

Life – A Thesis

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Abstract

Currently we define life as cellular life: organisms whose genetic information and cytoplasm are encapsulated by a cellular membrane or wall. However the definition of life likely could be much broader, as life potentially can be described as a form of resonating standing waves in multi-dimensional space.

Keywords: Evolution; Biology; Phylogenetic; Eukaryotes; Phages

Introduction

The current notion is that life on earth started in a primordial soup many millions of years ago [1]. The first life, as we define it today, is thought to have evolved under beneficial conditions from self-replicating molecules made of RNA, from these RNA world DNA-based life forms evolved [2]. The RNA/DNA are the molecules that carry most of the information for life, other molecules such as proteins and lipids also carry information (Such as folding states, see below, as well as modifications or the formation of multi-molecular complexes) – although to a more limited extent. The life forms we normally define as “living” or cellular-life are tremendously diverse; animals, plants, fungi, bacteria as well as a type of single-celled organisms belonging to a phylogenetic kingdom called the Archaea [3]. Life is found everywhere we look at earth: in soil, in the atmosphere, kilometres down below the surface of the earth, in hot springs, salt lakes, in lakes under kilometres of ice, or inside other organisms as some parasites. Some of these organisms multiply extremely slowly (years) others extremely rapid (min). Some use energy provided from the sun to survive and multiply (we humans indirectly get our energy from the sun) for others chemical energy provided from the Earth.

Importantly, cellular life did not evolve directly from a single ancient ancestor: eukaryotes that include humans, other animals, plants and fungi, are mosaic organisms that arose when millions of years ago cells belonging to Archaea, became the benefiting hosts to bacteria cable of synthesising specific energy rich molecules needed by the hosts [4,5]. Similarly, exchanges of genetic information between related bacteria or related archaea cells occur, and in case of animals, plants and fungi hybridization between species take place. So when one is describing most cellular life forms from an evolutionary point of view, there is not a specific origin. One reason for this is mobile genetic elements [6-8], these currently are not considered as life forms, but arguably should be so, although a simple form. Mobile genetic elements are fairly short pieces of DNA that can move between and within the DNA of cellular life. Mobility of the elements can occur when two cells intentionally (or unintentionally) fuse. For some species their genome mainly originates from such mobile elements and in many organisms DNA originating from such elements plays vital biological functions and in some cases even the element itself is of direct advantage to the host cell. What also arguably should be

considered for other forms of life forms are viruses and phages. Viruses/phages are pieces of DNA or RNA packed in proteins and in some cases lipids that by themselves cannot replicate, instead rely on infecting cellular life for replication and propagation. Viral/phage infections are parasitic. Some DNA viruses can insert themselves into the cellular host DNA and as such becomes a part of the organism. It should be mentioned that also viruses exchange information (DNA/RNA) when co-infection occurs. Finally, there is a form of infectious proteins, called prions that could be the simplest form for life on earth [9-11]. Prions, which can infect yeast, several animals as well as humans, are actually proteins folded in a non-functional state that are infectious. When such a protein molecule enters the cell, it promotes its own folding state and thus lack of function of all the molecules of that protein type in the cell. Thus, here it is the information state of a protein that is infectious and replicated. Common for all the mentioned cellular organisms, mobile elements, viruses/phages and prions are that they carry information, and that this information allows them under the right conditions (here referred to as the right multi-dimensional space), through time to replicate (sometime imperfectly leading to variation) their information to create copies of themselves.

While I above pointed out that there has been an immense exchange and hybridisation of information between organisms during evolution, it is also important to realise the enormous degree of interrelation and interdependence between organisms. Virtually all organisms interact and affect other organisms, through symbiosis, pathogenesis, competition and the list goes on and on, thus the multi-dimensional space of one organism is interdependent with another organism's multi-dimensional space, and indeed in the extreme case of some parasites as well as mobile genetic elements, one life form constitutes another life form's multi-dimensional space.

Also, life itself affects the space it replicates in. Consumption of metabolites, physical mechanical interactions, and secretion of waste products alter the multi-dimensional space life exists in. The extreme case is the earth atmosphere where the evolution of green plants lead to the rise of oxygen levels allowing the evolution of animals and fungi and to some degree now in our time where CO₂ emission are leading to global changes in the temperature through the greenhouse effect.

These life-driven changes in the environment, combined with changes cause by processes deep in the earth or from outer space (meteorites) have contributed to drive evolution described by Darwin

[12]. Rapid changes in the environment have led to population crashes and extinction of species such as like the demise of the dinosaurs as well as rapid evolution when a new stable environment was formed, as potentially occurred during the Cambrian explosion. However, living organisms can also stabilise and maintain the multi-dimensional space they inhabit. We humans are the prime example of this as we are experts in creating environments suitable for our existence. Thus life and the multi-dimensional space it is reproduced in are interconnected and inseparable.

To try to redefine the definition of life one should look at life from chemical and physical points of view. From a chemical view the basic characteristics of living beings are: single molecules to complex “aggregations” of molecules that contain information that is reproduced over time and which are dependent on a chemical environment conducive to this reproduction, but importantly the process of reproduction also affect the chemical environment present. The process of life depends on chemical and thermal energy. Also, since life is an exothermic reaction leading to increased entropy, it will initiate given enough time under the correct conditions. One example of this is the recent creation of synthetic life where whole bacterial genomes have been synthesized and where introduction into the right environment leads to live bacteria [13]. Also, it should be mentioned, there are simple oscillating chemical reactions that show similar characteristics to life, although the amount of information present in these systems is not comparable [14,15].

To look at life from classical physical viewpoints one has to compare it to a standing wave in a defined space. A standing wave of molecules/particles in a space, medium or object, such as a system containing information as frequency, amplitude and length of the standing wave, and this information is regenerated over time unless there are changes to the space, medium or object. Importantly, if reflection of the wave at the ends is slightly imperfect, and minor changes in the space, medium or object, the standing wave will adapt to the changes, while is they are catastrophic, as a oscillating bridge collapsing, the standing wave will cease to exist. Such a standing wave is also dependent on the influx of energy to be maintained, as there is loss of energy due to resistance. Again, the information in the system is limited to frequency, amplitude and length of the standing wave.

Using the viewpoint of quantum physics on life, thus not only including our four Newtonian dimensions, the three dimensions of space as well as time, but instead uses a multi-dimensional system. Life then constitutes multi-dimensional standing waves where each wave encodes separate but interrelated information, the multi-dimensional space where each life form exists would also be constituted by wave functions, standing and non-standing that together create the space where that life form is propagated. The complexity of each standing wave function determines the amount of information that is propagated through time for an individual life form. One aspect that is interesting about life is that it contains information about the past, present and the future. Life forms carry information about how they evolved, how they exist in the current moment, but also about what they are going to evolve into, in the sense that a cat cannot evolve into a dog in the near future. One possibility is that life as standing multi-dimensional waves fixes the number of potential futures described in superstring theory [16,17], as well as providing a partial history of the past. Another interesting aspect of this theory is it can potentially explain convergent evolution; on the molecular level, on the cellular level and on the level on whole organisms, similar structures have evolved several times independently of each other [18]. This model

suggests that as life is a form of resonance, similar multi-dimensional spaces will lead to similar standing wave functions.

It also, should be mentioned, that the human and animal mind potentially also can be described as a multi-dimensional standing wave function, however here the number of dimensions must be many magnitudes higher.

There are several consequences of this theory. One is that life present on other planets in the universe, as it will appear in the presence of a conductive multi-dimensional space and might even exist in forms we have not thought of. Another is that is highly unlikely that humans will ever be able to colonise another planet. We exist on earth because we evolved here, and our life or resonance is interdependent with other life on earth. Finally, it is essential for our future existence that a global effort is made to stabilize the climate on earth by limiting CO₂ emission. Major changes in the climate will lead to a collapse of species, and unstable environments not suitable for life, thus threatening the existence of our societies, as we know them. However, I believe that with a concerted effort major changes in the environment can be prevented.

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