

Review: Understanding the Role of Time and Length Scale Concept Along with Quantum Concept in Biological Sciences

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ABSTRACT

Existence and survival of a biosystem is well organised and systemized. Changes in shape, size and behavior of biological matter, like, zygote, stages of embryonic development, early life stages, growth stages up to a full grown-up to adulthood and full life-span exhibit synchronized and chronological patterns. Even the normal dynamic steady state and various pathological states also represent the structural and functional state of biological matter. These indicate that the biomolecules, cells, tissues and the whole biosystem including the body fluids follow the principles of quantum mechanism within restricted physiological conditions. Prime biomolecular activities such as muscular functionality, coupling interactions, active transport, nervous action and conduction of nerve impulse, biosynthetic interactions, allosteric modifications etc., follow and correlate with time, amount of mass i.e., 'amounts' of reactants consumed, and the products formed involving exothermic or endothermic or molecular energy in a sequential manner. The energy provided relates with the kinetics of ATP and ADP cycle, and electron carriers. This presentation is an effort to understand and evaluate the role of concept of time length scale and also of quantum mechanics at biomolecular aspects.

Keywords: Biological Mass; Electronic Energy Transfer; Franck-Condon Factor; Harvesting Energy; Matter; Po-roelastic Nature of Cell; Rule of Fermi; Steady-State Dynamism; Resonance Energy Transfer

Overview

Biological mass is a systematically arranged simple atom that either singly or jointly performs specific communication between energy and time. One can observe conversion of mass in given span of time utilizing energy. One has to come down to smallest particle which participate or facilitate either accepting or releasing energy via these smallest particles and help in the formation of high energy rich molecules which in turn are used in a biological system and provide energy for molecular interactions, muscle contraction, respiration (releasing energy form molecules, photosynthesis trapping energy (solar, molecular, electrical, chemical) either from the ambient atmosphere. All these phenomena jointly represent life in a biological system. A non-living entity has either potential and kinetic energy in a wholesomeness and at atomic levels. It is observed that quantum

concept plays its role at sub-atomic level which in turn is physically visible exists in the ecosystem. If one observes then it is obvious that biological matter like any other matter exhibits and follows laws of physics like elasticity, energy kinetics, gravitational behavior, stress and strain response etc.

The 'time' is one of the basic functional components of the time and length scale concept. It also relates with quantum mechanism. The time scale indicates the duration of completion or achieving specific physiological or physical interaction or function. The evolutionary molecular status, organ of a biological system, involvement of 'energy' component in biomolecular compound, exchange of energy in the ecosystem, vibrations and bond formations etc., correlate with time and length scale. It may extend from a few moments to a billion years. This duration can be the extension from second (10^0), De-

ci-second- (10^{-1}) , Centi-second (10^{-2}) , Milli-second (10^{-3}) , Miro-second (10^{-6}) , Nano-second (10^{-9}) , Pico-second (10^{-12}) , Femtosecond (10^{-15}) , Atto-second (10^{-18}) , Deca-second (10^1) , Hecto-second, (10^2) , Kilo-second (10^3) , Mega-second (10^6) , Giga-second (10^9) , Tera-second (10^{12}) and so on. The second parameter is length (mass/amount), it represents the product of interaction or process, so, one can refer it as an entity having dimensions i.e., size (mass). Like second, meter unit of length is expressed prefix for length increasing mode is Deca-meter (10^1) , Hecto-meter (10^2) , Killo-meter (10^3) , Mega-meter (10^6) , Giga-meter (10^9) , Tera-meter (10^{12}) . The decreasing mode meter is expressed as Deci-meter (10^{-1}) , Centi-meter (10^{-2}) , Milli-meter (10^{-3}) , Miro-meter (10^{-6}) , Nano-meter (10^{-9}) , Pico-meter (10^{-12}) , Femto-meter (10^{-15}) , Atto-meter (10^{-18}) . These units express the decreasing and ascending of time and length.

The unit of length or mass represents products either formed or used/transformed such as atoms, molecules, cell-organelles, cells, tissues, organs, species, population, communities, ecosystem etc. These are the products of ionic, molecular interactions, synthesis, dissociation, steady state dynamic process, in the physiological, ecological, adaptive and evolutionary aspects (Lahir [1]). The concept of quantum mechanics illustrates the behavior of matter within the dimensions of microscope, but the general integrity remains some flaws which need more investigation. The current informations are more soundly placed on the concept of evolution which also exhibits some limitations. There appears to be a very fine line of demarcation between the quantum and classical regime. The biological processes and the application of the concept of quantum mechanism exhibit limitations of both these concepts. Basically, matter consists of animate and inanimate components. Biological sciences are among the one of applicative and demonstrable examples of quantum mechanics or theoretical physical-chemistry. In a biosystem, during the interactions, there is an excitation of electrons, protons, suitable bond formation, exchange of electronic charge among interacting molecules and attainment of dynamic steady state (homeostasis); all these phenomena follow the principles of quantum mechanics.

All these processes directly establish a bond formation involving electrons, protons, electrical charges and the sub-atomic or molecular excitation. Further, these features have specific significant functional dynamics based on the quantum mechanism. The resultant entities decide the structural and functional features of the higher organizational levels in a biosystem and these higher levels are referred to as 'biomolecular complexes'. Their interactions are relatively better understood based on the principles of quantum biology (Kristian [2]). Assuming, cell as mass and its performance to achieve inter and intra molecular functions and the respective behaviours indicate their interface status which behaves following principles of physical, chemical and biological sciences. The matter of the cell shows physico-mechanical features which in turn influence the respective cellular biological events (Li, et al. [3]). The expression of a biosystem of any

evolutionary level, is the result of the time and length scale concept. This conceptual phenomenon relates with the mass of its own (Lahir, 2016). This mass is the aggregation of molecular elements organized in a well-knit system and mostly utilizes solar and/or chemical energy. This energy influences the status of the matter, its sub-atomic and molecular behavior which in turn is the expression of any biological phenomenon.

These features indicate the conglomeration of time, mass and steady-state dynamism (Lahir [4]) which responds to the environmental parameters like temperature, light, internal as well as external energy (Lahir [1,4]). The process of receiving energy and releasing energy and its impact on matter can be understood, at least partly if not completely, on the basis of principles of quantum mechanism. The role of quantum mechanism is obvious but needs investigation in more depth. The interactions of matter energy seem to be very complex but are the probable means of understanding biological, physicochemical and inter and intra cosmic impacts. The processes such as molecular excitation, sensing, responding, conduction of impulses, trapping solar-energy (photosynthesis), releasing energy (respiration), protective responses to infection, toxic xenobiotics (immune responses) relate and function in accordance to the concept of quantum mechanism. The working principles of physicobiological phenomena are ambiguous and need more deeper study. To achieve thorough understanding of the physicobiological phenomena one has to develop more sophisticated technology which helps to observe these principles. This need of developing technology is the result of the inabilities of the classical principles of basic sciences like chemistry, physics and life sciences to explain the intricacies of living and non-living.

The conscientious efforts of many years have brought forth the cytological information that proves to be the most significant structural, functional, physicochemical and biophysical entities. In general, a biological cell has size of ~ 10 microns in diameter and ~ 1 picoliter in volume, encompassing about 42 million proteins, 3.6 million messenger RNAs, and 20 to 30 thousand genes. These miniscule dimensional entities are capable to host and provide suitable space and physiological environment that promote the innumerable reactants and the final products of the such innumerable biomolecular interactions and facilitate the maintenance of physiologically favorable medium for the respective cellular functionalities. Further, there are receptions and transmission of signals (cues), biosynthesis, keeping toxic and xenobiotics free inter and intercellular environment and provide suitable sites for translational and transcriptional processes, epigenetic modifications, trapping energy and maintaining energy balance etc, in these entities. More so, the intra and intercellular functions proceed and sustain the specific cell shape, cell division, structural and functional fate including intercellular and immunological interactions along with senescence is amazingly maintained for the specific duration. There are cytological changes takes place within a cell, like arrangement and size or shape of internal organelles during

embryonic stem cell differentiation, cell division and differentiation, cytological deformability, specifically, when cells encounter pathogenic conditions like malignancy, or stem cells undergoing differentiation. In a normal cell, the specific spatiotemporal pattern among the cytological organelles are very striking and conspicuous features; these gets disturbed in any abnormal functional, surviving and pathogenic state [Lahir, et al. [3,5,6]].

It is obvious that biological mass is the systematic accumulation of chemical elements and their behavior is based on the principles of theoretical chemistry and quantum mechanism. When the sub-atomic components interact in relation either light energy (or radiation energy) result in either formation or breakdown to next level of organization, at least in a biosystem. Impacts of quantum mechanism are very obvious in a biological interaction (Figure 1). In these interactions are

observed in processes like role of electron and proton during respiration, photosynthesis, most of the physiological aspects of sensory, transduction and response related processes. Any agency like intensity of light radiation, magnetic field etc., that can influence the status of electron and proton is capable to affect the state of quantum mechanism. The works of Preston Snee, (<https://libertext.chemistry.org>) elaborate the electron and proton tunnelling phenomenon influences and affects the distance related effects of protein and electron; this phenomenon is affected due to ambient temperature, strength of magnetic field, resonance impacts the position of these sub-atomic particles. The quantum particles have ability to tunnel through barriers as these have negative kinetic energy; the kinetic energy elevates when trapped and a change in their size, result is in change in colour (Preston [7]).

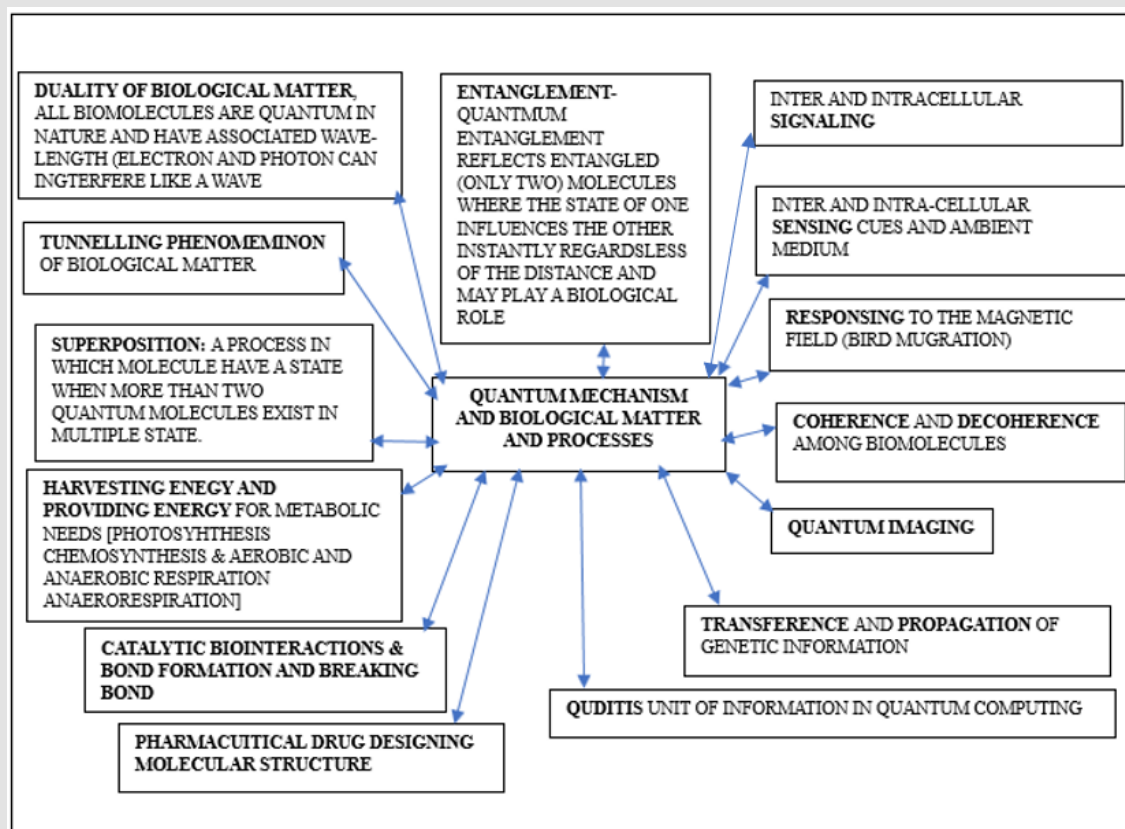


Figure 1: Applications of Quantum Mechanism in Biological Matter and Biosystem.

All biological processes specifically, enzyme, molecular interactions, photosynthesis, respiration etc, utilize energy to accomplish their specific functions. The absorbed energy gets shifted to the energy sensitive molecules which get excited and this excitation-energy is transferred to the electrons and/or protons (hydrogen ions) and these electrons and/or protons move on to the respective acceptors (intermediate products one get oxidized and reduced) as these interactions proceed towards the completion providing energy in the molecular form (Brooks [8]). Basically, biological interactions involve the 'principle of rate' (rate equation) and have a pigment, more precisely, ligand/odorant/flavin which need protein ambient environment (Brooks [8]). The most astonishing aspect of this protein medium is that it remains stable i.e., it does not get either camouflaged or structurally and functionally disorientated. This set up follows Golden rule of Fermi; this basic concept facilitates to understand quantum effects. During biological system phenomenon interactions, either energy transfer takes place or charge is shifted which results in change from one state to another following the principle of rate of transition, also referred to golden rule of Fermi.

$$RATE(D \rightarrow A) = 2\pi\hbar X[HDA]^2 X\rho$$

The rate of transition from donor/reactant/initial state (D; initial molecules which donates transition particle) to product/final stage/acceptor (A; final molecule it accepts the transition particle); ρ represents density of the state of the acceptor the transferring particle (also called Franck-Condon factor-FC factor); $\pi\hbar$ represents Plank Constant, the quantum of action; while HDA represents Hamiltonian transition matrix, (it is the site of tunnelling phenomenon). The transfer of electron and proton takes place between initial Donor (D) (reactor) and the final acceptor A (product) this transfer accomplished within protein environment; may be complex having small molecule and belongs to substrate, odorant or chromophore. This transit exhibits varied degrees of quantum definition such as electronic state and/or nuclear state. The 'configuration coordinate' appears to be one of the common effective means to describe the transfer (Gray, et al. [3,8-10]).

Viscoelastic Nature of a Biological Cell

Viscoelasticity represents the mechanical signature of a cell. When a biological cell is treated with high frequency force and short time scale (duration) it acts as an elastic solid. When it is put under low-frequency or comparatively slow loading, it acts in moderate manner and maintains its viscous nature (Zhu, et al. [11-13]). The viscoelastic nature is of functional significance during cellular physiological and pathological conditions like cell migration, embryonic development and diseases like cancer. Such investigations are carried out using techniques like step displacement and creep test. Such methodology helps to find relaxation time, material constant (elastic modulus, and viscosity). Alternatively, dynamic mechanical measurement can be applied to characterise rheological properties of a cell. The parameters considered are input i.e., strain and stress; these are

applied to with some frequency and the output is noted. The specific ratio between the stress and strain is observed and it gives the elastic modulus (initial value) and the loss modulus (final value). Under normal conditions, the elastic modulus has higher values as compared to the loss modulus (frequency range ~ 0.3 Hz and above) and is related with apparent relaxation time w. r. t. biological cell (Hu, et al. [3,13]).

Cellular viscoelasticity correlates with its physiological status and cytoskeleton and it fluctuates when cell is in normal status or under the pathological impact. Hence, cellular viscoelasticity acts as a mechanical signature of a cell. The major three bipolar components of mammalian cytoskeleton act as functional participants; filamentous actin (F-actin) and microtubules, their performance involves continuous reorientation and repolymerization (Lahir [14]). Any deviation in the orientation or disturbance in the filamentous actin (F-actin) and microtubules softens the cell and affects its status of viscoelasticity. The intermediate filaments respond slowly to any change in their orientation and help to retain the original orientation maintaining original mechanical integrity of the cell. This feature also retains the cellular stretchability, strength, toughness (Yamada, et al. [3,15-19], Huet al., 2019).

Poroelastic Nature of Biological Cell

The structural and molecular organization of a cell is very similar to a biphasic solid material; the cellular porous configuration is well soaked within cytoplasm and external fluid (interstitial fluid). These both fluids are in constant dynamic steady state and maintain specific turgor state of pressure providing turgidity and viscous nature to a living cell (Li, et al. [3,14]). The synthetic hydrogels also possess such properties and exhibit similar behavior; this nature is referred to as poroelasticity. The basis of the feature of hydrogels depends on the redistribution of the background fluid present in the system, it gets more pronounced when the hydrogels undergo experimental deformation. The parameters like viscoelasticity, poroelasticity exhibit correlation with length scale (degree) of deformation. Similar functional viscoelastic and poroelastic behavior has been reported in case animals cells too. (Zhu, et al. [3,11,20,21]). In such cases, the a specific correlation between the mechanical response of cells and the movement of cytosol through cytoskeletal mesh-work; such correlation is common a characteristic feature in case of animals cell as seen in poroelastic hydrogel. The pressure of the fluid present within the porous matter affects its viscoelastic behavior. Similarly, there is a 'mechanical response' of the cytosol present within the cell as a matter and its mechanical behavior on being deformed, specifically. the moving cell within circulation in the body fluid.

The comparison of duration (time scale) of initiation of poroelastic pressure (deformation-tp) and time of relaxation of poroelasticity pressure (regaining original shape-op) and the total time poroelastic pressure T or L-length of time, represents the cellular mechanical response. It is worthwhile to investigate probable cellular mechanical state of live normal status and cell under pathological state, poroelas-

tic response, pure viscostic and elastic responses of the standard fluid, this fluid represents the cytosol and interstitial fluid (for comparison with the fluid understudy). Other parameters that affect poroelastisity are cellular mechanical properties, nature of cytosol and interstitial fluids, fluctuation in respective volumes, state of molecular crowding in the fluid and the cell under consideration and its rheological behavior. The parameters like elastic module of the after deformation in the cytoskeleton, pore size formed in cell by cytoskeleton and the viscosity of cytosol can also influence the poroviscoelastic behavior of a biological cell. The poroelastisity of a biological cell also relates with hyper/hypo osmotic pressure, pore size in cytoplasm, cell volume, state of molecular crowding in the cell, declined fluid influx, and components of cytoskeleton i.e., F-actin and intermediate filaments and myosin present in study medium. All these parameters influence the cellular poroelastic behavior. (Moeendarbary, et al. [3,21]).

Biological Cell is a Nimble and Agile Unit of a Biosystem

Biological cells are physico-biomolecularly active entity which exhibit fluctuations not only from thermal equilbrial aspects but also from the rate of hydrolysis of adenosine triphosphate (ATP) aspect. The cellular cytoplasm sets various varieties of forces that result-in fluctuations in the cellular thermal equilibrium. Most of these forces provide energy to operate molecular- motors such as kinins, dynein. These motors bring about the directed transportation of various molecule with a cell (cytoplasm) using microtubules as tracks. Myosin-II motor effectively cause contraction actin filaments (Alex Mogilner, et al. [3,22-25]). The coordinated efforts of these motors along with processes (fluctuations) within cytoplasm are responsible for the cellular contraction, division and migration (Li, et al. [3]). Fluidization is an important cellular feature and ensures the shift of cellular molecular solid like state of cellular tissue to the fluid like state of tissue, more specifically, during cellular mobility. Fluidization is a tendency of a biological cells specifically when subjected to shear or stretch and regain normal status after the shear or stretch is removed. In this behaviour entangled F-actin solution, myosin-II seems to play specific role. The most suitable example is of myosin-II, which controls the viscoelastic behaviour of entangled (meshed) F-actin solution. The process of interaction between myosin and actin reduces the time of viscoelastic relaxation of an entangled F-actin solution; probably, this process causes the longitudinal motion of actin which is under the influence of myosin-II mini-filaments (Humphry, et al. [26]).

In all probabilities the cellular fluidization process influences dynamics of inert-glassy system, like hard colloids behave under soft-glassy rheology concept (Fabry, et al. [3,27-30]). In all probabilities, the molecular richness of cytoskeleton contributes to the transition of glass to the glassy-matrix appearance (Doyle, et al. [31]). The active and effective cellular functionality and its total metabolic status are in accordance with the aggregated efforts and incoherent ever-changing impacts of the forces within cell. The apparent intracellular movements of the organelles and exogenous inert entities are the reflection

of congregated effect of ever fluctuating intracellular forces which resemble the Brownian movements. These so-called hidden forces are very important with respect to the normal and pathogenic cellular states. Thus, there is a need to quantify these alterations based on the 'force spectrum microscopy' that quantify such forces in a dynamic biological cell. The observations indicate that these forces increase or deviate from the normal status during cellular pathogenesis reflecting the cytoplasmic intense activity. The investigations based on optical-tweezers on active micro-rheological aspects reveal the cellular non-equilibrium state and exhibit low frequencies less than 5Hz ($f < 5\text{Hz}$) which correspond to longer time scale up to more than 0.2s ($t > 2\text{s}$) (Gupta, et al. [3,32]). Although, under the force spectroscopy microscopy, the fluctuation of spectrum of forces overlaps with the frequencies of thermal noise of higher frequencies. This concept is applicable in the practical purposes to determine spontaneous fluctuations at high frequencies. This concept is also useful to distinguish normal cell and cell under pathogenesis (Li, et al. [3]).

Each living being is an aggregation of inorganic and organic elements arranged in a specific conformational pattern and performs actions for its survival. In all probability, inorganic and organic biocomponents appear to exist in a three-dimensional geometric space-Hilbert space or Euclidean space, within dynamic biosystem. These basic structural and functional components exhibit changes in their quantum states with respect to 'time-evolution', 'quantum transition' and 'transformation' in their quantum status (Prugoveck [33]). These functional efforts are physiological, psychological and energy related. Mostly, this innate ability of survival associates with the proficiency to utilize energy and it relates with the concept of time, length (mass) and quantum principles. Every biosystem is dynamic and capable to interchange matter and energy constantly. This interchange of energy is internal and between a biosystem and its ambient environment which in turn relates with ecosystem. Each biosystem is in non-homeostatic state and always makes an effort to attain homeostatic state. This effort is dependent on the relative variations in the physiological, environmental, degree of discernment and psychological conditions of the biosystem (Lahir [14]). This effort is energy based and depends on the related ability of the individual biosystem. The dynamic tendency relates with the capacity to interchange energy and matter at all scales. Further, quantum principles illustrate these types of interactions more convincingly. The quantum mechanism involves nanoscale and/or sub-nanoscale interactions and the fundamental life functionalities are better expressed based on the concept of quantum mechanism. The incorporation of energy into biosystem and its dissipation is a fundamental live process. This reflects on the wave-like efficacy of the matter which exhibits quantum coherence in between the physical quantities manifesting wave like-nature.

Role of Photosynthesis and Respiration

Life processes such as photosynthesis and respiration, maintain a specific level of harvesting or transference of energy, charge, en-

zymatic biointeractions, encoding of information, sensation and responding with respect to cues/stimuli are basically related to quantum technology (Brookes, et al. [8,34]). In spite of the theoretical and practical significance of quantum mechanism, it seems to be unable to integrate with common relativity in the field of biological science (Tuhin [35]). There is a need to find more apt correlations between energy and biological matter; there is a possibility that each biosystem has a well-defined quantum of energy with respect to its mass. This energy quantum undergoes cyclic harvesting and transference process in the ecosystem. The birth and death of a living-being, provides a biological entity to be a part of a part of this cyclic process which plays its role in maintaining balance of time, mass and energy quanta. The processes of photosynthesis and respiration are directly concerned with the concept of time, mass (length) and quantum mechanism. their evolutionary status varies at different levels of cellular organizations in the biotic aspects of earth ecosystem. The mode and intensity may vary in different biosystems but the nature of both these processes are dedicated to harvesting solar energy although artificial energy causes some deviations but the concept remains constant. The most common feature of both these processes is that they are accomplished in a systematic mode of harvesting and releasing energy in a stepwise gradual manner.

Both of these processes involve oxidation and reduction process which facilitate the shift of electron for electron donor to electron acceptor. This exchange of electron consumes and liberate energy (photons) and used to form a molecule of energy molecule, Adenosine-tri-phosphate (ATP). The energy molecule is capable to provide energy needed for the physiological activities of an organism. Basically, biosystems containing photosynthetic pigments can perform the act of photosynthesis; the pigments may be enveloped in a well-defined organelle or dispersed in cytoplasm. Carbon-di-oxide, water and energy (light as photon) are utilized from the atmosphere; there is an (e^-)electron donor (hydrogen) provided by hydrolysis of water in presence of solar energy (photo-hydrolysis of water; harvesting energy); further reaction results in the formation of carbohydrate, oxidized electron (e^-), oxygen and water. [Water participates as a reactant as well as product in this reaction]. The process photosynthesis is accomplished as light-dependent reaction (light reaction) and other part is light independent (Dark reaction). In light reaction NADP is the hydrogen carrier and ATP acts as energy storing molecule. In dark reaction carbon-di-oxide gets reduced and carbohydrate is formed via Calvin's cycle (C-3 cycle). The photosynthetic pigments, mostly, are able to utilize visible light spectrum (400 to 700nm) but can draw energy from short-wave light radiation like infrared range (700nm to 1mm) (Shimakawa, et al. [36]).

The role of light-harvesting-complex is a key factor during photosynthesis. This complex aggregates in the vicinity of photosynthetic reaction center and trap more radiating (solar) energy in comparison to reaction center alone. Thus, this set-up enhances the overall efficacy of the capturing capacity of light-harvesting complex. This trapped solar radiation (energy) excites chromophore molecules from the ground level (unexcited state) to temporary excited stage. The process of Förster Resonance Energy Transfer system plays significant role during this process (Warner [37]). This energy transfer system is also called by different names, like Förster resonance energy transfer (FRET), fluorescence resonance energy transfer, resonance energy transfer (RET) or electronic energy transfer (EET). This process explains the mechanism of shift of energy between two light sensitive molecular referred to as chromophores. Initially, the donor chromophore molecule attains an excited state and possibly transfers energy to transfer the energy to the acceptor molecule. There develops a 'non-radiating dipole-dipole coupling process'; (there exists intermolecular force (IMF/secondary force) which plays functional role during the interaction between the two molecules. These forces include electromagnetic forces of attraction and repulsion between the interacting molecules which are responsible for the interaction between the two. Intermolecular forces are comparatively weaker to intramolecular forces. Thus, hold the molecules together.

The covalent bond between atoms is due to the sharing of a pair of electrons, is stronger than the forces present between the neighbouring atoms or molecules. These two sets of forces participate in 'force fields' and are utilized during molecular mechanics). The FRET process is very efficient because efficiency of energy transfer is inversely proportional to the 6th power of the distance between the donor and acceptor molecules (Figure 2) (Helms, et al. [38,39]). Respiration is a step wise process which provides energy in a biosystem so that appropriate physiological activities are maintained and the biosystem remains unharmed. It is a complex process and is accomplished via these sub-processes namely, glycolysis a process in which 6C-carbohydrate is broken down to a 2C compound-pyruvate followed by the formation of acetyl Coenzyme in cytoplasm. This 2C compound enters TCA cycle and mitochondria. In this cycle there is a use of nicotinamide adenine dinucleotide phosphate (NADP), flavin dinucleotide phosphate (FAD) and are converted into NADPH and $FADH_2$. During oxidative phosphorylation these biomolecules transfer the electrons to the 'electron transport chain' and finally releasing ATP and water molecules. This transfer of electron and H^+ involves redox reactions, cytochrome systems and ubiquinon co-enzyme; finally, H^+ under goes oxidation (terminal oxidation) and interacts with oxygen forming water molecule. This process involves F-1 particles present on the inner phase of mitochondrial wall [40-42].

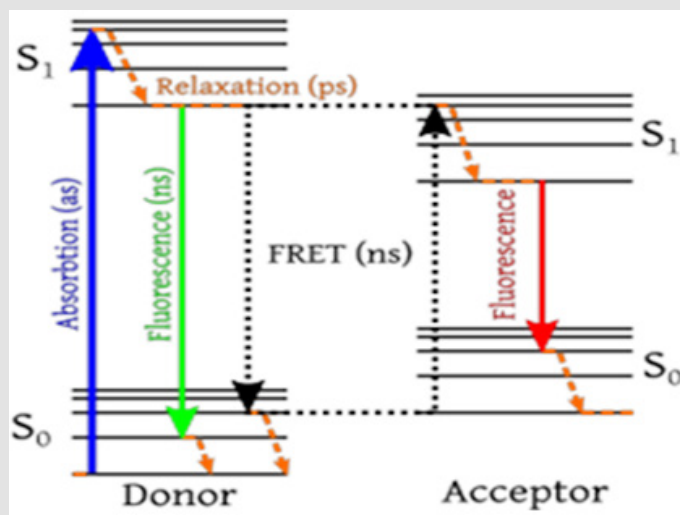


Figure 2: Diagram for Förster resonance energy transfer also referred to as Jablonski diagram. It elucidates the electronic status, the vibrational levels of give molecule and the transition occurring between the molecules.

Lipids and Proteins as Sources of ATP

Lipids and proteins also participate in the process of respiration under very specific conditions like extreme physical exercise and starvation or malnutrition. Lipolysis prepares lipids for the production of acetyl Co-A i.e., lipids are converted into fatty acids and glycerol and this process is accomplished in cytoplasm. The fatty acids undergo β -oxidation and form acetyl Co-A to be used in Krebs's cycle. The glycerol participates in the glycolysis pathway in the form of DHAP (Dihydroxy acetone phosphate). Glycerol in the form of glycerol-3-phosphate is converted into DHAP due to the action of glycerol-3-phosphate dehydrogenase. To participate in glycolysis the fatty acetyl Co-A has to reach the lumen mitochondria. This biomolecule is treated with carnitine and fatty-acyl-carnitine is formed; this molecule readily enters the mitochondrial lumen. Here, it is converted back into acetyl Co-A and enters the Krebs's cycle. During starvation, the amino acids do participate in the production of ATP. As the breakdown of body proceeds the body proteins are broken down into amino acids. These amino acids are used in the production of glucose or the intermediates which take part in the citric acid cycle (Krebs's cycle) as its functional components. The conversion of amino acids into glucose is accomplished via gluconeogenesis. The amino acids formed as a result of enzymic digestion of proteins can participate in energy pathway; before this participation their amino group is eliminated by deamination. Alanine amino acid after deamination changes into pyruvate; aspartic acid changes into oxaloacetate. These products take part in energy cycle in biosystem.

Role of ATP in Biosystem

ATP (adenosine triphosphate) is energy currency formed from oxidation of carbohydrate, lipids and proteins. All biological activities

depend on this energy storing and releasing biomolecule. Activities like muscular, coupling interactions, active transport, conduction of impulses through nerves, biosynthetic interactions, allosteric modifications etc. This energy is provided when the phosphate-bonds break. When ATP is hydrolysed into ADP one phosphate group is released and 7.3 kilocalories or 30.6 kilojoules per mole under normal conditions (7.0 pH, body temperature). The interconversion of ATP and ADP is intracellular process.

Conclusion

In a conclusion one can investigate formation, development and growth of a biosystem and functionality of biomaterials and their relation with time, and mass formed and accumulated differentially in due course of time. All biological processes follow the concept of time and length and the energy utility relates with quantum mechanism. The nature of biological matter and functionalities surprises as it exhibits characters like elasticity, poroelasticity, viscoelasticity, and very extended ability of adaptation. There is a need to find more apt correlations between energy and biological matter; there is a possibility that each biosystem has a well-defined quantum of energy with respect to its mass. There is a need to develop more suitable technology on matter and its behavior to illustrate correlation between matter and life.

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Conflicts of Interest

The author declares no conflict of interest.

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