

What is LIFE?

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What is Life? Indeed, what is it, that separates a thinking, talking and walking individual, from a decaying corpse? What distinguishes one who is vivacious and dynamic, from one who is very dead? It is a vital question that has perplexed us since the dawn of our existence; since we realized our ineluctable mortality.

We know that life is not synonymous with consciousness. Sleep, for example, is a state of unconsciousness during which we still maintain minimal motion; and from which we always return, or can be easily returned, to the normal state. Less common is coma, when unconsciousness is more prolonged, is accompanied by other ominous changes in the individual, and from which, recovery is rare. If recovery occurs, it is rarely complete. But both are very different from death, the undiscovered country from whose bourn i.e. border, no traveler returns, Act III, s.1, Hamlet. It is the irreversible finality of death that has troubled us; and we have wallowed in worry and itched for a salve.

Humans found a salve in the Spirit, or -at least- in the concept of the spirit. It has been believed that the spirit (the soul) is the difference between a living person and a dead body. Philosophers and theologians have differentiated between the soul and the spirit; but for the purpose of this talk, I will presume them identical, and use the two words interchangeably. It is the spirit that got into the clay body, starting the continuous sequence of life; as Michelangelo famously depicted for us; and it is the spirit that leaves our body at the time of our death, as less famous works of art have depressed us. So it is our solace that when beloved Grandpa dies, his base body goes down into the earth but his soul sublimates to heaven. It is Grandpa's spirit that is the essential part of him, and therefore it IS Grandpa. So we need not grieve that he is rotting in a grave, but rather rejoice that he is exalted and is among the angels.

From the nineteenth century English philosopher and mystic, William Wordsworth we got worthy words with which he acknowledged loss but also, allayed despair:

*Though nothing can bring back the hour
Of splendor in the grass, of glory in the flower.
We shall grieve not, rather find,
Strength in what remains behind,
In the primal sympathy,
Which having been must ever be,
In the soothing thoughts that spring,
Out of human suffering,*

*In the faith that looks through death
In years that bring the philosophic mind.*

There is another useful corollary to the concept of the immortal soul. Since a soul will never perish, then it can and will be rewarded for its merits and punished for its transgressions. It is a corollary that is socially responsible and conducive to order and goodness.

Religion has incorporated the concept of the soul. According to the book of Genesis, 2:7, "The Lord formed man of the dust of the ground, and breathed into his nostrils the breath of life, and man became a living soul." So the soul originates in, and emanates from God, who is absolute goodness and absolute power. Indeed, it is very comforting that all might and all mercy reside in the same entity. It is worth noting in Genesis 2:7, that the base body has a terrestrial origin whereas the exalted soul has a divine one. The Koran in 32:7&9 says "God excelled in everything He created, and He began the creation of Man from clay; then perfected him and breathed of His spirit into him."

Of note, is the attempt made, to give scientific credence to the concept of the soul. (This came up in the Feb.22, 2005 paper by Arthur Brooks to the Philosophical Club of Cleveland). A study, that reported weighing people just before and just after death, found the dead to be 21 grams lighter; thus implying that there was an actual physical weight for the soul. The methodology of that study held as much water as a sieve.

The association between the spirit, God and religion is well established in human thinking and human culture; and the verbal expression of that is apparent in our very vocabulary. We speak about the spiritual life of a community and we really mean its religious beliefs & practices. We say someone is very spiritual, and we mean that they are religious. They find psychological comfort-though they call it a spiritual one- in subscribing to a set of beliefs that are time-honored but never proven. And of course the very word belief is often used to indicate firm conviction that requires no factual basis, and has none. Though I say that the concept of the spirit is unproven, I nevertheless, have a lot of admiration for it.

The concept of the spirit comforts us when we face the most disturbing occasion of all, the death of someone we know, and it comforts us when we brood about our own death. It explains our communication with a dead person in a dream or in a séance, communications that often give us inspiration or give us peace of mind. The concept of the spirit, is of course essential to the belief in incarnation. And we have the nebulous idea that the spirits of the dead exist in a different plane or sphere where they have access to information inaccessible to us. So when we dream of a loved one who had died, we presume that it is the spirit of the dead loved one visiting us, and we give credence to what it tells us in that dream.

Having displayed doubt about the conventional (i.e. religious) distinction between life and death, I still need to address my original question:

I admit that we don't have a complete answer that is based on all the facts and figures. Still, I submit to you that the current collective human knowledge contains enough to answer the question(WHAT IS LIFE?). My paper does not claim to tell you anything new. It merely aims to remind you, of what you, the representatives of the human race, already know.

Let me start by saying that a person who is breathing, walking, talking, seeing, hearing, feeling and respondingis alive. Conversely, a human body that lacks these activities, is dead. And it is the *collective* absence of these qualities that is death. I say *collective* because a creature can lack one or more of these attributes and still be alive.

Consider BREATHING, one of these life-associated activities; whose presence proves the presence of life, and whose absence, especially prolonged absence, definitely denotes death.

[Here, I want to digress: I want to highlight the irony between my qualms to accept the Spirit as the essential component of life, and my selection of breathing as the sine qua non of life. The irony is in the fact that the word spirit comes from the Latin noun *spiritus* which means breath. So the spirit concept, which I expressed doubt in, also associates life with breathing.]

The next step is to ask "How do we breath, and what does it take to breath?" Humanity has answers to these questions. Breathing is involuntary. We usually we don't even think of it (unlike the raising of an arm); though breathing can also be conscious and voluntary; as when we sniff something.

Currently, humanity knows that breathing is initiated in the brain; then the impulse for breathing, travels down the spinal cord, then down certain nerves and eventually gets the muscles of breathing to contract. Because of the configuration of the ribs and the diaphragm, the contractions of the muscles of breathing enlarge the chest cavity, thus creating negative pressure in that cavity. The negative pressure draws-in air, which then comes in proximity to blood, which takes in oxygen and gives off carbon dioxide, back to the air.

This explanation gives rise to many questions, for which humanity, fortunately, also has answers; e.g.(1) how is the impulse for breathing initiated in the brain? By the release, within the brain, of chemicals called neurotransmitters. (2)How does the neurotransmitter cause the impulse to travel down the pathways of the central nervous system? By starting a series of chemical reactions that are propagated along these central pathways, and then along peripheral nerves, at the end of which, another chemical, called acetylcholine is produced and reacts with the receptor in the membrane of the muscle cell. (3)What is a receptor? It is a complex compound located in the membrane of the cell, and made mostly of protein. When this chemical receptor in the cell membrane, reacts with an external chemical such as acetylcholine,

then that activity results in chemical reactions within the cell. These chemical reactions affect the myosin and actin filaments inside the cell of the muscle.(4)What are actins and myosins? Actins & myosins are chemical structures, mostly protein, in the form of threads that are laid parallel to each other in the long axis of the muscle cell in interdigitating pattern. The chemical interaction inside the muscle cell, causes the interdigitating filaments of actin and myosin to slide into each other, along their longitudinal axis, thus shortening the muscle cell. Since all muscle cells are laid longitudinally in a bundle, then the whole bundle shortens and we get a visible contraction.

So the whole process consists of various chemical molecules, interacting chemically, until the very end when the cascade of chemical reactions results in the visually apparent physical act of breathing; an act that **is** a sign of life.

The events that sustain breathing, highlight other important aspects of life. One of these is Interdependence. The lung needs the heart to pump the blood to it to get oxygenated; after which, the action of the heart takes back the oxygenated blood, and pumps it all over the body. The heart, being necessary for the work of the lung, is in turn totally dependent on the oxygen that the lung provides. This dependence of the heart on the lung is highlighted by the fact that oxygen absence, quickly causes the heart to slow down then stop. Sustained absence of heart beats is another sure sign of death. But because, the detection of heart beats requires knowing where to touch and then requires touching the person, absence of heart beating is less easily detected than absence of breathing, which simply requires merely looking at the person and observing that her or his chest is not moving. Also, the above description of breathing reveals the total dependence of the lung on intact connections to the basal portion of the brain, which initiates involuntary inspiration. Any event that disrupts the integrity of the spinal cord at a point above the site of emergence of nerves destined toward muscles of breathing, will cause immediate death. One long-known example of that is execution by hanging, when the second vertebra in the neck breaks, and the spinal cord is crushed at that level, by the bony fragments thus disrupting the propagation of breathing impulses from the brain to the muscles of breathing. Also, humans know the fact that the brain is inept without proper function of both lungs and concurrent proper activity of the heart. Furthermore, Interdependence is present, not only at the level of distinct organs, but also among the chemical reactions at the level of individual cells. These chemical reactions both inside and outside the cells, require each other in various ways and in different degrees, to ensure proper performance of the cells; and consequently, optimal operation of the organ as a whole and the multi-organ individual, at large.

An example of chemical Interdependence at the cellular level, is the simple molecule of glucose, the cleanest, most efficient and most ubiquitous source of cellular energy. **[So, already we know that the source of all energy in the body is chemical energy.]** Glucose enters the body as a component of complex carbohydrates, which are digested i.e. chemically broken down, with contribution of yet more chemical compounds called digestive enzymes. Inside the gut, glucose undergoes chemical reactions that get it inside the cells of the gut lining, and then more chemical reactions

that finally get this simple glucose into the blood which distributes it to cells all over the body. One type of cells, the *B*-cells in the pancreas chemically sense the rise of the level of glucose in the blood. When they sense this rise, they respond by secreting the hormone insulin. (5)**What's a hormone?(A chemical compound, manufactured by endocrine glands and secreted directly into the blood stream then is carried away by the blood; to act *chemically* on receptors in the membranes of various cells in the body, thus initiating specific chemical reactions within those distant cells).** In this case, the hormone insulin, reacts with chemicals in the membranes of body cells, called receptors, thus allowing glucose to enter the cells and provide them with "high octane" energy. In the disease Diabetes Mellitus, insulin is deficient or defective so the entry of glucose into cells is impaired, and the glucose level in the blood rises. This rise of the level of glucose in the blood, is how we recognize the presence of the illness. But the more sinister aspect of impaired entry of glucose into cells, is that the cells are starved for energy. So they resort to chemicals other than glucose, such as fat, a source of energy that is less clean and more costly-in the metabolic sense- than glucose. Evolution has supplied us with tools to bear this added cost, but for only a limited extent, before permanent damage sets in and progresses. Examples of the ravages of long term poorly controlled diabetes, are damages to kidneys, eye-sight, nerves and arteries. By arterial damage I mean the accelerated hardening of arteries and damage to arterioles and capillaries thus narrowing and then closing them, causing strokes, heart attacks and loss of limbs.

Talking about damaged organs brings me to another requirement of life: that is the **Structural Integrity** of individual organs and of the body as a whole. Humanity has always realized the importance of this integrity, that mentioning it seems mundane. But this does lead to the question: (6)What is the structural integrity of an organ? What's an organ normally made of? An organ is made of tissues. (7)What's a tissue? A tissue is made of a group of cells that have similar chemical composition and function. Take the heart for example. The heart has an external cover called the Pericardium that is made mainly of fibrous tissue. Inside this cover is the main bulk of the heart called Myocardium that is made mainly of specialized muscle tissue that can beat without having to stop and rest like ordinary skeletal muscles. Then there is the thin lining tissue in the inner aspect of the heart called the Endocardium. We know that the myocardium is alive because it is contracting and relaxing repeatedly and pushing the blood to the entire body. But is the external covering of the heart alive? How is it different from the cellophane wrap of merchandise? What proof is there of its life? One indication is that when the Pericardium is injured, it repairs itself by forming a visible scar. Another is that the pericardium can produce fluid, with which it fills itself, thus choking the heart, unless that fluid is let out.

Central to our examination of structural integrity is the structural integrity of each individual cell, the basic unit of living things and the building block for larger organisms. (8)What's a cell? A cell is a three dimensional structure, a miniature of this room, surrounded by the cell membrane that totally engulfs the cell contents. We know the chemical structure of the cell membrane; it is two layers of a chemical called phospholipid and we know how the two layers are laid out. We know that,

unlike the cellophane wrap, a cell membrane is dynamic. It allows some chemical compounds and ions to come into the cell; and it keeps others out. It does that by the work of chemical compounds facilitating chemical reactions between these external molecules and molecules in the membrane of the cell. All this activity at the cell membrane, within the cell and outside it; all of it requires energy. Energy in biology is supplied chemically from energy-rich molecules such as AdenosineTriPhosphate, that are constantly formed by living cells, used-up by them and then re-manufactured by them.

Putting all these facts together, one can suggest that life is the continuation, the **sustainment**, the perpetuation or persistence of **interdependent chemical reactions** that support **activities**, such as breathing, that **we** associate with life.

The reason for the emphasis on “we associate” is this question: When breathing stops, and heart beating stops and brain activity stops, and hence death is diagnosed, do the chemical reactions stop? The answer is: Yes, chemical reactions that support life-sustaining activities stop. Also, the answer is NO, not all chemical reactions stop. Reactions that break down cell molecules and organ structures are present in the aftermath of life and are called decomposition or Autolysis, from which simpler molecules emerge and are used to feed and build other organisms. Feeding is followed by digestion, a chemical process that is the simplifying of complex chemicals. So autolysis is the simplifying- within the dead body- of complex body compounds, forming simpler ones that join the pool of chemicals in the environment. There is evidence that these facts were known to common people at least in the sixteenth century, when we got the statement:

*A man can fish with a worm that hath eat of a king,
And eat of the fish that hath fed of that worm.*

(Hamlet: Act IV, sc. 3)

Therefore, if I say that the essence of life is not the spirit, but is a bunch of chemicals whose components can be altered but never annihilated, then I have to accept what I questioned earlier, namely that the soul is indeed immortal; as the good books say. The slight modification is that whatever makes life, does persist but broken down and dispersed and not with the integrity heretofore awarded, without evidence, to the Spirit.

Importantly, what is the elixir of life? It is **WATER**, a chemical whose simple structure has long been known to humanity. And water, is the most required medium for chemical reactions. It has thus earned itself the title of Universal Solvent. **Water has been to life, as the wheel has been to civilization; each has been essential for its parent to move.** And water is the one chemical that scientist try to find, when searching for signs of life, in distant sites. AND, not surprisingly, water alone, comprises more than half the body weight of each of us. All other chemicals, combined, contribute less than half.

Realistically, a discussion of life requires a mention of death.

Death occurs whenever a vital organ is catastrophically knocked out. Individuals that escape those catastrophes, have their interdependent chemical reactions continue. Because these reactions are complex, eventually one of their components breaks down. Evolution has given us mechanisms that repair the break and so we continue on. But reparative processes are not exactly restorative. Repair occurs at a cost; the cost of getting a replacement that has less efficiency and inferior quality. An example is a heart attack when a small portion of the heart muscle is damaged, and that fancy, never tiring muscle is replaced by a scar. A scar does not perform contraction, and a big scar hampers the action of undamaged heart muscle, but still a scar allows for the continued work of the whole heart, albeit with reduced power. The cumulative effect of inferior replacements to single or multiple structures, big or small; eventually catches up with the vital organs and the chemical processes that sustain life. Death is thus the inevitable end, **of our concept** of life.