

New study sheds light on origins of life on Earth

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a Rutgers-led team has discovered the structures of proteins that may be responsible for the origins of life in the primordial soup of ancient Earth.

The study appears in the journal *Science Advances*.

The researchers explored how primitive life may have originated on our planet from simple, non-living materials. They asked what properties define life as we know it and concluded that anything alive would have needed to collect and use energy, from sources such as the Sun or hydrothermal vents.

In molecular terms, this would mean that the ability to shuffle electrons was paramount to life. Since the best elements for [electron transfer](#) are metals (think standard electrical wires) and most biological activities are carried out by proteins, the researchers decided to explore the combination of the two—that is, proteins that bind metals.

They compared all existing [protein](#) structures that bind metals to establish any common features, based on the premise that these shared features were present in ancestral proteins and were diversified and passed down to create the range of proteins we see today.

Evolution of protein structures entails understanding how new folds arose from previously existing ones, so the researchers designed a computational method that found the vast majority of currently existing metal-binding proteins are somewhat similar regardless of the type of metal they bind to, the organism they come from or the functionality assigned to the protein as a whole.

"We saw that the metal-binding cores of existing proteins are indeed similar even though the proteins themselves may not be," said the study's lead author Yana Bromberg, a professor in the Department

of Biochemistry and Microbiology at Rutgers University-New Brunswick. "We also saw that these metal-binding cores are often made up of repeated substructures, kind of like LEGO blocks. Curiously, these blocks were also found in other regions of the proteins, not just metal-binding cores, and in many other proteins that were not considered in our study. Our observation suggests that rearrangements of these little building blocks may have had a single or a small number of common ancestors and given rise to the whole range of proteins and their functions that are currently available—that is, to life as we know it."

"We have very little information about how life arose on this planet, and our work contributes a previously unavailable explanation," said Bromberg, whose research focuses on deciphering the DNA blueprints of life's molecular machinery. "This explanation could also potentially contribute to our search for life on other planets and planetary bodies. Our finding of the specific structural building blocks is also possibly relevant for synthetic biology efforts, where scientists aim to construct specifically active proteins anew."

The study, funded by NASA, also included researchers from the University of Buenos Aires.

More information: Yana Bromberg, Quantifying structural relationships of metal-binding sites suggests origins of biological electron transfer, *Science Advances* (2022). DOI: [10.1126/sciadv.abj3984](https://doi.org/10.1126/sciadv.abj3984). www.science.org/doi/10.1126/sciadv.abj3984

Provided by Rutgers University

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