Source:

#ref #ret #disorganized #incomplete

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1 | **Larger themes**

Video? perhaps like Melody sheep? https://www.youtube.com/watch?v=ThDYazipjSI

heavy blender

2 | **General research**

start with: How did life start?

content: theories of how life started,

explain miller-urey

end with we are not alone in the universe explanation:

life is inevitable

2.1 | **deeper research**

- Volcanic clay
  - In simulated ancient seawater, clay forms a hydrogel – a mass of microscopic spaces capable of soaking up liquids like a sponge. https://www.sciencedaily.com/releases/2013/11/131105132027.htm
  - chemicals confined in those spaces could have carried out the complex reactions that formed proteins, DNA and eventually all the machinery that makes a living cell work. Clay hydrogels could have confined and protected those chemical processes until the membrane that surrounds living cells developed.
  - theorists have shown that cytoplasm – the interior environment of a cell – behaves much like a hydrogel.
  - Unlike surfactants, lipids are difficult to synthesize. Surfactants may transform into lipids. Apatite has been reported to be capable of catalyzing the formation of a proto-lipid 58. https://www.intechopen.com/book minerals-in-nature-their-characterization-modification-and-application/role-of-clay-minerals-in-chemical-evolution-and-the-origin-of-life
  - Clay minerals might function as a primordial cell 4. When clay minerals are deposited on the ocean floor (or dried), the particles form a pile, enclosing small spaces (Figure 6). It is conceivable that the small spaces behave like cells. Further, when clay minerals are dispersed in water, bubbles form in water or the surface of water, while the clay particles gather at the boundary between water and air, as shown in Figure 7 57. In such a case, clay minerals make a cell-like spherule.
- Deep sea vents
  - Deep under the Earth's seas, there are vents where seawater comes into contact with minerals from the planet's crust, reacting to create a warm, alkaline (high on the pH scale) environment containing hydrogen. The process creates mineral-rich chimneys with alkaline and acidic fluids, providing a source of energy that facilitates chemical reactions between hydrogen and carbon dioxide to form increasingly complex organic compounds. https://www.sciencedaily.com/releases/2019/11/1911 rather than shallow pools.&text=Some of the world's oldest,originated in such underwater vents.

    - The researchers found that molecules with longer carbon chains needed heat in order to form themselves into a vesicle (protocell). An alkaline solution helped the fledgling vesicles keep their electric charge. A saltwater environment also proved helpful, as the fat molecules banded together more tightly in a salty fluid, forming more stable vesicles
    - The researchers also point out that deep-sea hydrothermal vents are not unique to Earth.
    - Authors of the new theory argue the environmental conditions in porous hydrothermal vents — where heated, mineral-laden seawater spews from cracks in the ocean crust — created a gradient in positively charged protons that served as a "battery" to fuel the creation of organic molecules and proto-cells. Later, primitive cellular pumps gradually evolved the ability to use a different type of gradient — the difference in sodium particles inside and outside the cell — as a battery to power the construction of complex molecules like proteins. https://www.livescience.com/26173-hydrothermal-vent-life-origins.html
    - thriving on a chemical soup rich in hydrogen, carbon dioxide, and sulfur, spewing from the geysers https://www.whoi.edu/press-room/news-release/study-tests-theory-that-life-originated-at-deep-sea-vents/

- tides of ponds
    - Researchers report that shallow bodies of water, on the order of 10 centimeters deep, could have held high concentrations of what many scientists believe to be a key ingredient for jump-starting life on Earth: nitrogen. https://news.mit.edu/2019/earth-earliest-life-ponds-not-oceans-0412
    - Atmospheric nitrogen consists of two nitrogen molecules, linked via a strong triple bond, that can only be broken by an extremely energetic event — namely, lightning. "Lightning is like a really intense bomb going off," Ranjan says. "It produces enough energy that it breaks that triple bond in our atmospheric nitrogen gas, to produce nitrogenous oxides that can then rain down into water bodies."
    - In the ocean, ultraviolet light and dissolved iron would have made nitrogenous oxides far less available for synthesizing living organisms. In shallow ponds, however, life would have had a better chance to take hold. That's mainly because ponds have much less volume over which compounds can be diluted. As a result, nitrogenous oxides would have built up to much higher concentrations in ponds.
    - In environments any deeper or larger, nitrogenous oxides would simply have been too diluted, precluding any participation in origin-of-life chemistry.
    - about rna Having bonded in pairs at low tide, these newly formed molecular strands would then dissociate at high tide, when salt concentrations were reduced, providing what Lathe terms a self-replicating system. https://www.scientificamerican.com/article/moon-life-tides/#:~:text=The ocean tides mirror life itself.&text=Life emerged some 700 million,tides were much more extreme.

- at home in the universe
    - The chance that a single chemical is self replicating is very low
    - however, this chemical is much more likely to another chemical
    - as the number of chemicals and complexity increases, the likelihood that these chemicals will become cyclic increases exponentially

    - life doesnt just become likely, it becomes inevitable.

3 | **Outline**

Life is amazing, incredibly complex, the question becomes, how did it start?

Three theories:

volcanic clay deep sea vents tides of ponds

But there's more than just theories:

miller-urey experiment

TRANSITION IDEA: While the results of this experiment seem profound, looking at this same scenario from a mathematical perspective reveals startling new conclusions

At home in the universe

Life, is – inevitable.

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