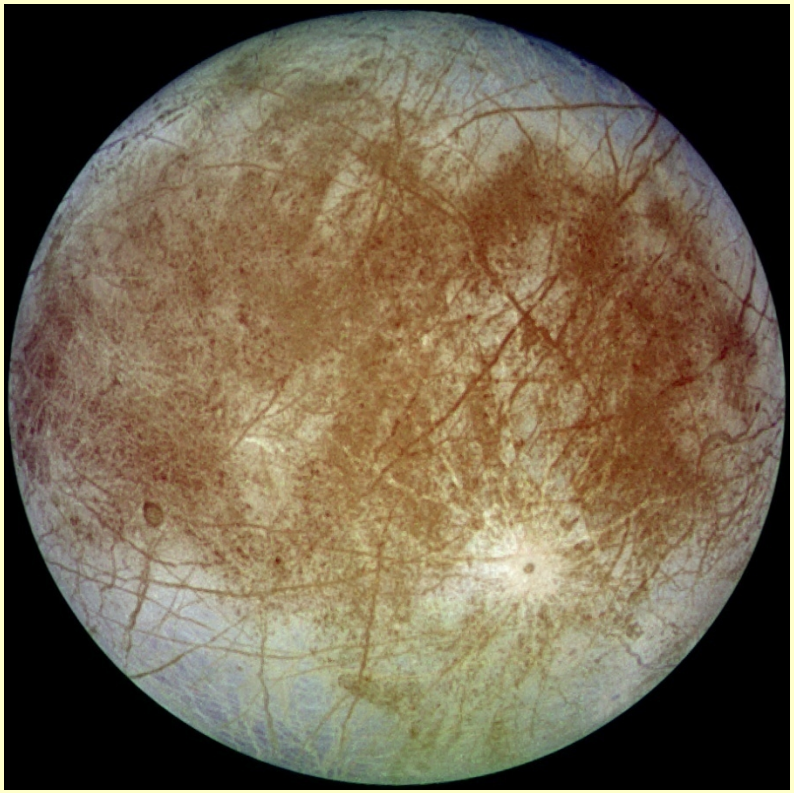
Heather B. Franz, Sang-Tae Kim, James Farquhar, James M. D. Day, Rita C. Economos, Kevin D. McKeegan, Axel K. Schmitt, Anthony J. Irving, Joost Hoek, James Dottin III. Isotopic links between atmospheric chemistry and the deep sulphur cycle on Mars. *Nature*, 2014; 508 (7496): 364 DOI: 10.1038/nature13175

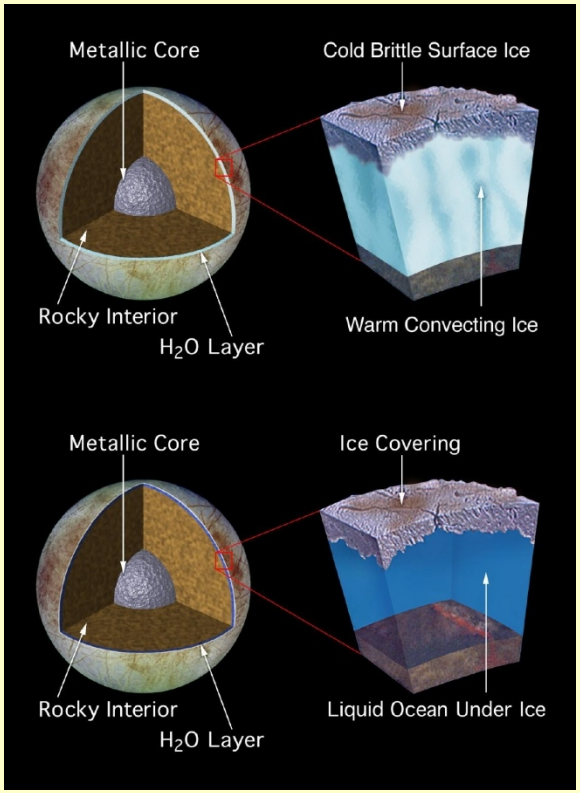
Geologists analyzed 40 meteorites that fell to Earth from Mars to understand the history of the Martian atmosphere. Their new article shows the atmospheres of Mars and Earth diverged in important ways early in the solar system's 4.6 billion year evolution.

Credit: NASA/JPL/MSSS



Супутник Юпітера Європа





Зародження життя:
Як?

Hardy little space travelers could colonize Mars, space station research shows that

Date:

May 2, 2014

Source:

NASASilvano Onofri, Rosa de la Torre, Jean-Pierre de Vera, Sieglinde Ott, Laura Zucconi, Laura Selbmann, Giuliano Scalzi, Kasthuri J. Venkateswaran, Elke Rabbow, Francisco J. Sánchez Iñigo, Gerda Horneck. Survival of Rock-Colonizing Organisms After 1.5 Years in Outer Space. *Astrobiology*, 2012; 12 (5): 508 DOI: 10.1089/ast.2011.0736

"After testing exposure to the simulated Mars environment, we wanted to see what would happen in real space, and EuTEF gave us the chance. To our surprise, some of the spores survived for 18 months." These surviving spores had higher concentrations of proteins associated with UV radiation resistance and, in fact, showed elevated UV resistance when revived and re-exposed on Earth.

Lichen can survive in space: Space station research sheds light on origin of life; potential for better sunscreens

Date:

June 23, 2012

Source:

European Space Agency Hervé Cottin, Yuan Yong Guan, Audrey Noblet, Olivier Poch, Kafila Saiagh, Mégane Cloix, Frédérique Macari, Murielle Jérome, Patrice Coll, François Raulin, Fabien Stalport, Cyril Szopa, Marylène Bertrand, Annie Chabin, Frances Westall, Didier Chaput, René Demets, André Brack. The PROCESS Experiment: An Astrochemistry Laboratory for Solid and Gaseous Organic Samples in Low-Earth Orbit. *Astrobiology*, 2012; 12 (5): 412 DOI: 10.1089/ast.2011.0773

Summary:

You can freeze it, thaw it, vacuum dry it and expose it to radiation, but still life survives. Research on the International Space Station is giving credibility to theories that life came from outer space -- as well as helping to create better sunscreens.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© Maciej Winiarczyk HEMEDIA

Oceans arrived early to Earth; Primitive meteorites were a likely source of water, study finds

Date:

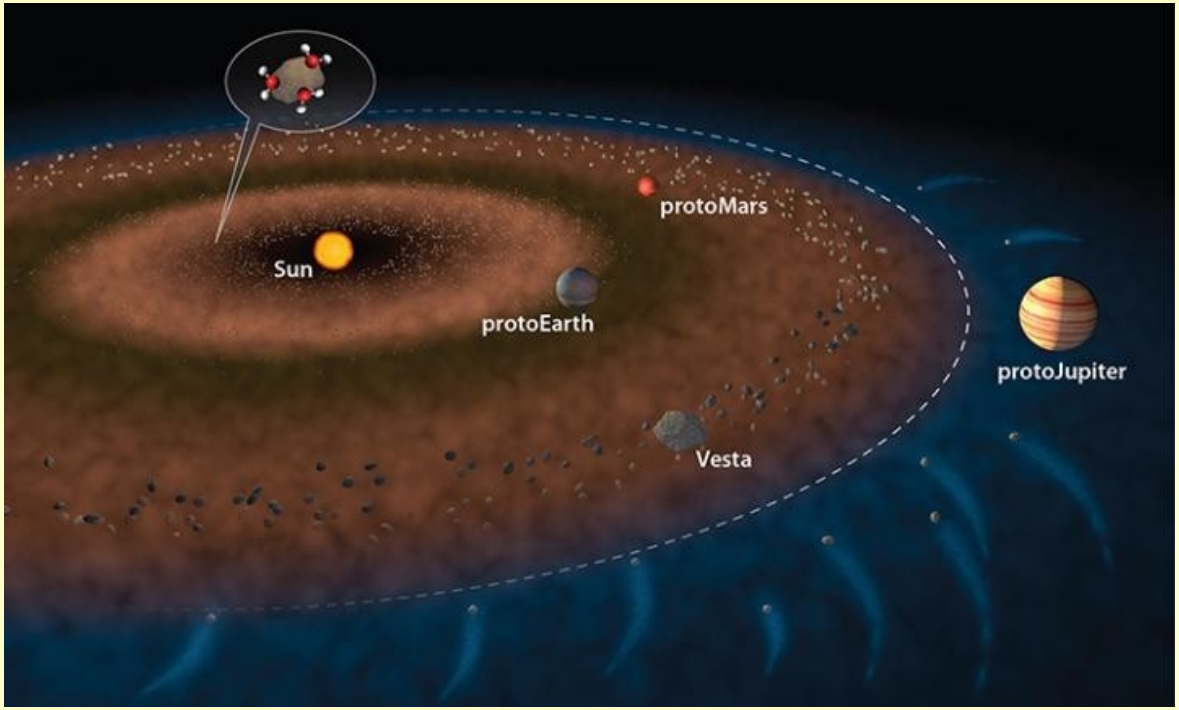
October 30, 2014

Source:

A. R. Sarafian, S. G. Nielsen, H. R. Marschall, F. M. McCubbin, B. D. Monteleone. Early accretion of water in the inner solar system from a carbonaceous chondrite-like source. *Science*, 2014; 346 (6209): 623 DOI: 10.1126/science.1256717

Summary:

Earth is known as the Blue Planet because of its oceans, which cover more than 70 percent of the planet's surface and are home to the world's greatest diversity of life. While water is essential for life on the planet, the answers to two key questions have eluded us: Where did Earth's water come from and when? While some hypothesize that water came late to Earth, well after the planet had formed, findings from a new study significantly move back the clock for the first evidence of water on Earth and in the inner solar system.



New evidence that comets could have seeded life on Earth

Date:

March 5, 2013

Source:

R. I. Kaiser, A. M. Stockton, Y. S. Kim, E. C. Jensen, R. A. Mathies. ON THE FORMATION OF DIPEPTIDES IN INTERSTELLAR MODEL ICES. *The Astrophysical Journal*, 2013; 765 (2): 111 DOI: 10.1088/0004-637X/765/2/111

Summary:

Scientists have shown that complex molecules can form on icy dust in space, suggesting that comets may have brought these molecules to Earth and seeded the growth of more complex building blocks of life. The team zapped icy snowballs of carbon dioxide and hydrocarbons, producing complex molecules, such as dipeptides, that are capable of catalyzing the formation of more complex structures.

Ancient minerals: Which gave rise to life?

Date:

November 25, 2013

Source:

R. M. Hazen. Paleomineralogy of the Hadean Eon: A preliminary species list. *American Journal of Science*, 2013; 313 (9): 807 DOI: 10.2475/09.2013.01

Carnegie Institution

Summary:

Life originated as a result of natural processes that exploited early Earth's raw materials. Scientific models of life's origins almost always look to minerals for such essential tasks as the synthesis of life's molecular building blocks or the supply of metabolic energy. But this assumes that the mineral species found on Earth today are much the same as they were during Earth's first 550 million years -- the Hadean Eon -- when life emerged. A new analysis of Hadean mineralogy challenges that assumption.

The magnesium silicate forsterite was one of the most abundant minerals in the Hadean Eon, and it played a major role in Earth's near-surface processes. The green color of this mineral (which is also known as the semi-precious gemstone peridot, the birthstone of August) is caused by small amounts iron. The iron can react with seawater to promote chemical reactions that may have played a role in life's origins.

Origin of Life: Hypothesis Traces First Protocells Back to Emergence of Cell Membrane Bioenergetics

Dec. 20, 2012 — A coherent pathway -- which starts from no more than rocks, water and carbon dioxide and leads to the emergence of the strange bio-energetic properties of living cells -- has been traced for the first time in a major hypothesis paper in *Cell* this week.

Nick Lane, William F. Martin. The Origin of Membrane Bioenergetics. *Cell*, 2012; 151 (7): 1406 DOI: 10.1016/j.cell.2012.11.050

Where did it all that energy come from on the early Earth, and how did it get focused into driving the organic chemistry required for life?

The answer lies in the chemistry of deep-sea hydrothermal vents. In their paper Nick Lane (UCL, Genetics, Evolution and Environment) and Bill Martin (University of Dusseldorf) address the question of where all this energy came from -- and why all life as we know it conserves energy in the peculiar form of ion gradients across membranes.

"Life is, in effect, a side-reaction of an energy-harnessing reaction. Living organisms require vast amounts of energy to go on living," said Nick Lane.

Lane and Martin show that bacteria capable of growing on no more than hydrogen and carbon dioxide are remarkably similar in the details of their carbon and energy metabolism to the far-from-equilibrium chemistry occurring in a particular type of deep-sea hydrothermal vent, known as alkaline hydrothermal vents.

Based on measured values, they calculate that natural proton gradients, acting across thin semi-conducting iron-sulfur mineral walls, could have driven the assimilation of organic carbon, giving rise to protocells within the microporous labyrinth of these vents.

Origins of Life: In Early Earth, Iron Helped RNA Catalyze Electron Transfer

May 19, 2013 — A new study shows how complex biochemical transformations may have been possible under conditions that existed when life began on the early Earth.

Chiaolong Hsiao, I-Chun Chou, C. Denise Okafor, Jessica C. Bowman, Eric B. O'Neill, Shreyas S. Athavale, Anton S. Petrov, Nicholas V. Hud, Roger M. Wartell, Stephen C. Harvey, Loren Dean Williams. RNA with iron(II) as a cofactor catalyses electron transfer. *Nature Chemistry*, 2013; DOI: 10.1038/nchem.1649

Free oxygen gas was almost nonexistent in Earth's atmosphere more than 3 billion years ago. When free oxygen began entering the environment as a product of photosynthesis, it turned Earth's iron to rust, forming massive banded iron formations that are still mined today. The free oxygen produced by advanced organisms caused iron to be toxic, even though it was -- and still is -- a requirement for life.

"Our findings suggest that the catalytic competence of RNA may have been greater in early Earth conditions than in present conditions, and our experiments may have revived a latent function of RNA,"

Reconstructed ancient ocean reveals secrets about the origin of life

Date:

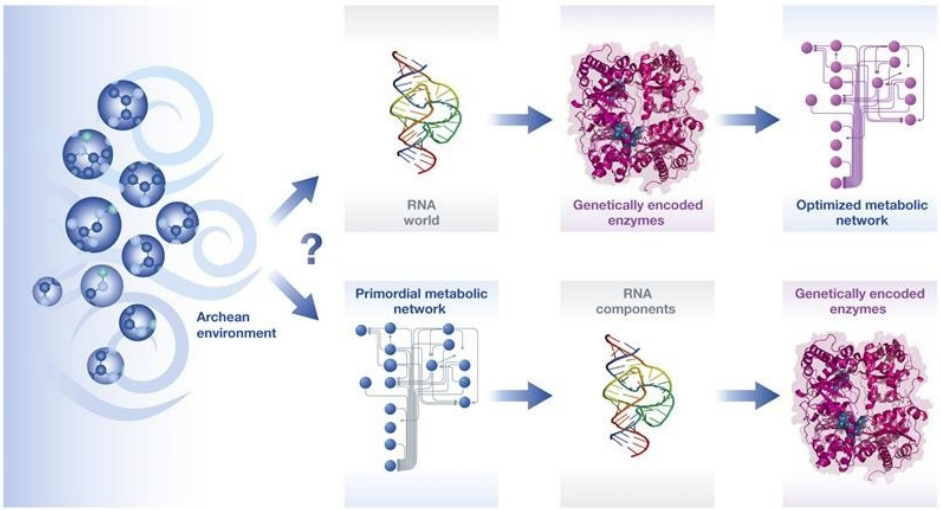
April 25, 2014

Source:

Markus A Keller, Alexandra V Turchyn, Markus Ralser. Non-enzymatic glycolysis and pentose phosphate pathway-like reactions in a plausible Archean ocean. *Molecular Systems Biology*, 2014; DOI: 10.1002/msb.20145228

Summary:

Researchers have published details about how the first organisms on Earth could have become metabolically active. The results permit scientists to speculate how primitive cells learned to synthesize their organic components -- the molecules that form RNA, lipids and amino acids. The findings also suggest an order for the sequence of events that led to the origin of life.



A reconstruction of Earth's earliest ocean in the laboratory revealed the spontaneous occurrence of the chemical reactions used by modern cells to synthesize many of the crucial organic molecules of metabolism. Previously, it was assumed that these reactions were carried out in modern cells by metabolic enzymes, highly complex molecular machines that came into existence during the evolution of modern organisms.

- **Finding a series of reactions that resembles the "core of cellular metabolism" suggests that metabolism predates the origin of life. This implies that, at least initially, metabolism may not have been shaped by evolution but by molecules like RNA formed through the chemical conditions that prevailed in the earliest oceans.**

The detection of one of the metabolites, ribose 5-phosphate, in the reaction mixtures is particularly noteworthy. Its availability means that RNA precursors could in theory give rise to RNA molecules that encode information, catalyze chemical reactions and replicate

New study outlines 'water world' theory of life's origins

Date:

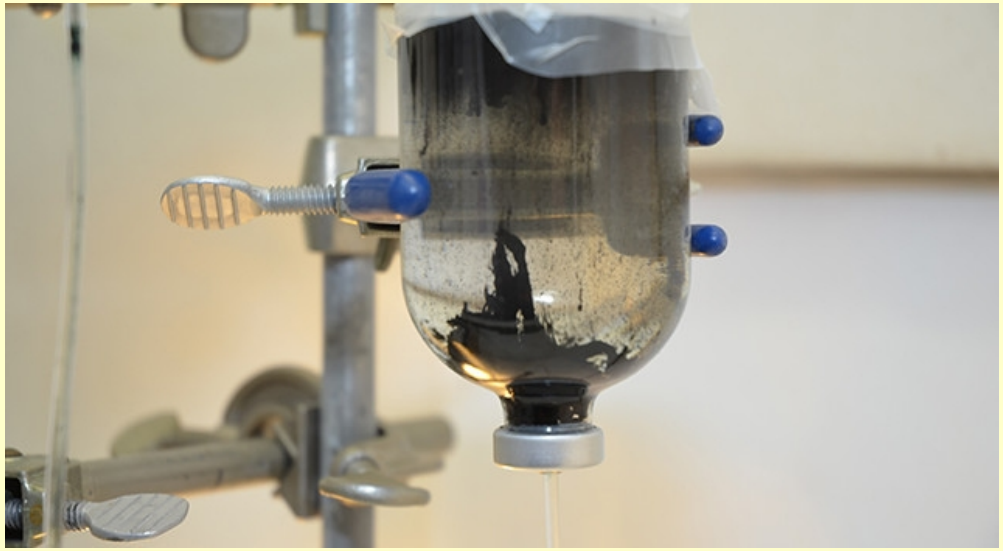
April 15, 2014

Source:

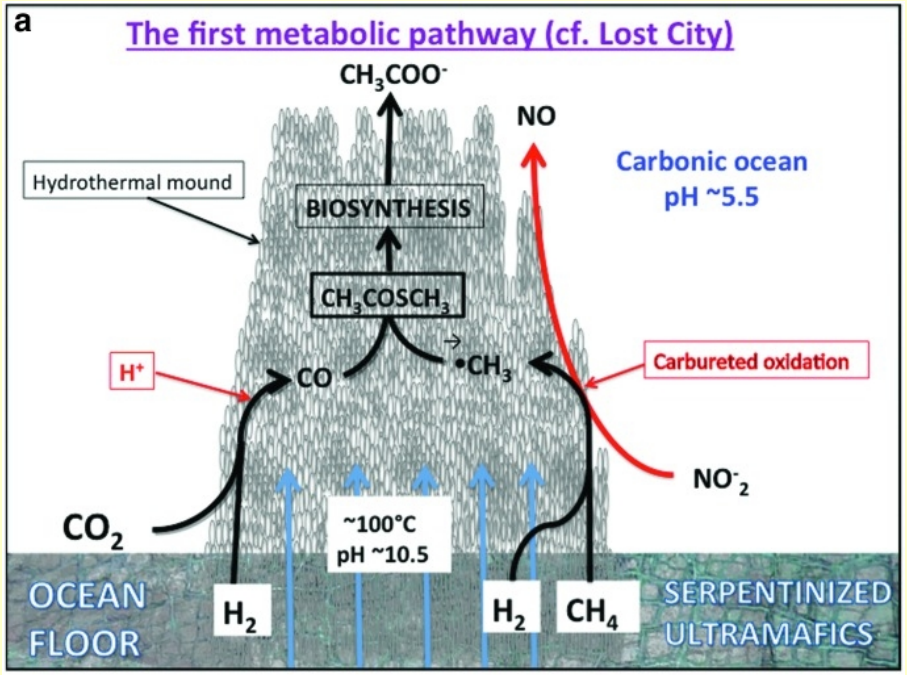
Michael J. Russell, Laura M. Barge, Rohit Bhartia, Dylan Bocanegra, Paul J. Bracher, Elbert Branscomb, Richard Kidd, Shawn McGlynn, David H. Meier, Wolfgang Nitschke, Takazo Shibuya, Steve Vance, Lauren White, Isik Kanik. The Drive to Life on Wet and Icy Worlds. *Astrobiology*, 2014; 14 (4): 308 DOI: 10.1089/ast.2013.1110

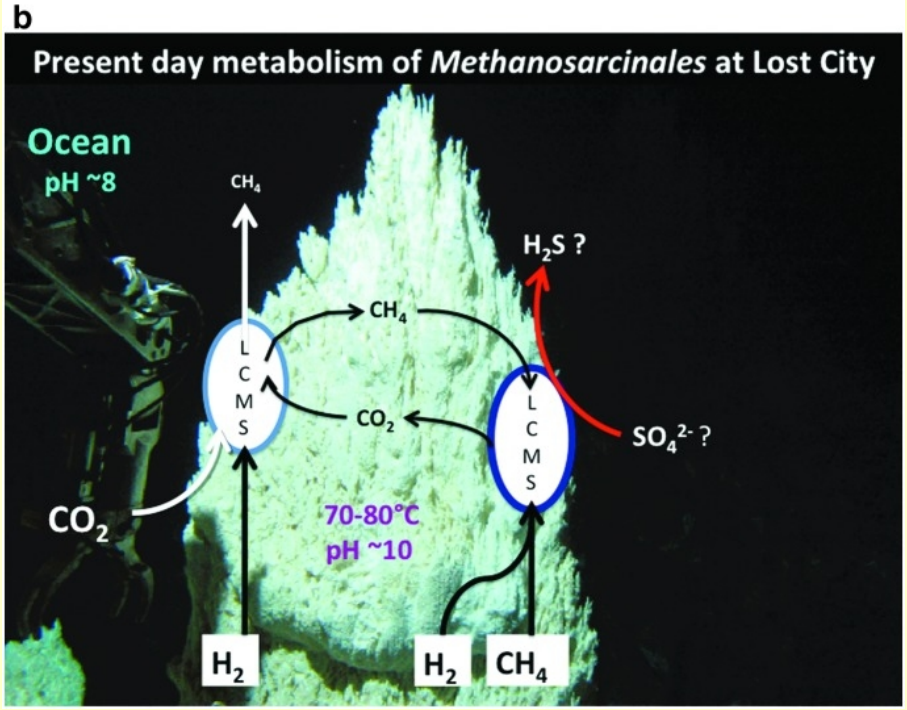
Summary:

Life took root more than four billion years ago on our nascent Earth, a wetter and harsher place than now, bathed in sizzling ultraviolet rays. What started out as simple cells ultimately transformed into slime molds, frogs, elephants, humans and the rest of our planet's living kingdoms. How did it all begin?



According to the findings, which also can be thought of as the "water world" theory, life may have begun inside warm, gentle springs on the sea floor, at a time long ago when Earth's oceans churned across the entire planet. This idea of hydrothermal vents as possible places for life's origins was first proposed in 1980 by other researchers, who found them on the sea floor near Cabo San Lucas, Mexico. Called "black smokers," those vents bubble with scalding hot, acidic fluids. In contrast, the vents in the new study -- first hypothesized by scientist Michael Russell of JPL in 1989 -- are gentler, cooler and percolate with alkaline fluids. One such towering complex of these alkaline vents was found serendipitously in the North Atlantic Ocean in 2000, and dubbed the Lost City.





The water world theory from Russell and his team says that the warm, alkaline hydrothermal vents maintained an unbalanced state with respect to the surrounding ancient, acidic ocean -- one that could have provided so-called free energy to drive the emergence of life. In fact, the vents could have created two chemical imbalances. The first was a proton gradient, where protons -- which are hydrogen ions -- were concentrated more on the outside of the vent's chimneys, also called mineral membranes. The proton gradient could have been tapped for energy -- something our own bodies do all the time in cellular structures called mitochondria.

The second imbalance could have involved an electrical gradient between the hydrothermal fluids and the ocean. Billions of years ago, when Earth was young, its oceans were rich with carbon dioxide. When the carbon dioxide from the ocean and fuels from the vent -- hydrogen and methane -- met across the chimney wall, electrons may have been transferred. These reactions could have produced more complex carbon-containing, or organic compounds -- essential ingredients of life as we know it. Like proton gradients, electron transfer processes occur regularly in mitochondria.

"Within these vents, we have a geological system that already does one aspect of what life does," said Laurie Barge, second author of the study at JPL. "Life lives off proton gradients and the transfer of electrons."

Four-billion-year-old chemistry in cells today

Date:

July 24, 2014

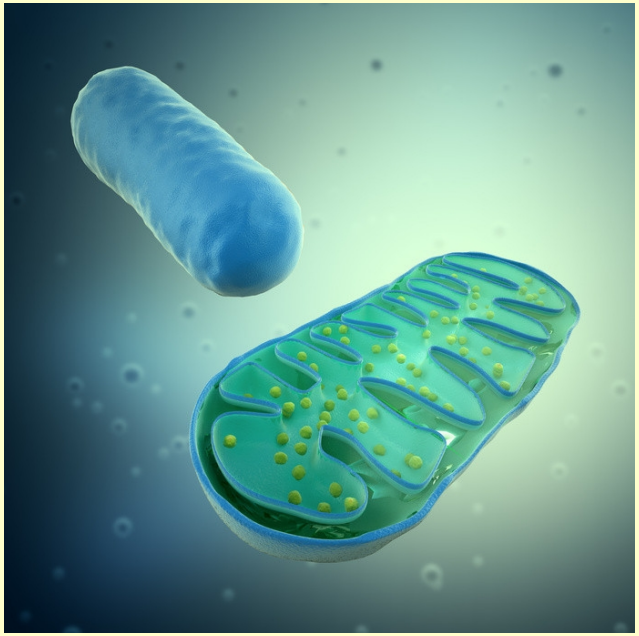
Source:

T. A. Schaedler, J. D. Thornton, I. Kruse, M. Schwarzlander, A. J. Meyer, H. W. van Veen, J. Balk. A Conserved Mitochondrial ATP-Binding Cassette Transporter Exports Glutathione Polysulfide for Cytosolic Metal Cofactor Assembly. *Journal of Biological Chemistry*, 2014; DOI: 10.1074/jbc.M114.553438

University of East Anglia

Summary:

Parts of the primordial soup in which life arose have been maintained in our cells today according to scientists. Research has revealed how cells in plants, yeast and very likely also in animals still perform ancient reactions thought to have been responsible for the origin of life -- some four billion years ago.

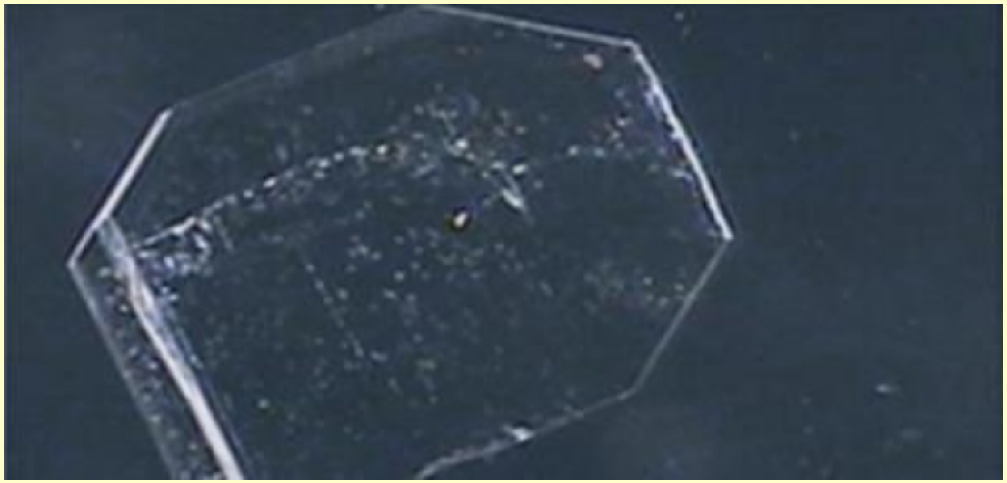


The new research shows how small pockets of a cell -- known as mitochondria -- continue to perform similar reactions in our bodies today. These reactions involve iron, sulfur and electro-chemistry and are still important for functions such as respiration in animals and photosynthesis in plants.

'Ancestral Eve' crystal may explain origin of life's left-handedness

Date:
April 21, 2010
Source:
Tu Lee, Yu Kun Lin. The Origin of Life and the Crystallization of Aspartic Acid in Water. *Crystal Growth & Design*, 2010; 10 (4): 1652 DOI: 10.1021/cg901219f
American Chemical Society

Summary:
Scientists are reporting discovery of what may be the "ancestral Eve" crystal that billions of years ago gave life on Earth its curious and exclusive preference for so-called left-handed amino acids. Those building blocks of proteins come in two forms -- left- and right-handed -- that mirror each other like a pair of hands.



Tu Lee and Yu Kun Lin point out that conditions on the primordial Earth held an equal chance of forming the same amounts of left-handed and right-handed amino acids. Nevertheless, when the first forms of life emerged more than 3 billion years ago, all the amino acids in the proteins had the left-handed configuration. That pattern continued right up to modern plants and animals.

The scientists used mixtures of both left- and right-handed aspartic acid (an amino acid) in laboratory experiments to see how temperature and other conditions affected formation of crystals of the material. They found that under conditions that could have existed on primitive Earth, left-handed aspartic acid crystals could have formed easily and on a large scale.

Study builds on plausible scenario for origin of life on Earth

Date:

August 10, 2011

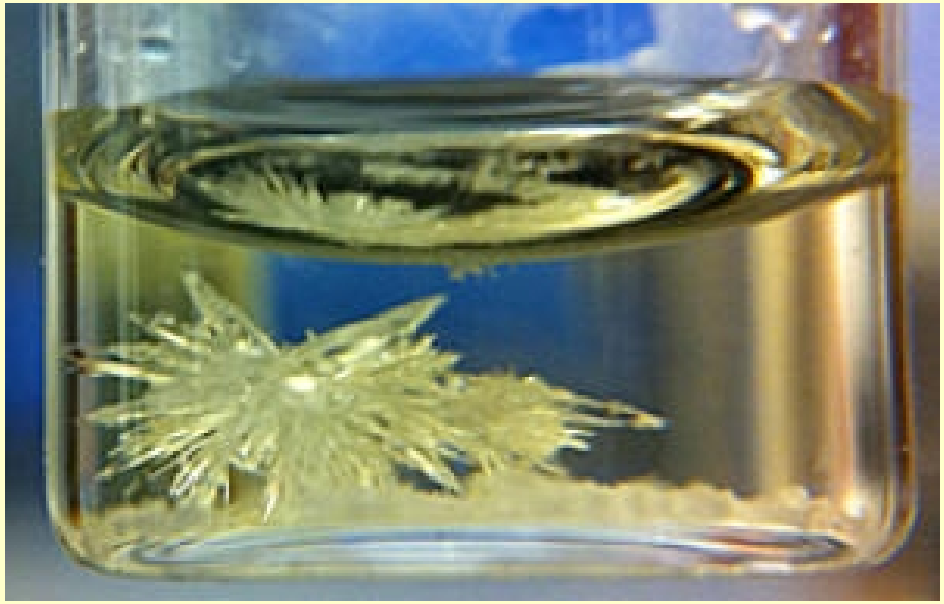
Source:

Jason E. Hein, Eric Tse, Donna G. Blackmond. A route to enantiopure RNA precursors from nearly racemic starting materials. *Nature Chemistry*, 2011; DOI: 10.1038/NCHEM.1108

University of California - Merced

Summary:

A relatively simple combination of naturally occurring sugars and amino acids offers a plausible route to the building blocks of life, according to a new article. The study shows how the precursors to RNA could have formed on Earth before any life existed.



The natural enantiomer of the RNA precursor molecules formed a crystal structure visible to the naked eye. The crystals are stable and avoid normal chemical breakdown. They can exist until the conditions are right for them to change into RNA.

Scientists discover new clue to chemical origins of life

Date:

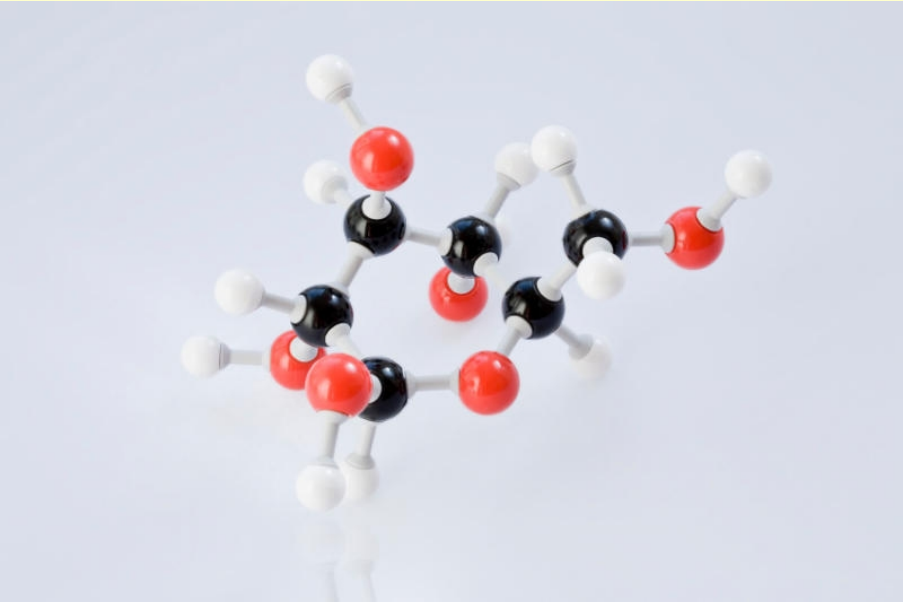
January 24, 2012

Source: **Laurence Burroughs, Paul A. Clarke, Henrietta Forintos, James A. R. Gilks, Christopher J. Hayes, Matthew E. Vale, William Wade, Myriam Zbytniewski. Asymmetric organocatalytic formation of protected and unprotected tetroses under potentially prebiotic conditions. *Organic & Biomolecular Chemistry*, 2012; DOI: 10.1039/C1OB06798B**

University of York

Summary:

Organic chemists have made a significant advance towards establishing the origin of the carbohydrates (sugars) that form the building blocks of life. The researchers have re-created a process which could have occurred in the prebiotic world.



The researchers found using simple left-handed amino acids to catalyse the formation of sugars resulted in the production of predominately right-handed form of sugars. It could explain how carbohydrates originated and why the right-handed form dominates in nature.

Dr Clarke said: "There are a lot of fundamental questions about the origins of life and many people think they are questions about biology. But for life to have evolved, you have to have a moment when non-living things become living -- everything up to that point is chemistry.

How Did Early Primordial Cells Evolve?

Feb. 28, 2013 — Four billion years ago, soon after the planet cooled enough for life to begin, primordial cells may have replicated and divided without protein machinery or cell walls, relying instead on just a flimsy lipid membrane. New research on bacteria examines exactly how these primitive cells could have evolved without such crucial structures.

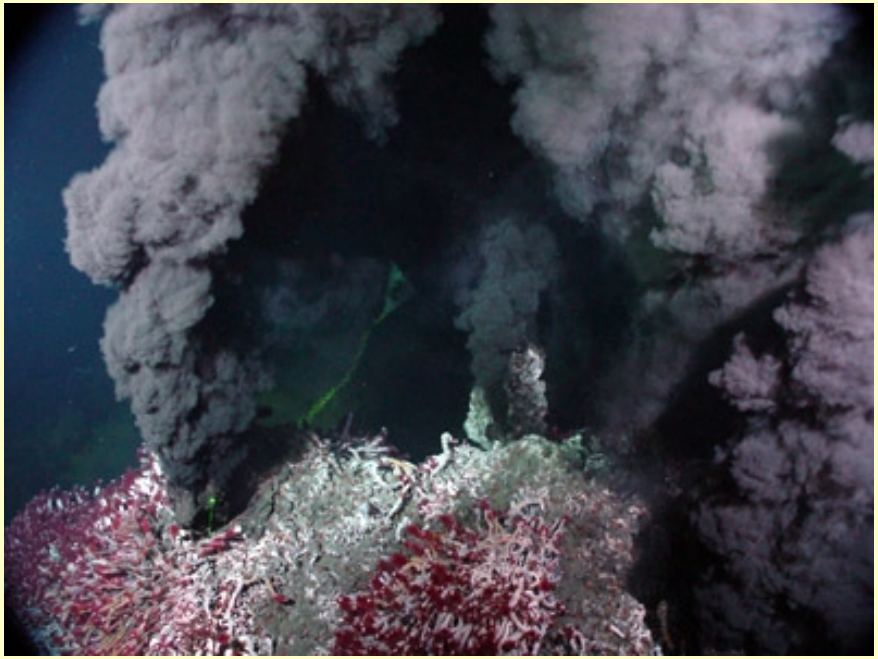
Romain Mercier, Yoshikazu Kawai, Jeff Errington. Excess Membrane Synthesis Drives a Primitive Mode of Cell Proliferation. *Cell*, 2013; 152 (5): 997 DOI: 10.1016/j.cell.2013.01.043

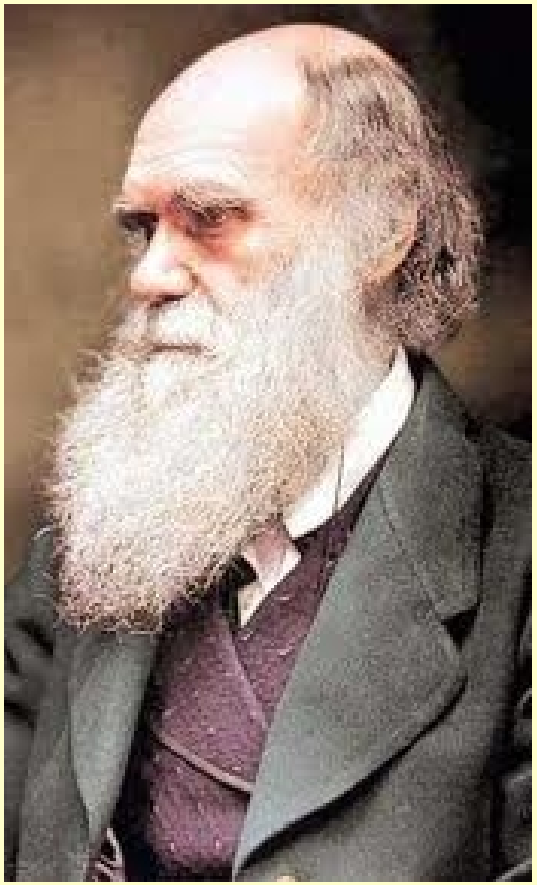
While the vast majority of bacteria have cell walls, many bacteria can switch to a wall-free existence called the L-form state, which could mirror the structure of primordial cells. A study published Feb. 28 by Cell Press in the journal *Cell* reveals how bacteria in this L-form state divide and proliferate, shedding light on how the earliest forms of cellular life may have replicated.

One of these mutations was necessary for the increased production of fatty acids in the cell membrane, which would be expected to increase the cell's surface area relative to its volume.

The findings suggest that a simple biophysical change -- an imbalance between surface area and volume -- underlies L-form cell division.

Scientists call it LUCA, the Last Universal Common Ancestor, but they don't know much about this great-grandparent of all living things. Many believe LUCA was little more than a crude assemblage of molecular parts, a chemical soup out of which evolution gradually constructed more complex forms. Some scientists still debate whether it was even a cell.





Charles Robert Darwin

(12 February 1809 – 19 April 1882)

English naturalist

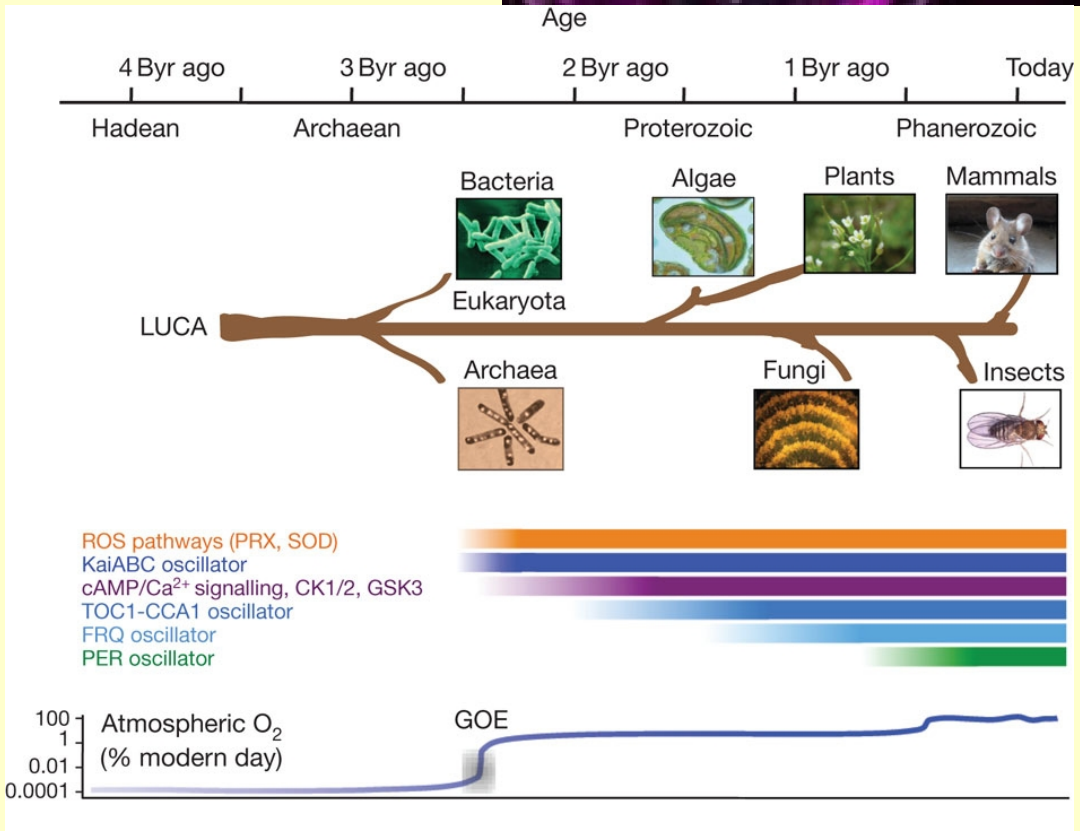
Protocells and information strings: Self-organizing autocatalytic network created in computer model

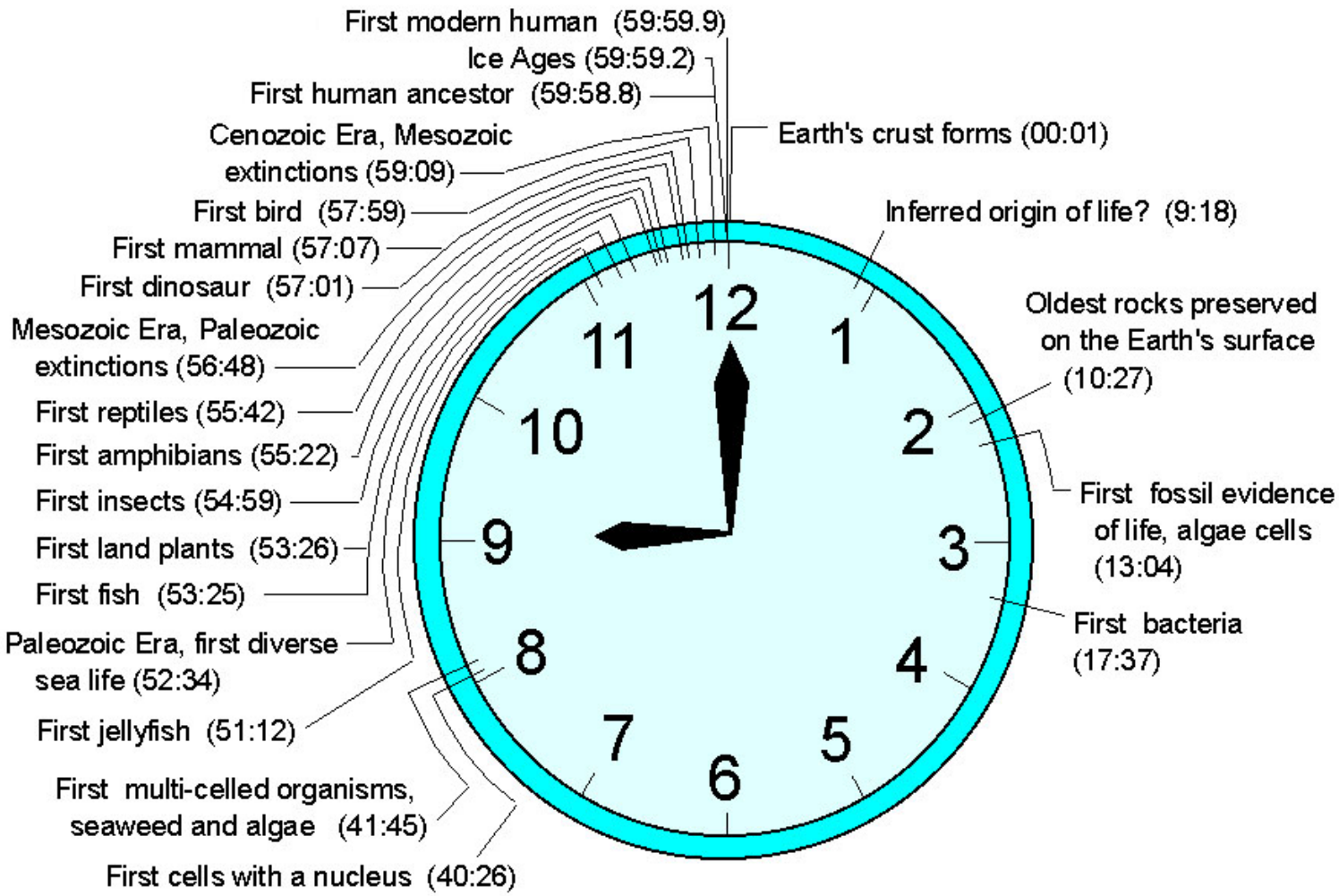
Date:
October 20, 2014
Source:
University of Southern Denmark

Summary:
Protocells are the simplest, most primitive living systems, you can think of. However, creating an artificial protocell is far from simple. One of the challenges is to create the information strings that can be inherited by cell offspring, including protocells. Such information strings are like modern DNA or RNA strings, and they are needed to control cell metabolism and provide the cell with instructions about how to divide. Now using a a virtual computer experiment, researchers in Denmark have discovered information strings with peculiar properties.

"In our computer simulation -- our virtual molecular laboratory -- information strings began to replicate quickly and efficiently as expected. However, we were struck to see that the system quickly developed an equal number of short and long information strings and further that a strong pattern selection on the strings had occurred. We could see that only very specific information patterns on the strings were to be seen in the surviving strings. We were puzzled: How could such a coordinated selection of strings occur, when we knew that we had not programmed it. The explanation had to be found in the way the strings interacted with each other," explains Steen Rasmussen.


LUCA
Last Universal Common Ancestor

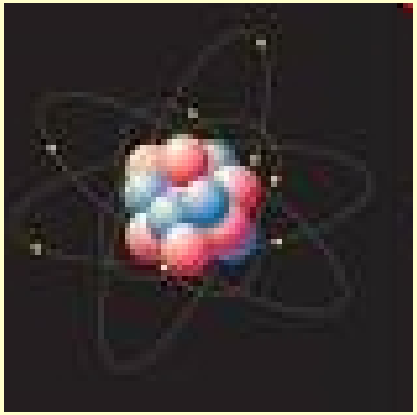

Age
4 Byr ago
3 Byr ago
2 Byr ago
1 Byr ago
Today
Hadean
Archaean
Proterozoic
Phanerozoic
Bacteria
Algae
Plants
Mammals
Eukaryota
LUCA
Archaea
Fungi
Insects
ROS pathways (PRX, SOD)
KaiABC oscillator
cAMP/Ca2+ signalling, CK1/2, GSK3
TOC1-CCA1 oscillator
FRQ oscillator
PER oscillator
100
1
0.01
0.0001
Atmospheric O2
(% modern day)
GOE



4.6 billion years in one hour

Зародження життя:
Чому?

Theory of Cosmological natural selection



Lee Smolin

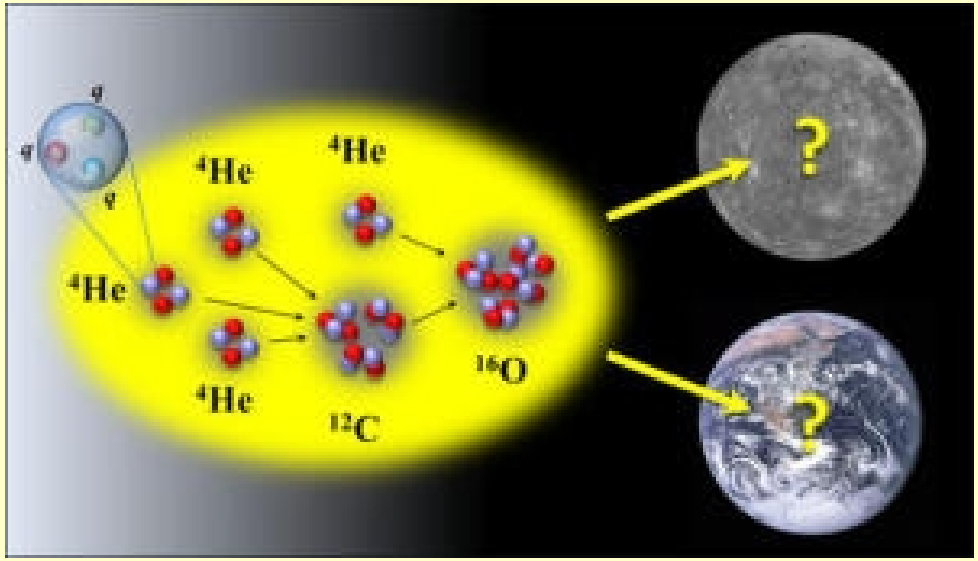
University of Waterloo

Life in the Universe: Foundations of Carbon-Based Life Leave Little Room for Error

Evgeny Epelbaum, Hermann Krebs, Timo A. Lähde, Dean Lee, and Ulf-G. Meißner. Viability of Carbon-Based Life as a Function of the Light Quark Mass. *Physical Review Letters*, 2013 DOI: 10.1103/PhysRevLett.110.112502

Mar. 13, 2013 — Life as we know it is based upon the elements of carbon and oxygen. Now a team of physicists, including one from North Carolina State University, is looking at the conditions necessary to the formation of those two elements in the universe. They've found that when it comes to supporting life, the universe leaves very little margin for error. "The Hoyle state of carbon is key," Lee says. "If the Hoyle state energy was at 479 keV or more above the three alpha particles, then the amount of carbon produced would be too low for carbon-based life. In new lattice calculations done at the Juelich Supercomputer Centre the physicists found that just a slight variation in the light quark mass will change the energy of the Hoyle state, and this in turn would affect the production of carbon and oxygen in such a way that life as we know it wouldn't exist.

Both carbon and oxygen are produced when helium burns inside of giant red stars. Carbon-12, an essential element we're all made of, can only form when three alpha particles, or helium-4 nuclei, combine in a very specific way. The key to formation is an excited state of carbon-12 known as the Hoyle state, and it has a very specific energy -- measured at 379 keV (or 379,000 electron volts) above the energy of three alpha particles. Oxygen is produced by the combination of another alpha particle and carbon.



Швейцарський астроном Мішель Майор, який в 1995 році відкрив першу планету за межами Сонячної системыи— біля зірки 51 Пегаса.

«Я відчуваю себе дуже комфортно, вважаючи життя «Космічним імперативом». Цю концепцію запропонував біохімік, нобелівський лауреат Крістіан де Дюв, який говорив, що «Там, де є відповідні умови, життя виникне саме»».

Це моє ососбисте відчуття, але … нам потрібно довести це з наукової точки зору. Це прекрасний виклик для майбутніх поколінь!

The algorithmic origins of life.

Walker SI[1], Davies PC.

J R Soc Interface. 2012 Dec 12;10(79):20120869. doi: 10.1098/rsif.2012.0869. Print 2013 Feb.

Abstract

Although it has been notoriously difficult to pin down precisely what is it that makes life so distinctive and remarkable, there is general agreement that its informational aspect is one key property, perhaps the key property. The unique informational narrative of living systems suggests that life may be characterized by context-dependent causal influences, and, in particular, that top-down (or downward) causation-where higher levels influence and constrain the dynamics of lower levels in organizational hierarchies-may be a major contributor to the hierarchal structure of living systems. **Here, we propose that the emergence of life may correspond to a physical transition associated with a shift in the causal structure, where information gains direct and context-dependent causal efficacy over the matter in which it is instantiated.** Such a transition may be akin to more traditional physical transitions (e.g. thermodynamic phase transitions), with the crucial distinction that determining which phase (non-life or life) a given system is in requires dynamical information and therefore can only be inferred by identifying causal architecture. We discuss some novel research directions based on this hypothesis, including potential measures of such a transition that may be amenable to laboratory study, and how the proposed mechanism corresponds to the onset of the unique mode of (algorithmic) information processing characteristic of living systems.

Папа Римський визнав теорію еволюції і "Великий вибух"

28 жовтня 2014 р.

Папа Римський Франциск офіційно визнав, що всі живі істоти на Землі еволюціонували, а сама планета і галактика з'явилися в результаті "Великого вибуху". Але на все це була "воля Божа".

Як повідомляє The Independent, про це глава католицької церкви заявив під час виступу в Папській академії наук. Таким чином, понтифік відмовився від теорії креаціонізму, яку підтримував його попередник Папа Бенедикт XVI.

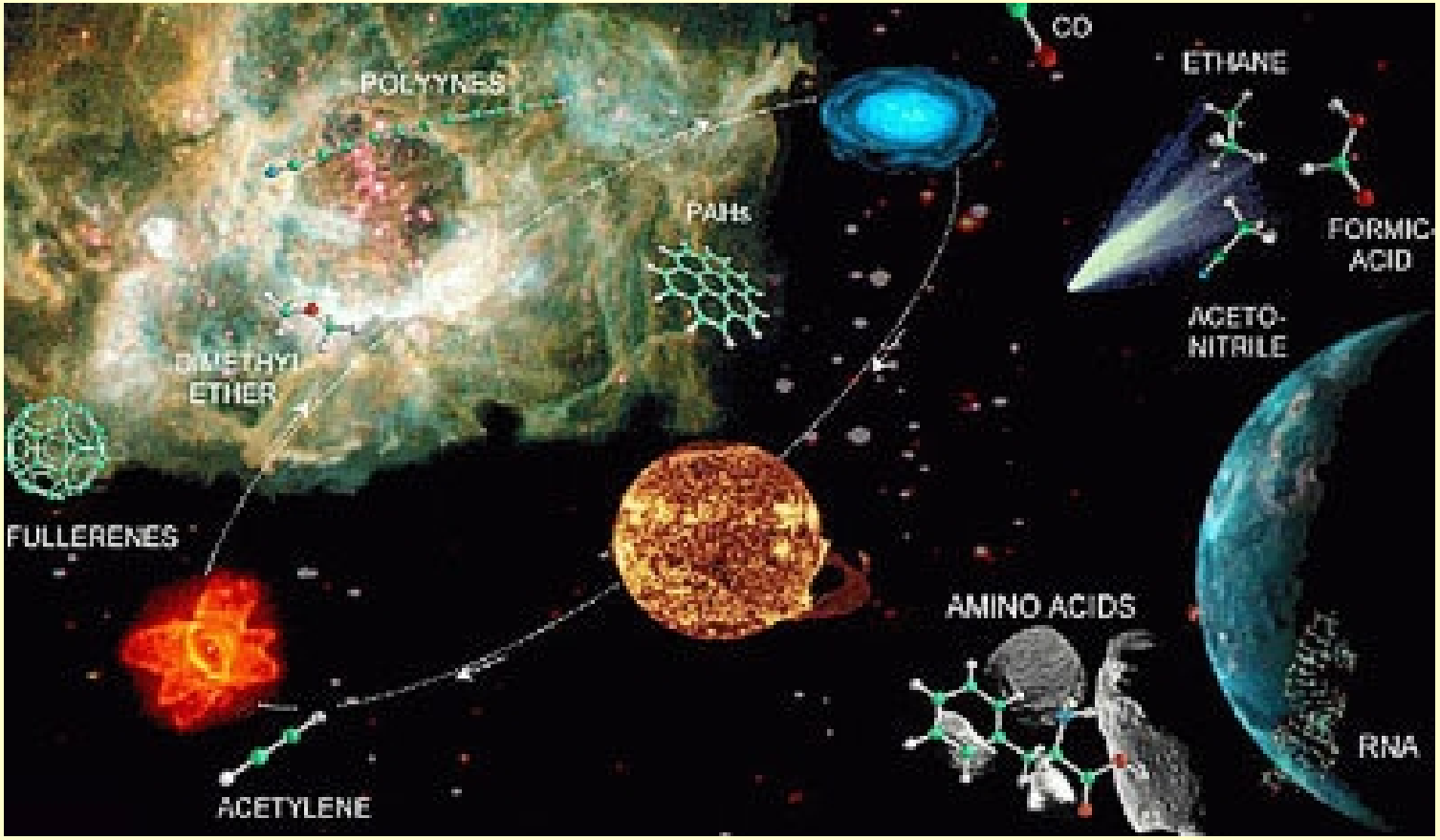
"Коли ми читаємо Книгу Буття, ми уявляємо, що Бог – це чарівник з магічної паличкою. Але це ж не так", - сказав папа Франциск.

"Він створив людей і дозволив їм розвиватися згідно із вічними законами природи, які він дав усім", - додав глава католицької церкви.

Папа Франциск також заявив, що "Великий вибух" як причина виникнення світу не заперечує існування Творця. Навпаки, наукова теорія "вимагає цього".

«Там, де є відповідні умови, життя виникне саме» (Крістіан де Дюв)

???



Що таке життя???

Дякую
за увагу !

A team of ASU researchers has demonstrated that a particular mineral, sphalerite, can affect the most fundamental process in organic chemistry: carbon-hydrogen bond breaking and making. This is a sample of gem-quality sphalerite in a quartz matrix.

July 28, 2014

Source:

Arizona State University

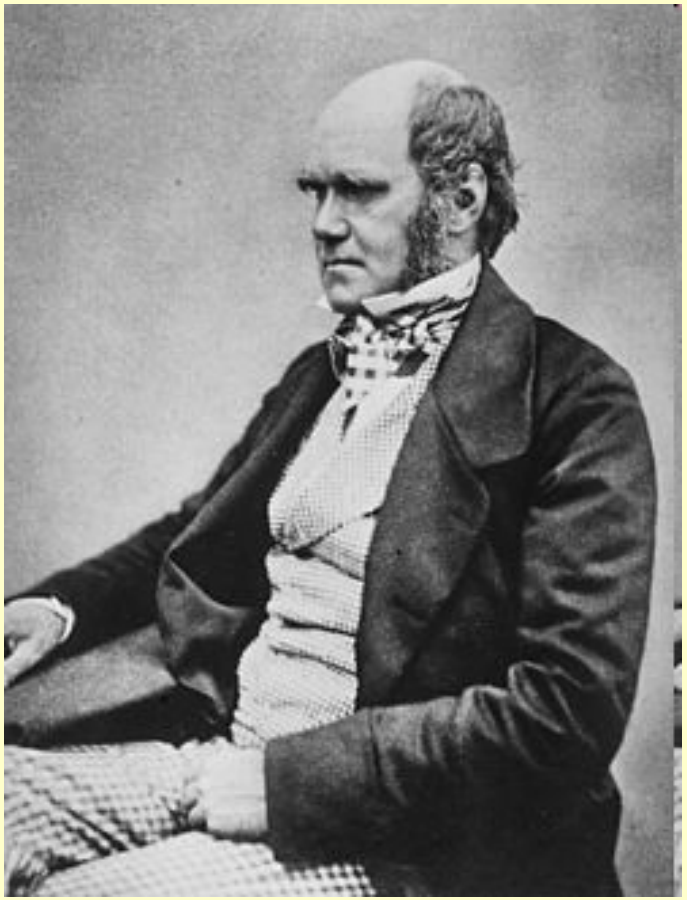
Organic chemical origins in hydrothermal systems

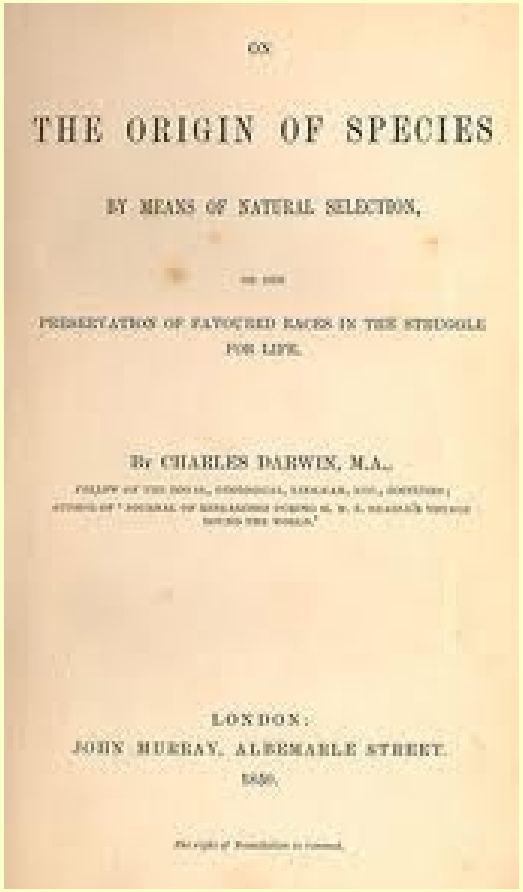
Date:
January 22, 2014
Source:
Tokyo Institute of Technology
Summary:
Researchers have revealed the mechanisms for the formation of methane, which may have been a crucial stage in the origin of life on Earth.

Serpentinite-hosted hydrothermal systems have been suggested as likely sites for the formation of organic compounds in the abiotic conditions of early Earth, that is, in the absence of living organisms.

Запропонував наукову теорію, згідно з якою еволюція живих організмів є результатом процесу, названого ним природнім добором

- Терія була опублікована у 1859 році у книзі Дарвіна “Походження видів”





ON

THE ORIGIN OF SPECIES

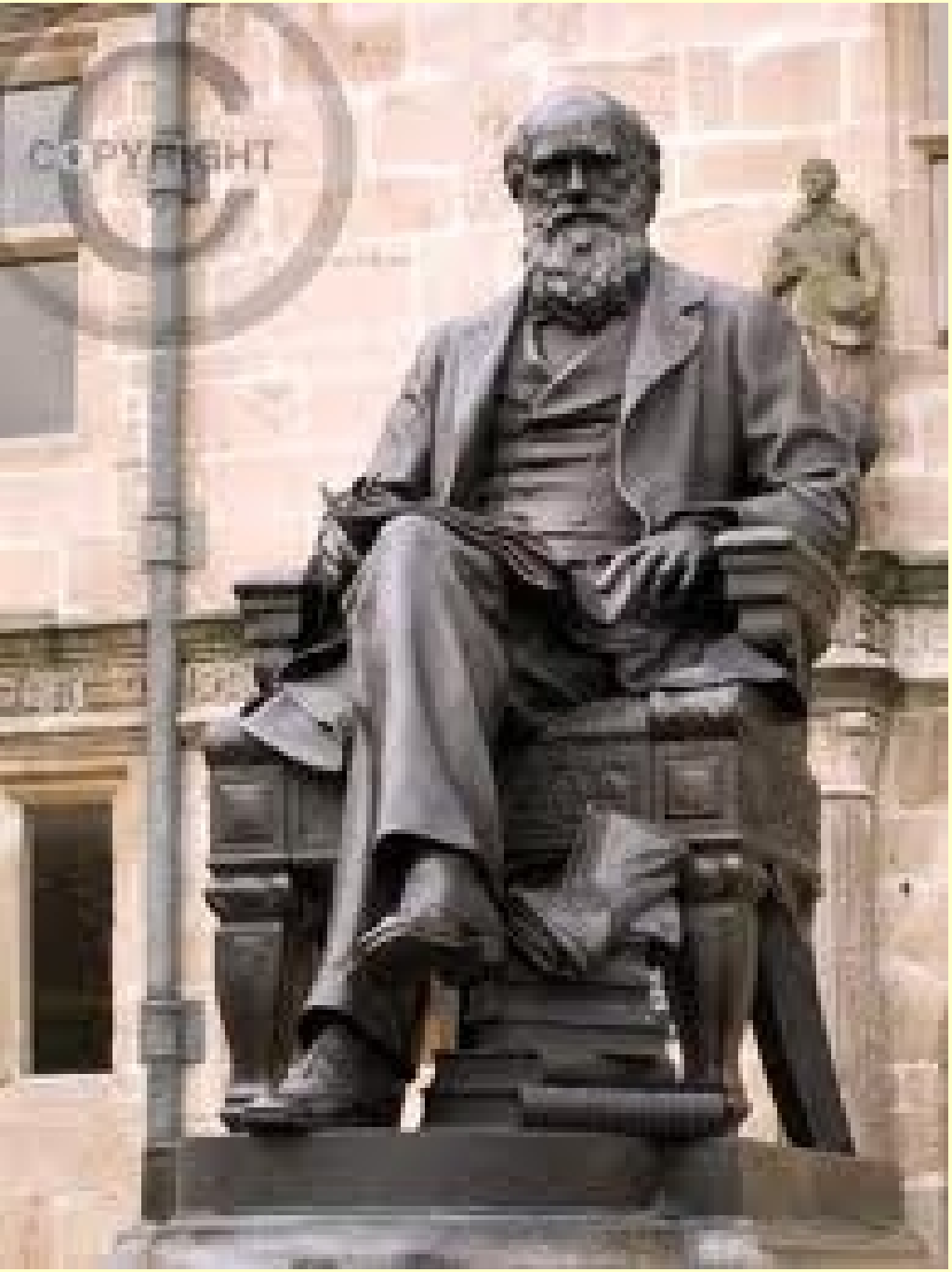
BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.



Успадкування з модифікаціями і Природній відбір як рушій Еволюції

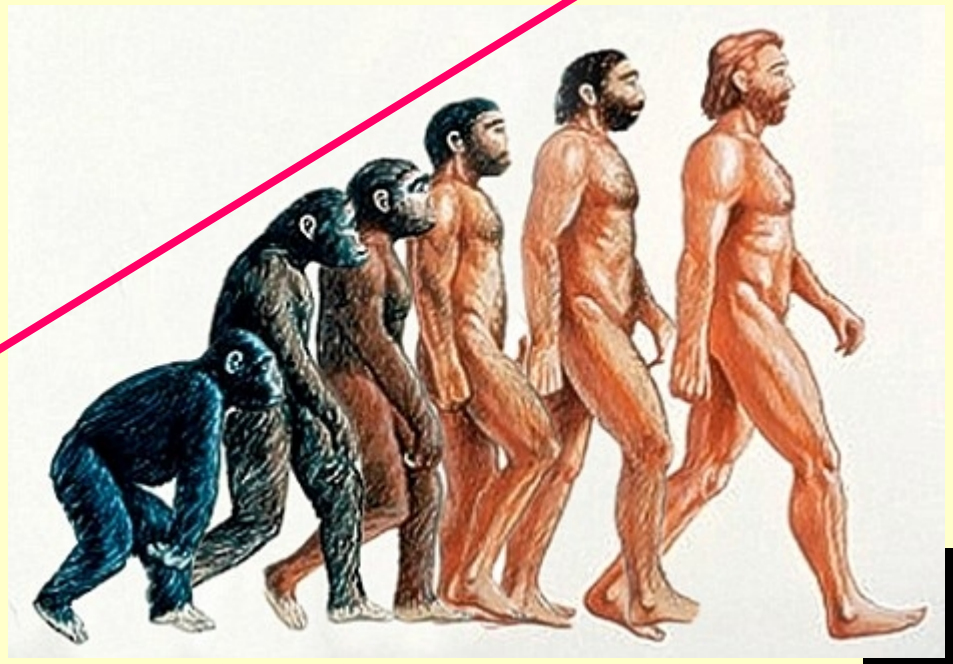
Еволюція має механізм але не має Мети

Мікеланджело “Створення Адама”

1871

Charles Darwin

“The Descent of Man, and Selection in Relation to Sex”



Чи все було так просто?

Ми не походимо від мавп, але мали з ними спільних предків

1,2%

1,2%

1,6%

3,1%