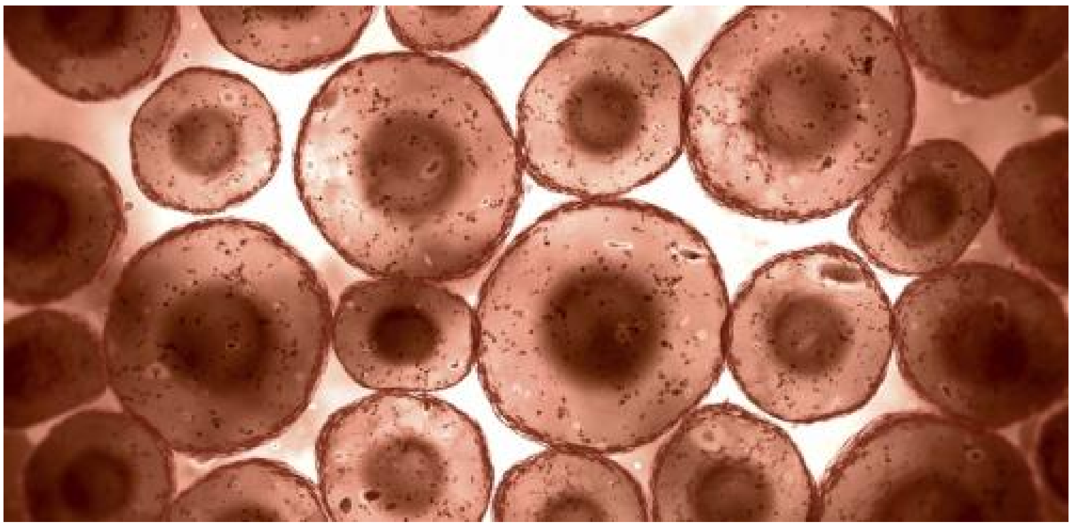
PHYS.ORG

Chemists show life on Earth was not a fluke

October 24 2013, by Andrew Bissette



In them, began life. Credit: University of Utah

How life came about from inanimate sets of chemicals is still a mystery. While we may never be certain which chemicals existed on prebiotic Earth, we can study the biomolecules we have today to give us clues about what happened three billion years ago.

Now scientists have used a set of these biomolecules to show one way in which life might have started. They found that these molecular machines, which exist in living cells today, don't do much on their own. But as soon as they add fatty chemicals, which form a primitive version of a cell membrane, it got the chemicals close enough to react in a highly specific manner.

This form of self-organisation is remarkable, and figuring out how it happens may hold the key to understanding life on earth formed and perhaps how it might form on other planets.

The 1987 Nobel Prize in Chemistry was given to chemists for showing how complex molecules can perform very precise functions. One of the behaviours of these molecules is called self-organisation, where different chemicals come together because of the many forces acting on them and become a molecular machine capable of even more complex tasks. Each living cell is full of these molecular machines.

Pasquale Stano at the University of Roma Tre and his colleagues were interested in using this knowledge to probe the origins of life. To make things simple, they chose an assembly that produces proteins. This assembly consists of 83 different molecules including DNA, which was programmed to produce a special green fluorescent protein (GFP) that could be observed under a confocal microscope.

The assembly can only produce proteins when its molecules are close enough together to react with each other. When the assembly is diluted with water, they can no longer react. This is one reason that the insides of living cells are very crowded, concentrated places: to allow the chemistry of life to work.

In order to recreate this molecular crowding, Stano added a chemical called POPC to the dilute solution. Fatty molecules such as POPC do not mix with water, and when placed into water they automatically form liposomes. These have a very similar structure to the membranes of living cells and are widely used to study the evolution of cells.

Stano reports in the journal *Angewandte Chemie* that many of these liposomes trapped some molecules of the assembly. But remarkably, five in every 1,000 such liposomes had all 83 of the molecules needed to produce a protein. These liposomes produced large amount of GFP and glowed green under a microscope.

Computer calculations reveal that even by chance, five liposomes in 1,000 could not have trapped all 83 molecules of the assembly. Their calculated probability for even one such liposome to form is essentially zero. The fact that any such liposomes formed and that GFP was produced means something quite unique is happening.

Stano and his colleagues do not yet understand why this happened. It may yet be a random process that a better statistical model will explain. It may be that these particular molecules are suited to this kind of self-organisation because they are already highly evolved. An important next step is to see if similar, but less complex, molecules are also capable of this feat.

Regardless of the limitations, Stano's experiment has shown for the first time that self-assembly into simple cells may be an inevitable physical process. Finding out how exactly this self-assembly happens will mean taking a big step towards understanding how life was formed.

More information: dx.doi.org/10.1002/anie.201306613

Source: The Conversation