Essential Concepts of Life

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Abstract: Life is a physical and chemical process. We are life. From ontology aspect, the world is timeless and the life exists forever as any other body in the nature. On the Earth, common life normally are: plants, animals, fungi, archaea and bacteria, viruses, etc. All the life are composed of carbon, water, etc. to form the cells form with complex organization and heritable genetic information. The life undergoes metabolism, possess a capacity to grow, respond to stimuli, reproduce and, through natural selection, adapt to their environment in successive generations. An entity with the above properties is considered to be a living organism. The nature of life is that life is a process of negative entropy, evolution, autopoiesis (auto-organizing), adaptation, emergence and living hierarchy. Up to now, there is no scientific evidence to show that life body and non-life body obey the same natural laws. But, all the researches are made by the methods of biology, biochemistry and molecular biology, etc. It is very possible that the life and non-life are essential different in the biophysics, i.e. the quantum level. In the future, it is possible to make artificial life by either biological method or electronic technique.

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1. Introduction

We are life. Life is unique in the known universe, which is in a diversity of forms ranging from bacteria to human. The life organisms exist in everywhere of the earth. The first forms of life on earth spontaneously arose out of a preexisting prebiotic chemical soup. Individual living organisms maintain their self-identity and their self-organization while continually exchanging materials and energy and information with their environment. It is really different between the life and non-life bodies, but nobody knows what the exact difference it is, even this is one of the most important issues that attracted people in the whole human history. There are millions of people are working in life science researches, many with Ph.D. degree. More money has been spent in the life science studies than that spent in any other fields. Nature, Science, and other big journals published more papers in life science than the papers in any other topic. But, there are very few people are thinking about the nature of life. This topic has attracted thinkers since the beginning of human history, but ignored by the modern society. Most philosophers ignore the issue today, perhaps because it seems too scientific. At the same time, most scientists also ignore the issue, perhaps because it seems too philosophical. The nature of life is not clear for the current intelligence. It is a topic of philosophy, and also of biology (Bedau, 2005). However, it is very difficult to get financial support for the study of nature of life (Ma and Cherng, 2005).

To understand the nature of life is always a exciting topic in the human history. But, what life is? It never has a clear answer in the human history. As most people agree, life is a condition that distinguishes organisms from non-living objects, such as non-life, and dead organisms, being manifested by growth through metabolism and reproduction. Some living things can communicate and many can adapt to their environment through changes originating internally. A physical characteristic of life is that it feeds on negative entropy. In more detail, according to physicists such as Erwin Schrödinger, John Bernal, Eugene Wigner and John Avery, life is a member of the class of phenomena which are open or continuous systems able to decrease their internal entropy at the expense of substances or free energy taken in from the environment and subsequently rejected in a degraded form. From the biochemistry and molecular biology points, life is the chemical materials to exist in the earth that has neither special physic nor chemical property which is different from non-life (Ma and Cherng, 2005).

From ontology aspect, the world is timeless and the life exists forever as any other body in the nature (Ma, 2003). The nature of life is that life is a process of negative entropy, evolution, autopoiesis (auto-organizing), adaptation, emergence and living hierarchy. Up to now, there is no scientific evidence to show that life body and non-life body obey the same natural laws. But, all the researches are made by the methods of biology, biochemistry and molecular biology, etc. It is very possible that the life and non-life are essential different in the biophysics, i.e. the quantum level. In the future, it is possible to make artificial life by either biological method or electronic technique, and keep life live forever, like Turritopsis nutricula.

On the Earth, common life normally are: plants, animals, fungi, protists, archaea and bacteria, viruses, etc. All the life are composed of carbon, water, etc. to form the cells form with complex organization and heritable genetic information. The life undergoes metabolism, possess a capacity to grow, respond to stimuli, reproduce and, through natural selection, adapt to their environment in successive generations. An entity with the above properties is considered to be a living organism. However, not every definition of life considers all of these properties to be essential. In the life, virus is not cell.

To the life, the most important are two points: live and die. Conventionally, everybody of us thinks that all the life has a beginning as the birth and the end as the die. All plants and animals, including all the people must die. But, it is found that there is an animal named Turritopsis nutricula (a jellyfish) is immortal and this jellyfish can live forever. So the concept of our life property must be changed. Life is a physical and chemical process, it can be changed to non-life, also can keep the life forever (Ma and Yang, 2009).

2. Definition of Life

What is life? As the life is too complex and too many things are not clear, there is no universal definition of life. There is debate in the definition of the life. It is difficult to give an exact definition for the life, as the nature of life is not clear.

1) My definition on the life

- Spiritual existence transcending physical death; the period from birth to death; the quality that makes living animals and plants different from dead organisms and inorganic matter. Its functions include the ability to take in food, adapt to the environment, grow, and reproduce (Encarta® World English Dictionary, 2005).
- The condition that distinguishes animals and plants from inorganic matter, including the capacity for growth and functional activity (Compact Oxford English Dictionary, 2005).
- The property or quality that distinguishes living organisms from dead organisms and inanimate matter, manifested in functions such as metabolism, growth, reproduction, and response to stimuli or adaptation to the environment originating from within the organism (Dictionary.com, 2005).

2) Conventional definition:

Life is a characteristic of organisms that exhibit the following phenomena:

- **Homeostasis**: Regulation of the internal environment to maintain a constant state; for example, sweating to reduce temperature.
- **Organization**: Being composed of one or more cells, which are the basic units of life.
- **Metabolism**: Consumption of energy by converting nonliving material into cellular components and decomposing organic matter. Living things require energy to maintain internal organization (homeostasis) and to produce the other phenomena associated with life.
- **Growth**: Maintenance of a higher rate of synthesis than catalysis. A growing organism increases in size in all of its parts, rather than simply accumulating matter. The particular species begins to multiply and expand as the evolution continues to flourish.
- **Adaptation**: The ability to change over a period of time in response to the environment. This ability is fundamental to the process of evolution and is determined by the organism's heredity as well as the composition of metabolized substances, and external factors present.
- **Response to stimuli**: A response can take many forms, from the contraction of a unicellular organism when touched to complex reactions involving all the senses of higher animals. A response is often expressed by motion, for example, the leaves of a plant turning toward the sun or an animal chasing its prey.
- **Reproduction**: The ability to produce new organisms. Reproduction can be the division of one cell to form two new cells. Usually the term is applied to the production of a new individual, although strictly speaking it also describes the production of new cells in the process of growth.

3) Proposed definition:

- Living things are systems that tend to respond to changes in their environment, and inside themselves, in such a way as to promote their own continuation.
- Life is defined as a network of inferior negative feedbacks subordinated to a superior positive feedback.
- Life is a characteristic of self-organizing, self-recycling systems consisting of populations of replicators that are capable of mutation, around most of which homeostatic, metabolizing organisms evolve.

- Type of organization of matter producing various interacting forms of variable complexity, whose main property is to replicate almost perfectly by using matter and energy available in their environment to which they may adapt. In this definition almost perfectly relates to mutations happening during replication of organisms that may have adaptive benefits.
- Life is a potentially self-perpetuating open system of linked organic reactions, catalyzed simultaneously and almost isothermally by complex chemicals that are themselves produced by the open system.

As the references, here also the definition from some dictionaries: (1) Spiritual existence transcending physical death; the period from birth to death; the quality that makes living animals and plants different from dead organisms and inorganic matter. Its functions include the ability to take in food, adapt to the environment, grow, and reproduce (Encarta® World English Dictionary, 2005). (2) The condition that distinguishes animals and plants from inorganic matter, including the capacity for growth and functional activity (Compact Oxford English Dictionary, 2005). (3) The property or quality that distinguishes living organisms from dead organisms and inanimate matter, manifested in functions such as metabolism, growth, reproduction, and response to stimuli or adaptation to the environment originating from within the organism (Dictionary.com, 2005).

3. Essential Concepts of Life

The biological world is viewed as a hierarch of levels. These levels include quanta, chemicals, molecules, cells, tissues, organelles, organs, organisms, species, and ecologies, etc. There are three conceptions for life: as a loose cluster of properties, a specific set of properties, and metabolization. There are many other opinions of life, such as that life is something of autopoiesis and self-replication, etc. Several hundred years ago, people thought that there was a vitalism inside life bodies that keep the body to be a life. The scientific results absolutely denied the existence of vitalism. The demise of vitalism told us that no super physical substance or force or spirit to distinguish any life from non-life. For all we know, all life phenomena obey to all the natural laws (physical and chemical) that adapted to the non-life world. There is no any extra natural law for the life world only. Life is no more unified than a collection of overlapping properties from overlapping disciplines, such as, biophysics, biochemistry, molecular biology, genetics, evolution, ecology, cytology, microbiology, physiology, anatomy and heredity, etc. However, the biophysics is poor result up to now.

Farmer and Belin listed eight characteristics of the life: (1) process, (2) self-reproduction, (3) information storage of self-representation, (4) metabolism, (5) functional interactions with the environment, (6) interdependence of parts, (7) stability under perturbations, and (8) the ability to evolve. According to Farmer and Belin, life is a pattern of spacetime, rather than the specific identities of the atoms (Farmer, 1992).

Taylor described the properties of life: "Each property by itself, even when considered with others, is unable to clearly delineate the living from the non-living, but together they do help to characterize what makes living things unique" (Taylor, 1992).

Monod listed three characteristics of life: teleonomic or purposeful behavior, autonomous morphogenesis and reproductive invariance (Monod, 1971). Crick focused on the points related to: self-reproduction, genetics, evolution and metabolism (Crick, 1981). Küppers pointed life as: metabolism, self-reproduction and mutability (Küppers, 1985). Maynard Smith gave life two properties: metabolism and parts with functions (Maynard, 1986). Ray cited two aspects: self-reproduction and the capacity for open-ended evolution (Ray, 1992).

Mayr thought that the process of living could be defined by a list of the kinds of characteristics by which living organisms differ from inanimate matter: (1) All levels of living systems have an enormously complex and adaptive organization. (2) Living organisms are composed of a chemically unique set of macromolecules. (3) The important phenomena in living systems are predominantly qualitative, not quantitative. (4) All levels of living systems consist of highly variable groups of unique individuals. (5) All organisms possess historically evolved genetic programs which enable them to engage in teleonomic processes and activities. (6) Classes of living organisms are defined by historical connections of common descent. (7) Organisms are the product of natural selection. (8) Biological processes are especially unpredictable (Mayr, 1982). (8) Life is continuum. (9) All life organisms are programmed to death naturally, which is called apoptosis (Ma, 2005b).

Schrödinger persisted that the second law of thermodynamics plays key role in the process of metabolization. The following sentences give his opinions: What is the characteristic feature of life? When is a piece of matter said to be alive? When it goes on doing something, moving, exchanging material with its environment, and so forth, and that for a much longer period than we would expect an inanimate piece of matter to keep going under similar circumstances. How does the living organism avoid decay? The obvious answer is: By eating, drinking, breathing and assimilating. Linguistically, the scientific term of life is metabolism. The essential thing in metabolism is that the organism succeeds in freeing itself from all the entropy (Schrödinger, 1969).

All living beings have a genuine biological autonomy spontaneously, and may be physically indeterminate or arbitrary cellular decisions that initiate quantum effects in support of biological performance. The biologically initiated spontaneous processes may be assisted by vacuum processes. This would indicate that the Cosmos is not only the source of stars, galaxies, and cosmic clouds, but also of biologically initiated and organized cosmic "forces" pre-existing in the vacuum and, ultimately, the Cosmic Subject (Grandpierre, 2014).

All life bodies perform self-control. The origin of life was happened in about 3 billion years ago in the earth, where the prebiotic milieu existed. Since that time, the evolution is always happening, and finally the unique species human appears. In the whole life event, the life molecules play key roles. All living beings live by their specific chemical molecules which follow all the general physical and chemical laws in the nature. Man-made new chemical combinations can also play living activities. The proposal of the DNA structure by Watson and Crick is important for the earth life.

The living cell in the life body is the self-contained and self-reproducing unit, and cells live independently in the nature. Some living body can be a single cell and some others are multi-cell. A normal human body consists of 100 trillion cells. In the living body macromolecules are assembled into complexes of cells and organelles that are further organized into the self-perpetuating units as the living body. All the properties of the molecules in cells follow the same physical and chemical laws as all others in the universe. There is no any extra natural law in living systems. Biochemical reactions follow as natural laws as the universal physical and chemical reactions.

Living things get genetic properties from the descendants which transfer the genetic information from one generation to the next generation in millions years continuously. The genes can be changed through the mutations and create new properties for the species, which cause a species disappear or give evolution and adapt the environment. The progeny keeps most of the genetic properties same genetic property as the parents but it is changeable by mutations. All cells have the abilities to express the genes and show the activities from the gene information. All the chemical reactions happen naturally in the living body follow the same laws as what happen in the experimental laboratories. There is no any extra force discovered for the living process. Most biochemical reactions are catalyzed by enzymes that are protein molecules composed by amino acids.

Four macromolecules are most important in the living body: nucleic acids, proteins, polysaccharides and lipids. (1) The nucleic acids are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). The primary functions of DNA and RNA are storage and translation of genetic information. (2) Proteins play role for the catalytic functions as enzymes on biochemical reactions, and they are found in structural association with lipids in membranes also. (3) The polysaccharides are polymers composed of simple sugars like glucose, which form structural materials like cellulose and chitin and function as energy stores in starch or glycogen. (4) The lipids are responsible for cellular compartmentalization and storing energy. Beside of the four main molecules above, the most abundant molecule in the cell is water, which constitutes about 70% of the total mass normally.

Bacteria Escherichia coli (E. coli) thrive in an aqueous soup containing sodium chloride, potassium chloride, magnesium sulfate, ammonium, and phosphate, sugar, etc. At 37°C and pH7, an E coli cell will duplicate its substance and divide into two essentially identical cells in about 20-40 minutes. The simple sugar glucose is adequate both as a source of carbon and as a source of the chemical energy needed to metabolize it. Body energy normally comes from the degradation of sugar.

Life is natural spontaneous chemical events in which simple molecules combine to form more complex molecules, which in turn formed supramolecular complexes that eventually appeared in aggregates that were ultimately compartmentalized into cells and living bodies. Up to now, we find that the earth may be the only planet in our solar system that supports life. Although other solar systems in our galaxy and in the 100 million other galaxies may have planets that can support life similar to the life in our earth, they are too far for us to see.

The universe contains 10 million millions earthlike planets, and we only know that there is living life in our earth, and not others. So that, what we are talking about the nature of life is what it is in our earth. In our earth, life began about one billion years after the earth was formed, and it has been continuously evolving for 3 billion years since then. The life in our earth has been existed about 4 billion years. In the universe all the physical and chemical laws are same, but the physical and chemical environments are different from the 4 billion years ago to now. The prebiotic earth contained water, carbon dioxide, carbon monoxide, nitrogen, and hydrogen, but no free oxygen. The absence of oxygen was essential for the accumulation of cellular precursors. The free oxygen environment is important for the development of photosynthesis in primitive cells. According to the experiment of the life initial, it is possible to make life chemical molecules such as amino acids in our experimental laboratories. In the spark gap experiment by S. L. Miller and Harold Urey, the simple substances methane, ammonia, hydrogen, and water vapor were placed in a sterile vessel and subjected to a maintained electrical discharge that simulated one possible primitive earth environment generated a number of organic substances, including amino acids, the monomer units of which proteins are composed. The dilute solutions of hydrogen cyanide (HCN) under another simulated prebiotic environment will form purines and pyrimidines, the precursor building blocks of nucleic acids. In this protocol, some conditions such as electrical discharges are important.

In the life molecular reactions, the hydrophilic (water-loving) interactions and hydrophobic (water-abhorring) interactions are important. The aggregation of the hydrophobic lipids into clusters is not random. It is important and basic thing for the life processing to follow the principle of thermodynamically lowest potential energy in the system. The energy force is the only way to drive the life things to gain the existence. This is the real nature of life. And, the life is a natural existence.

According to the universal physical and chemical laws, the life process must be reversible, even the spontaneous dissolution normally proceeds more readily than spontaneous synthesis of most large biological molecules. The formation of complexes in stabilizing macromolecules needs the expenditure of energy to maintain biological order. The totality of life forms that inhabit our planet control the concentrations of oxygen and carbon dioxide in our atmosphere.

Escherichia coli can operate by either the anaerobic or the aerobic mode.

The first photosynthesis probably evolved in a group of prokaryotcs called the cyanobacteria, and the eukaryotes may have begun to develop only after oxygen was abundantly present. It may seem peculiar that the earliest life forms evolved in the presence of poisonous gases, such as carbon monoxide (CO), hydrogen cyanide

(HCN), and hydrogen sulfide (H,S), but those gases are in fact poisons only for aerobic forms of life. The protein is composed by amino acids.

The cell growth could be restricted by contact inhibition, and the cancer cells could loss the restriction of contact inhibition. All the living bodies come from non-living bodies and finally go back non-living bodies after the die. It is not that the god creates living body but the living body such as human creates the god when the human does not understand the science. The living organisms arise spontaneously under certain conditions.

Organic compounds consist for the most part of four types of atoms: carbon, oxygen, nitrogen and hydrogen. These four atoms together constitute about 99% of living material. Hydrogen and oxygen form water. The organic compounds found in organisms fall mainly into four great classes: carbohydrates, fats, proteins and nucleic acids. Each fat consists of 3 fatty acids joined to glycerol. The starches and glycogens are made of sugar units strung together to form long straight and branched chains. The principal function of carbohydrates and fats in the organism is to serve as the source of energy. The nucleic acids are very large structures, composed of aggregates of at least 4 types of nucleotides. The proteins are composed by different amino acids. The organism is very complex.

All the tings even very small possibility can happen. If the trial numbers are increased to big enough, everything is possible. Any event can be achieved with any probability, however small, by multiplying sufficiently the number of trials. The organic compounds do not require living organisms to make them. It is possible to make life by chemical technique without a living body resource.

Normally, to have organic molecules one ordinarily needs organisms that needs the special class of proteins enzymes. Enzymes play a dominant role in the chemistry of life and it is impossible for an organism to complete the biochemical synthesis of living material without enzyme. However, enzyme is protein. There is a dilemma to see how the first enzyme came from. The answer could be that the biochemical reactions were happened without enzyme but in a very slow rate and it happened. Given enough time, the end result is the same.

Nucleic acids are a third kind of carbon compound. This is part of deoxyribonucleic acid, the backbone of which is five carbon sugar alternating with phosphoric acid. The early earth is oxygen free.

In the early history of the earth, when there were no organisms or any free oxygen, organic compounds should have been stable over very long periods. This is a big difference between the period before life existed and now. This is why the spontaneous generation of living organisms was possible once and is so no longer.

Any process catalyzed by an enzyme can occur in time without the enzyme. Any process to synthesize an organic substance accelerated by enzyme is reversible. It supposes that life first arose in the sea. The sea gradually turned into a dilute broth, sterile and oxygen-free.

In this broth molecules came together in increasing number and variety, sometimes merely to collide and separate, sometimes to react with one another to produce new combinations, sometimes to aggregate into multimolecular formations of increasing size and complexity. The liquid crystals are important to life.

A living organism is a dynamic structure. It is the site of a continuous influx and outflow of matter and energy. Living organisms use the organic matter accumulated before, and they also make organic matter themselves.

To release the chemical energy through biochemical reactions is a process of cold combustion (respiration).

The cellular respiration is significant important to the life organism. Respiration uses the material of organisms with an enormously greater efficiency. Coupled with fermentation, photosynthesis made organisms self-sustaining; coupled with respiration, it provided a surplus.

The sun's radiation contains ultraviolet components which no living cell can tolerate. A layer of ozone formed high in the atmosphere and absorbed this radiation. Oxygen provided not only the means of obtaining adequate energy for evolution but the protective blanket of ozone which made possible terrestrial life. At least 100,000 planets like the earth exist in our galaxy.

Some 100 million galaxies lie within the range of our most powerful telescopes, so that throughout observable space we can count apparently on the existence of at least 10 million million planets like our own.

Wherever life is possible, given enough time, it could appear. The history of life in the earth could be traced back to the beginning of the Cambrian period of geologic time, to the earliest recognized fossils, forms that are now known to have lived more than 500 million years ago. A far longer prehistory of life has since been discovered and supposed: about 3 billion years. During most of that long Precambrian interval the only inhabitants of the earth were simple microscopic organisms, as the modern bacteria. Genetic variations made some individuals better fitted than others to survive and to reproduce in a given environment, and so the heritable traits of the better-adapted organisms were more often represented in succeeding generations. The emergence of new forms of life is through this principle of natural selection and evolution.

One important event in Precambrian evolution was the development of the photosynthesis. Oxygen released as a by-product of photosynthesis accumulated in the atmosphere. The first organisms to evolve in response to this environmental change could merely tolerate oxygen.

A second important episode in Precambrian history is the new kind of cell, in which the genetic material is aggregated in a distinct nucleus and is bounded by a membrane. Such nucleated cells are more highly organized and obtained the ability for sexual reproduction.

The history of life has been reconstructed mainly from the study of fossils preserved in sedimentary rocks.

The fossil ages can be calculated from the constant rate of decay of radioactive isotopes in the earth's crust. By determining how much of an isotope has decayed since the minerals in a rock unit crystallized, a date can be assigned to that unit and to nearby strata containing fossils. Radioactive-isotope studies show that the Phanerozoic era began about 570 million years ago and the earth and the rest of the solar system are 4.6 billion years old.

Precambrian microfossils have been discovered and studied and it was found that the bacteria existed in the Precambrian from the fossil remains of a microorganism.

In retracing the information of Precambrian evolution and fossil record, it is supposed that the metabolism and the biochemical pathways of the Precambrian life were same as the modern living cells.

Beside the living information on fossil organisms, the inorganic geological records are important for the studies of the early evolutionary progression. The properties of the minerals influence the biological properties of the living organisms.

The most important of the life level is whether the cells have nuclei or do not have the nuclei. In terms of biochemistry, metabolism, genetics and intracellular organization, plants and animals are very similar. All higher organisms have nuclei and this is the key difference from bacteria and blue-green algae that are non-nucleated life.

Organisms whose cells have nuclei are eukaryotes and cells without nuclei are prokaryotcs. All green plants, fungi, yeasts and animals are eukaryotcs. The prokaryotes include only two groups of organisms, the bacteria and the blue-green algae. The blue-green algae produce oxygen through photosynthesis like other algae and higher plants, but they have much stronger affinities with the bacteria.

In the nucleus of a eukaryotic cell the DNA is organized in chromosomes and is enclosed by an intracellular membrane. The prokaryotes have only a single loop of DNA and have no nuclei. Prokaryotes reproduce asexually by the comparatively simple process of binary fission.

The prokaryotcs are bacteria and cyanobacteria, and the typical one is the bacterium Escherichia coli. The mitochondria in animals and plants, and chloroplasts in green plants may be derived from prokaryotcs that established a symbiotic relationship with the host cell. Prokaryotes vary widely in their tolerance of or requirement for free oxygen, and they are thought to have evolved during a period of fluctuating oxygen. All eukaryotes require oxygen for metabolism and for the synthesis of various substances, and they must have emerged after an atmosphere rich in oxygen became established. Eukaryotic cells are generally larger than prokaryotic cells. Almost all prokaryotes are unicellular organisms.

The eukaryotic cells have membrane-bounded organelles including mitochondria and chloroplasts. Mitochondria are present in all eukaryotes, which play a central role in the energy using of cells, and chloroplasts exist in some protists and in all green plants that work for the photosynthetic activities of those organisms. It has been supposed that both mitochondria and chloroplasts may be evolutionary derivatives of what were once free-living microorganisms. The modern chloroplast may be derived from a cyanobacterium that was engulfed by another cell and that later established a symbiotic relationship with it. Mitochondria and chloroplasts contain a small fragment of DNA whose organization is similar to prokaryotic DNA.

In anaerobic organisms glucose is broken down through fermentation, glycolysis, with a net gain of two phosphate bonds. In bacterial fermentation the pyruvate is converted into products such as lactic acid or ethyl alcohol and carbon dioxide, which are excreted as wastes. The metabolic system of aerobic organisms is respiration, which begins with glycolysis, but the pyruvate is treated not as a waste but as a substrate for a further series of reactions that make up the citric acid cycle. In these reactions pyruvate is decomposed one carbon atom at a time and combined with oxygen, the ultimate products being carbon dioxide and water. Respiration releases more energy than fermentation, and the proportion of the energy recovered in useful form is also greater; as a result 36 phosphate bonds are formed instead of two.

For prokaryotes oxygen requirements are variable. Some bacteria cannot grow or reproduce in the presence of oxygen that are anaerobes, and others are aerobic cells that need oxygen. There are also prokaryotes that grow best in the presence of oxygen but only at low concentrations, far below that of the present atmosphere. There are fully aerobic prokaryotes that cannot survive without oxygen. The prokaryotes evolved during a period when environmental oxygen concentrations were changing, but by the time the eukaryotes arose the oxygen content was stable and relatively high.

In eukaryotes the principle metabolic process is respiration, which uses the sugar glucose reacting with oxygen to produce carbon dioxide, water and energy. Some prokaryotes are also capable of respiration, but many derive their energy solely from the simpler process of fermentation. In bacterial fermentation glucose is not combined with oxygen but is simply broken down into smaller molecules. In both respiration and fermentation part of the energy released through the decomposition of glucose is captured in the form of high-energy phosphate bonds, usually in molecules of adenosine triphosphate (ATP). The rest of the energy is lost from the cell as heat.

Respiratory metabolism include glycolysis and citric acid cycle. In glycolysis a glucose molecule with 6 carbon atoms is broken down into two molecules of pyruvate (each has 3 carbon atoms). No oxygen is required for glycolysis and it releases small energy amount with a net gain of 2 molecules of ATP.

The molecule pyruvate used in the citric acid cycle is formed by glycolysis. Through a series of enzyme-controlled reactions the carbon atoms of the pyruvate are oxidized and the oxidations are coupled to other reactions that result in the synthesis of ATP. For each 2 molecules of pyruvate 34 additional molecules of ATP are formed. The complete respiratory pathway is more effective than glycolysis.

In bacterial fermentation a molecule of glucose is split into two molecules of pyruvate, with a net yield of two molecules of ATP. In glycolysis, no oxygen is required for the process. In anaerobic prokaryotes the metabolic pathway essentially ends at pyruvate. The anaerobic fermentation was an important event processed early in the history of life.

In mammalian muscle cells prolonged exertion can demand more oxygen than the lungs and the blood can supply. In the liver it can be converted back into glucose using the energy of ATP. The pyruvate is not transported to the liver but is converted into lactic acid, which in the liver it is returned to the form of pyruvate.

Oxygen-dependent steps can be carried out only by aerobic organisms that evolved comparatively late in history of Precambrian life.

In aerobic organisms all biochemical syntheses require oxygen. Eukaryotcs and some prokaryotes first make a fully saturated molecule, stearic acid, then introduce double bonds by the process of oxidative desaturation.

Molecular oxygen is needed in the synthesis of bile pigments in vertebrates. The oxygen dependence of two synthetic pathways in particular has been determined.

Sterols, such as cholesterol and the steroid hormones, are flat, plalclikc molecules derived from the compound squalene. which has 30 carbon atoms.

The primary means of determining a date to the origin of the eukaryotes is by the radiation fossil record.

When a fossil has been identified as unequivocally eukaryotic the available radioactive-isotope methods of dating can rarely assign it a precise age.

Cells larger than modern prokaryotes first become abundant in rocks about 1.400 million years old. In somewhat younger Precambrian sediments there are still larger cells, fossils greater than one millimeter in diameter.

Nitrogen fixation has a high cost in Energy. It is likely that the capability for nitrogen fixation developed early in the Precambrian among primitive prokaryotic organisms and in an environment where fixed nitrogen was in short supply.

There are many groups of bacteria that can do the photosynthesis. The anaerobic nature of bacterial photosynthesis seems to present a paradox.

The rise of aerobic photosynthesis in the mid-Precambrian introduced a change in the global environment that was to influence all subsequent evolution.

By the time eukaryotic cells arose 1.500 to 1.400 million years ago a stable, oxygen-rich atmosphere had long prevailed.

There should be no limitation on the size of living cells, even there is debate in this topic.

When the replication of DNA is terminated, the cell enters the G„ phase. The cell-cycle program requires a certain minimum amount of time.

The period of DNA replication is the S phase, the interval is the G phase, and the interval between the end of S and the onset of cell division is the G2 phase.

During the S phase the appearance of the cell surface changes again.

Virus-induced cell fusion has been used to study the other key event in the cell cycle: entrance into the M phase. This is the period of cell division, characterized by condensation of the chromosomes. In condensation the chromosomes pack themselves into threads that are visible under the microscope.

Agents that cause cancer must cause noncycling cells to reenter the cycle.

Only 20 different amino acids exist in proteins, but this makes possible an astronomical number of unique polypeptide chains. Proteins exemplify a number of important general concepts in the molecular design of living systems.

The main polypeptide chain appears as a continuous ribbon of electron density running through the image with regularly spaced promontories on it that are characteristic of the carbonyl groups that mark each peptide bond.

If a chemical process leads to a state of lower free energy, the reaction can proceed, but it should not be assumed that it necessarily will.

The overall chemistry of oxidation and of photosynthesis consists in a transfer of hydrogen, but it is not necessary at each stage of the process to transport complete hydrogen atoms. Indeed, in the chemiosmotic theory hydrogen carriers alternate with molecules that carry only electrons. The use of electron carriers is possible because protons are soluble in water and in the aqueous medium of the cell, whereas electrons are not. When a molecule that bears a whole hydrogen atom interacts with another molecule that accepts only electrons, the proton is released into solution. When an electron carrier then donates its electron to a hydrogen carrier, the hydrogen atom is reconstituted by withdrawing a proton from the medium.

The nucleic acids are responsible for genetic continuity in all living cells, and they are also essential to the expression of the encoded hereditary message. Nucleic acids are composed of long chains of nucleotides linked together by phosphodiester bonds. Each nucleotide consists of a sugar, a phosphate group, and a nitrogenous base. The alternating sugars and phosphates form the monotonous backbone of a chain.

4. Life in the Timeless World

As it was described in one of my papers “The nature of time and space”: From the ontology (or naturalism) angle, time and space are absolute (existed) and the universe is a timeless world, which means that all the past, the present and the future exist eternally. Everything in the universe will never change. Time and motion are nothing more than illusions. In the universe, every moment of every individual's life - birth, death, and anything in between - exists forever. Everyone is eternal. That means each and every one of us is immortal. The universe has neither past nor future. All the things in the past, present, and future exist forever. The concepts of past, present and future are depended on the human brain” (Ma, 2003). Life is something (substance) existing in the timeless world. So that, all the life processes are the simple existence of something in the universe, like a movie in a tape – exist already and forever. This is the essential nature of life, in the ontology point. Under the timeless principle, there is only existence in the universe, not something complexity and other thing simplicity. The life is not more complex than non-life from the ontological concept. However, in the timeless world, there are natural connections among the all the existence. All the scientific studies, philosophical ratiocinations and religious believe are the trial to reveal the natural rules.

According to Mr. Isaac Newton, the absolute time exists independently of any perceiver and progresses at a consistent pace throughout the Universe. Time as a way to measure the duration of events is not only deeply intuitive, but also plays an important role in our mathematical descriptions of physical systems. Time as a measure of the numerical order of change. In physics, we use time (t) as the x-axis in graph as a baosic physical-mathematical work, but we never really measure time. We use time as a unit to get speed and frequency, etc, but it is very difficult to say that time is. By the ontology point, the time is only a mathematical value, and not primary physical existence. Without people, there is no time exist in the universe nature. Time is depending on the human's measurement, depending on human making clock. The universe existence is timeless. So that, the life exists in the timeless universe. The Minlowski space is not 3D+t, but it is 4D, and this is not right. Timer is only the order of the events, and all the event exit forever. Everything exist forever. Space is the fundamental physical entity but time is not.

5. Life as Negative Entropy

The second law of thermodynamics was formulated in the middle of the last century by Clausius and Thomson, which could be formulated in four different ways: (1) Heat cannot flow from a colder body to a hotter one without energy input; (2) Entropy must increase in a closed system; (3) No cyclic process can convert heat entirely to work; (4) In any cyclic process the heat Q transferred to the system from its surroundings at the temperature T must obey an inequality: $\oint dQ/T<0$ (Ma, 2003). Above the four points, the principle concept of the second law of thermodynamics is to say that in the closed system all the natural processes increase entropy (decrease order). So, the second law of thermodynamics can be called the entropy law or law of entropy. However, life violates the second law of thermodynamics. In the natural world, the life process is negative entropy one. In the life process, the entropy decreases, which means that the order increases. More importantly, there is no evidence to say that the entropy decrease of life costs by the entropy increase of environment. The conclusion is that the life process does not obey the second law of thermodynamics. For all we know that all life phenomena obey to all the natural laws that adapted to the non-life world. How can we say that life violates the second law of thermodynamics? Is there any conflict? The answer is that there is no conflict here. As it was described in the article "The nature of time and space", "the second law of thermodynamics is a statistical result, ……, the basic statistical principles and the second law of thermodynamics are useful tools in human practice, but they are not the true natural existence" (Ma, 2003). The fact is that the life process does not obey the second law of thermodynamics, but it obeys all the natural laws. The second law of thermodynamics is not a natural law, but a technical tool.

The first law of thermodynamics and the second law of thermodynamics:

$$S = \int \frac{dQ}{T}$$

where

S= entropy

dQ= a differential amount of heat passed into a thermodynamic system

T= absolute temperature

Free energy: $\Delta G \equiv \Delta H - T\Delta S$

6. Life as Autopoiesis (Auto-organizing)

Autopoiesis is the process whereby an organization produces itself. An autopoietic organization is an autonomous and self-maintaining unity which contains component-producing processes. The components, through their interaction, generate recursively the same network of processes which produced them. An autopoietic system is operationally closed and structurally state determined with no apparent inputs and outputs. A cell and an organism is an autopoietic system. Autonomy is the condition of subordinating all changes to the maintenance of the organization. Self-asserting capacity of living systems maintain their identity through the active compensation of deformations. Allopoiesis is the process whereby an organization produces something other than the organization itself. An assembly line is an example of an allopoietic system (Varela, 2005). Life is an emergent property of autopoietic, dissipative systems. Life is an autopoiesis (auto-organizing) complex, which can organize itself without energy input, even without information input. Active life process costs energy and uses information. However, the cost of energy is not the requirement of energy by the second law of thermodynamics. It cannot stay long period without energy and information input. After a while without exchange energy and information with outside world, the active life will die.

Autopoiesis is originally presented as a system description that is to define and explain the nature of living systems. The typical autopoiesis system is the biological cell. For example, the eukaryotic cell is made of various biochemical components such as DNA, RNA, protein, sugar and lipid, etc, and is organized into bounded structures such as the cell nucleus, organelles, cell membrane and cytoskeleton, etc. These structures, based on an external flow of molecules and energy, produce the components which, in turn, continue to maintain the organized bounded structure themselves.

7. Evolution and Creation

Evolution theory is one of the most important theories in science. The evolution of life shows a remarkable growth in complexity. Simple prokaryotic one-celled life leads to more complex eukaryotic single-celled life, which then leads to multicellular life, then to large-bodied vertebrate creatures with sophisticated sensory processing capacities, and ultimately to highly intelligent creatures that use language and develop sophisticated technology as human. Creation theory is to say that the life is not evolution but created by God, and all the species do not change forever. The interest thing is that many scientists are strongly believe creation in their non-work time, which means that the scientists believe Bible when they are in their churches in their religious time (normally in the weekend) or when they spend time in their Bible studies. However, these scientists never do anything following creation theory in their work time, which means that they never do any experimental or publish any thing in the academic journals or teach students to support creation opinions. In the work time they need to do something that positive for their life as their income comes from the work, and non-work time they can do anything what they want.

Life evolves by mutations, genetic drift, and natural selection. Gene transfer is to transfer a gene from one DNA molecule to another DNA molecule, which can change the genetic background of an organism in anyway we want (Ma, 2005a). The evolution happens naturally, and also can happen artificially by gene transfer technique. Cloning creates a genetically identical copy of an animal or plant, which can be done in all the kinds of living things, including human being. Transgenic animal and clone for the study of gene regulation and expression has become commonplace in the modern biological science now (Pinkert, 1999). The sheep Dolly was the world's most famous clone animal, but it was not the first one. Many animals - including frogs, mice, sheep and cows had been cloned before Dolly. Plants have been often cloned since ancient people. Human identical twins are also clones. Dolly was the first mammal to be cloned from an adult cell, rather than an embryo. This was a major scientific achievement of Dolly, but also raised scientific and ethical concerns. Since Dolly was born in 1996, many other animals have been cloned from adult cells, such as mice, pigs, goats and cattle, etc. Cloning by interspecies nuclear transfer offers the possibility of keeping the genetic stock of those species on hand without maintaining populations in captivity (Lanza, 2002) and change the species, but also possibly creates the risk of biological calamity (Ma, 2004).

8. Adaptation

Adaptive evolutionary explanations are familiar to all of us from elementary school biology. A classic application of adaptationism is to explain the giraffe's long neck as an adaptation for browsing among the tops of trees, on the grounds that natural selection favored longer-necked giraffes over their shorter-necked cousins. There are alternatives to adaptive explanations, such as explanations appealing to allometry, genetic drift, developmental constraints, genetic linkage, epistasis, and pleiotropy. The presupposition that a trait is an adaptation and so deserves an adaptive explanation is usually treated as unfalsifiable. The adaptationist perspective on evolution emphasizes natural selection's role in creating the complex adaptive structures found in living systems.

9. Emergence

Both living systems and artificial life models are commonly said to exhibit emergent phenomena. Emergent phenomena share two characterizations: they are constituted by and generated from underlying phenomena, and they are autonomous from those underlying phenomena. There are three main points for emergent properties. The first key point of emergence is simply the idea of a property that applies to wholes or totalities but does not apply to the component parts considered in isolation. The second key point of emergence is to insist that emergent properties are supervenient properties with causal powers that are irreducible to the causal powers of micro-level constituents. The third key point of emergence is poised midway between the other two.

10. Living Hierarchy

Living phenomena fall into a complex hierarchy of levels, what can be called the *vital hierarchy*. Even broad brush strokes can distinguish at least eight levels in the vital hierarchy: (1) ecosystems, (2) communities, (3) populations, (4) organisms, (5) organ systems (immune system, cardiovascular system), (6) organs (heart, kidney, spleen), (7) tissues, and (8) cells. Under the life hierarchy, there are molecules, atoms and quanta that are substance but not life constituents. Items at one level in the hierarchy constitute items at higher levels. Individual organisms are born, live for a while, and then die. The vital hierarchy raises two basic kinds of questions about the nature of life. First, we may ask whether there is some inherent tendency for living systems to form hierarchies. Why are hierarchies so prevalent in the phenomena of life? The second question concerns the relationships among the kinds of life exhibited throughout the vital hierarchy. Are there different forms of life at different levels, and if so then how are these related? How are they similar and different? Which are prior and which posterior? What is the primary form of life? The theory supple adaptation reveals a two-tier structure with connected but different forms of life. The first tier is the primary form of life - the supplely adapting systems. At the second tier, entities that are suitably generated and sustained by such a supplely adapting system branch off as different but connected secondary forms of life. These secondary forms of life include organisms, organs, and cells.

11. Continuum or Dichotomy

Can things be more or less alive? Serious reflection about life quickly raises the question whether life is a boolean property (zero or one) - whether it is a continuum property. We can say that a rat is alive and a rock is not alive. But it is difficult to say some condition of living body is alive or not, such as a virus which is unable to replicate without a host and spores or a frozen cell which remain dormant and unchanging indefinitely but then come back to life when conditions become suitable. Furthermore, we all agree that the original life forms somehow emerged from a pre-biotic chemical soup, and this suggests that there is very little, if any, principled distinction between life and non-life. In fact, life is continuum and it can be more or less alive. There is no absolute line between life and non-life. If life is considered as supple adaptation the most important life/non-life distinction involves a continuum because the activity of supple adaptability comes in degrees.

12. Apoptosis

For all the things existed, including the life cells in the earth and universe itself, there is a time to live and a time to die. There are two ways in which cells die: (1) Cells are killed by injury or disease. (2) Cells suicide. Programmed cell death is also called apoptosis, which is cell suicide. Apoptosis is a mechanism by which cells undergo death to control cell proliferation or in response to DNA damage. Some types of cancers, such as B-cell chronic lymphocytic leukemia, follicular lymphoma (Tsujimoto, 1985) and tumors infected by human T-cell leukemia/lymphoma virus-1 (Hengartner, 2000) are characterized by defects in apoptosis leading to immortal clones of cells. Other malignancies have defects in the apoptotic regulatory pathways such as p53 (Kaufmann, 2001).

Apoptosis can be triggered by the following internal signals: (1) In a healthy cell, the outer membranes of its mitochondria express the protein Bcl-2 on their surface. (2) Bcl-2 is bound to a molecule of the protein Apaf-1. (3) Internal damage to the cell (e.g., from reactive oxygen species) causes: Bcl-2 to release Apaf-1; a related protein, Bax, to penetrate mitochondrial membranes, causing; cytochrome c to leak out. (4) The released cytochrome c and Apaf-1 bind to molecules of caspase-9. (5) The resulting complex of cytochrome c, Apaf-1, caspase-9 and ATP is called the apoptosome. (6) These aggregate in the cytosol. (7) Caspase-9 is one of a family of over a dozen caspases. They are all proteases. They get their name because they cleave proteins — mostly each other — at aspartic acid (Asp) residues. (8) Caspase-9 cleaves and activates other caspases. (9) The sequential activation of one caspase by another creates an expanding cascade of proteolytic activity, which leads to digestion of structural proteins in the cytoplasm, degradation of chromosomal DNA, and phagocytosis of the cell.

Apoptosis can be triggered by external signals also: (1) Fas and the TNF receptor are integral membrane proteins with their receptor domains exposed at the surface of the cell. (2) binding of the complementary death activator (FasL and TNF respectively) transmits a signal to the cytoplasm that leads to activation of caspase 8. (3) When cytotoxic T cells recognize their target, they produce more FasL at their surface. This binds with Fas on surface of the target cell leading to its death by apoptosis.

Apoptosis is a universal event in the universe, that happens in all the life bodies and azoic things in the universe, including the universe itself. To understand apoptosis clearly will be important to the understand of the basic nature laws (Ma, 2005b). Apoptosis is the nature of life, and apoptosis is also the nature of nature!

13. Artificial Life

Could robot do all the things what human do? Could artificial electronic life play all the functions what the organic life play? Up to now, nobody can answer these questions.

In 1966, John von Neumann made the first artificial life model with his famous creation of a self-reproducing, computation-universal entity using cellular automata. Von Neumann was pursuing many problems that are important in the artificial life today, such as understanding the spontaneous generation and evolution of complex adaptive structures. Originally, cybernetics applied two tools to the living system studies: the use of information theory and a deep study of the self-regulatory processes. Information theory typifies the abstractness and material-independence of artificial life, and self-regulation is one of the hallmarks of living systems studied in artificial life.

Biology studies have provided rich knowledge about actual living systems. Physics and mathematics have had a strong influence on artificial life, especially in the study of complex systems. Statistical mechanics and dynamical systems theory have improved artificial life's methodology.

The real artificial life should be organic life, same as the natural life. Right now, people can synthesize simple organic molecules such as sugar and amino acids from the inorganic carbon, hydrogen and oxygen. Just after the technique developing, people will have the ability to make the real cells, tissues, organs and animals even a real human. This will be the real artificial life – everything is same as the natural life.

14. Matter and Form of Life

The advent of the field of artificial life has focused attention on a set of questions about the role of matter and form in life. On the one hand, certain distinctive carbon-based macromolecules play a crucial role in the vital processes of all known living entities; on the other hand, life seems more like a kind of a process than a kind of substance. Furthermore, much of the practice of artificial life research seems to presuppose that life can be realized in a suitably programmed computer. This raises a number of related questions: Can a computer play all the functions of the organic life play? Is the natural life just substance properties what the substance has or life has independent proper that performs by the substance? Functionalism captures the truth about life. Furthermore, there is no evident reason why the functional structure specified the theory could not be realized in a suitably structured computational medium. If so, then a computerized "life" could in principle create a real, literally living entity. In fact, a computer can play many functions of the organic life play, but could not play all the functions of the organic life play, because the matter is essential different. The natural life is dependent on the substance of the life bodies.

15. Life and Mind

It is an essential philosophical question whether there is any intrinsic connection between life and mind. Viruses, plants, bacteria, worms, animals and human have various kinds of sensitivity to the environment, various ways in which this environmental sensitivity affects their behavior, and various forms of inter-organism communication. Various kinds of what one could call mental capacities are present throughout the biosphere. Furthermore, the relative sophistication of these mental capacities seems to correspond to and explain the relative sophistication of those forms of life. It is reasonable to ask whether life and mind have some natural connection. The process of evolution establishes a genealogical connection between life and mind, but life and mind might be much more deeply unified. Since all forms of life must cope in one way or another with a complex, dynamic, and unpredictable world, perhaps this adaptive flexibility inseparably connects life and mind. In fact, the mind comes from brain that composes by the organic molecules and the organic molecules compose by inorganic matter. But, there is no evidence to say that the inorganic matter in the living organism is different from the inorganic matter out the living organism.

16. Life and Quantum

Up to now, no scientific evidence to show that life body and non-life body obey the different natural laws. By the classic physics and chemistry, there is no essential difference discovered in life and non-life. There is no lifeline defined by modern science, this means that we neither qualitate nor quantitate life by any current scientific method. However, all the researches are made by the methods of biology, biochemistry and molecular biology, etc., which means that all current biological and neurobiological descriptions of the life and brain are based on Newton's physics, even if it is well known that Newton's physics has its limitations. Biophysics has started for several decades and it did not get many achievements. Up to now, nobody tried to reveal the nature of life under the quantum level. It is reasonable to think about that the life and non-life are essential different in the biophysics, i.e. the quantum level. The life phenomenon, especially consciousness, is unlikely to arise from classical properties of matter. Quantum theory allows for a new concept of matter altogether, which may well leave cracks for life and consciousness, for something that is not purely material or purely extra-material. Interactions with the quantum vacuum may not be limited to micro-particles: they may also involve macroscale entities, such as living systems. The recognition of openness is returning to the natural sciences. Traffic between our consciousness and the rest of the world may be constant and flowing in both directions. Everything that goes on in our mind could leave its wave traces in the quantum vacuum, and everything could be received by those who know how to tune in to the subtle patterns that propagate there.

17. Origin of Life

When the earth formed about 4.6 billion years ago, it was a lifeless place. A billion years later it was teeming with organisms such as blue-green algae. How did life begin? The discovery of self-replicating RNA was a critical milestone on the road to life. Before the mid-17th century, most people believed that God had created humankind and other organisms by mud. For the next two centuries, those ideas were subjected to increasingly severe criticism.

In 1903, Svante Arrhenius proposed that life on the Earth was seeded by spores originating from another planet. In 1905, the astronomer Simon Newcomb proposed that because the Earth was a representative planet orbiting a representative star Sun, life could be abundant throughout the universe (Zubay, 2000). But up to now, there is no discovery of the life existing in another planet.

All living things consist of similar organic compounds. Proteins in all organisms are consisted by one set of 20 amino acids. These proteins include enzymes that are essential to live, develop and reproduce, and the protein that essential to the organism structure. Organisms carry their genetic information in nucleic acids RNA and DNA, and use them as the same genetic code. This code specifies the amino acid sequences of all the proteins and peptides in each organism. The nucleotides consist of a sugar (deoxyribose in DNA and ribose in RNA), a phosphate group and one of four different bases. In DNA, the bases are adenine (A), guanine (G), cytosine (C) and thymine (T). In RNA, uracil (U) substitutes for T. The bases constitute the alphabet, and triplets of bases form the words as the genetic codes. As an example, the triplet CUU in RNA instructs a cell to add the amino acid leucine to a growing strand of protein when the protein is synthesized. Organisms store genetic information in nucleic acids that specified the composition of all synthesized proteins. It relies on proteins to play the biological metabolism processes.

18. Spirit and Soul

The discontinuity problem between nature and man is the essential tragedy of modern man. Can humans function as infinite fields of consciousness, transcending the limitations of time, space and linear causality? No answer. The space and time are transcended if the universe is timeless and eternal, and all existing outside of the usual space-time continuum. According to some opinions currently, life is timeless and spaceless. Time and space are inventions of the conscious mind. They are not present in the underconscious mind. Memory has a deep dimension, a sensation of being immeasurably ancient and knowing, as somehow prior to time and space. Mystical transcendence of time and space involves an experience described as eternity or infinity. All exist forever.

19. Discussions

Extraterrestrial life forms do not need to depend on DNA-encoded information or carbon chemistry processes. Will compute be good enough as a kind of life? The phenomena of life raise a variety of subtle and controversial questions. Life is a loose cluster of properties, a specific set of properties, having metabolization, self-replication, autopoiesis, and closed causal loops. There is no non-physical substance or force to distinguish all instances of life. There are many questions for the earth life, such as population, genetics, molecular, evolution, ecology, cytology, biochemistry, and physiology, etc. Metabolization is at least a necessary condition of all physical forms of life. All life is the evolutionary process of adaptation. Supple adaptation could provide this explanation even though an individual living organism is itself only a small and transitory part of the whole adapting population. Artificial life is an interdisciplinary field that attempts to understand the essential nature of living systems by means of devising and studying computationally implemented models of the characteristic processes of living systems. These processes include self-organization, metabolization, self-reproduction, and adaptive evolution (Bedau, 2014).

Life on the Earth has 3 key properties: (1) Life has a fundamental structural unit cell; (2) Cells play metabolism; (3) Cells have a heredity molecule DNA for genetics.

One possibility is that life started elsewhere in the universe and arrived on Earth by cometary, meteoric, or planetary delivery. Life does not abide the second law of thermodynamics (Andrulis, 2012).

There are plenty of puzzles about the concept of life. The concrete objects ready to hand are usually easily classified as living or non-living. Fish and ants are alive while candles, crystals and clouds are not. Yet many things are genuinely puzzling to classify as living or not. Viruses are one borderline case, biochemical soups of evolving RNA strings in molecular genetics laboratories are another. Extraterrestrial life forms, if any exist, might well not depend on DNA-encoded information or, indeed, any familiar carbon chemistry processes. How would we recognize extraterrestrial life if we found it? We have no reason to suppose it will have any of the accidental characteristics found in familiar forms of life. What, then, are the essential properties possessed by all possible forms of life? The search for extraterrestrial life needs some answer to this question, for we can search for life only if we have a prior conception of what life is.

Scientific discoveries made during the last two centuries have determined that the fundamental building blocks of the physical universe as we now find it consist of submicroscopic "atoms," each of which in turn has a complex inner structure of elementary "particles" and "forces." A further solidly established scientific determination is that since the establishment of atoms during one stage of cosmic evolution they have been involved in a universal process of rearrangement. Thus individual humans in their physical aspect are aggregates of atoms that formerly and variously constituted elements of other creatures or objects, and upon the death and decomposition of humans' bodies their atoms, rather than simply dissipating into nothingness, become parts of subsequent creatures or objects, and so forth indefinitely. In this sense deceased humans achieve an "atomic immortality." (Edmondson, 2005).

The phenomena of life raise a variety of subtle and controversial questions. Early life forms somehow originated from pre-biotic chemical soup. Does this imply that there is an ineliminable continuum of things being more or less alive, as many suppose? Another subtle question concerns the different levels of living phenomena, such as cells, organs, organisms, ecosystems and asks in what senses the concept of life applies at these various levels. Does the essence of life concern matter or form? On the one hand, certain distinctive carbon-based macromolecules play a crucial role in the vital processes of all known living entities; on the other hand, life seems to be more in the nature of a process than a kind of substance. The relationship between life and mind raises another question. When we consider plants, bacteria, insects, and mammals, for example, we apparently find different kinds of mental activity, and it seems that different degrees of behavioral sophistication correspond to different levels of intelligence. Might the various forms of life and mind be somehow connected? To answer questions like these above and make sense of the puzzling phenomena of life, we need a sound and compelling grasp of the nature of life. Can any property embrace and unify not only life's existing diversity but also all its possible forms? What is the philosophically and scientifically most plausible way to account for the characteristic life-like features of this striking diversity of phenomena? How can we resolve the controversies about life? The concept of life as supple adaptation, explained below, is my attempt to address these issues.

Notice that our ordinary, everyday concept of life does not settle what the true nature of life is. Thus, we are not concerned here with careful delineation of the paradigms and stereotypes that we commonly associate with life. We want to know what life is, not what people think life is. Glass does not fall under the everyday concept of a liquid, even though chemists tell us that glass really is a liquid. Likewise, we should not object if the true nature of life happens to have some initially counterintuitive consequences.

Four questions are important to answer: (1) How are different forms of life at different levels of the vital hierarchy related? (2) Is there a continuum between life and non-life? (3) Does life essentially concern a living entity's material composition or its form? (4) Are life and mind intrinsically connected?

For now, many people, including biologists and other scientists are still believing that God created the life, even they never publish any academic articles to describe that. The ridiculous things are that many biologists always write articles and teach students evolution in their work time but believe creation theory (deny evolution) in their weekend church time. Depending on the academic articles, they make their career and life, but depending on the Bible, they come back non-experiment believe. The fighting between science and religion is still a heavy topic in the modern time.

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