Self Gravity: The Major Investigation Gap in Life Science (Part II)

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Abstract

In part I of the article, it is conceptualized that biomass accumulated through photosynthesis and other build-up mechanism within volume of secluded structure serve as foundation. Build up and break down mechanism through anabolism and catabolism of metabolic energy causes a change in the amount of mass per unit volume at particular instant leading to contraction out of self gravitational potential energy and relaxation due to inertia plus kinetic energy of metabolic activity within volume of membrane bound mass. Metabolically inert infrastructure or buoyant force of fluids secludes self gravitating body from external stronger gravitational field and helps to maintain self gravity's free fall condition. With collapse of equilibrium between contraction and relaxation of self gravity, stronger force of extrinsic gravity makes living mass inert non-living.

Under the principle of abductive reasoning through successive approximation on sporadic set of observations, roles of self gravity on identical astrophysical principles of larger mass have been conceptualized. Faster growth of heavier cells, adjustment of mass-to-volume ratio, 'macromolecular crowding' and 'anomalous sub-diffusion', bilateral symmetry and convectional morphogenic development in animals, genetic and structural sophistications based on mass, isostatic balance in plant and animal, rhythmic pattern of growth, mimics of contraction-expansion phases, decline in biological growth rate with increase in mass were explained through potential gravitational energy and kinetic metabolic energy. Plant spacing and gravitation, mass balance in plants, biotensegrity, 'tight' and 'relaxed' mechanism in endothelial cell junctions, fetus or self gravity friendly postures for load distribution during prolonged space journey, physiological crisis on withdrawal of inertial gravitational anchor in microgravity including affect of interactions of self gravity and planetary gravity on evolutionary process, presence of self gravity at mesoscopic length scale and importance of designing biological structure on making 4D Architectural Information Modeling (4D AIM) for visualizing entire duration of construction events were discussed.

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Introduction

In part I of the article, it is conceptualized that biomass accumulated through photosynthesis and other build-up mechanism within volume of secluded structure serve as foundation. Build up and break down mechanism through anabolism and catabolism of metabolic energy causes a change in the amount of mass per unit volume at particular instant leading to contraction out of self gravitational potential energy and relaxation due to inertia plus kinetic energy of metabolic activity within volume of membrane bound mass. Metabolically inert infrastructure or buoyant force of fluids secludes self gravitating body from external stronger gravitational field and helps to maintain self gravity's free fall condition. With collapse of equilibrium between contraction and relaxation of self gravity, stronger force of extrinsic gravity makes living mass inert non-living.

Under the principle of abductive reasoning through successive approximation on sporadic set of observations, some more evidential roles of self gravity on identical astrophysical principles of larger mass have been conceptualized that are appended in the present article. We are going to present these in the following paragraphs.

Morphometry and Self Gravity

1. Paradoxes in biology- Why all living species are in spherical symmetry?

Why all living species starting from tiny bacteria to giant animal in natural world are more or less in the pattern of gyrate shape in their overall morphometry? Why round or spherical in pattern- why not rectangular or square? With the development of branches or with the growth of neighboring plants, the canopy becomes spherical in shape. The human body- head, hand, leg etc. are all in spherical pattern, starting journey from spherical shaped eggs. Tips of fingers, flowers or inflorescences are all in spherical symmetries[1, 2] (*Illustration 1*).

2. Is surface tension responsible for forming spherical symmetry in biology?

It is generally argued that surface tension is responsible for forming spherical water bubble, as sphere tends to occupy the minimum surface area. It however failed to satisfy me on witnessing many observed facts from the nature. For example, traditionally rice farmers put two to three rice seedlings in a bunch while transplanting in the main field, keeping 15-25 cm isolation between bunches. After the end of vegetative phase or at the end of reproductive phase, one can notice that the canopy of three seedlings coalesce and form a single top-round canopy. Why the middle one gets taller than the neighboring two on synchronization? All rice plants are of same age and same genetic constitution. Nutrient

availability is also same for all plants, since they are in the same spatial zone of the soil. Bending of plants towards source of light under indoor condition or the effective spectral region triggering phototropism in between 350-500 nm i.e. the blue region of the spectrum is also not found to be beyond the threshold limit under such open field condition. After studying various biological phenomena meticulously, it is therefore felt that without the presence of an invisible force, such spherical geometry is beyond any possibility. How unconnected seedlings develop in orchestrated manner with common understanding that middle one will be finally taller than the plants positioned in its side? It cannot be due to surface tension, as these plants are not inter-connected physically. Let us think that the two neighboring plants attract each other, as if they are situated within the sphere of individual's gravitational field or within gravity barrier. Position of centers of such individual self-gravitating entity goes on changing with consecutive accumulation of mass. Roots are denser than shoot on equal volume basis. A rice plant at the vegetative phase was photographed. The angle between tangent and radius from the common centre of self gravity remains equal due to action of self gravity (*Illustration 2*). The vacant space towards root would be filled up during next phase of growth out of isostatic balance. Of course there may be some variations due to local perturbing effect. Thus it is clear that self gravitational attraction pulls down the canopy of the neighboring plants to a single spherical entity with taller plant in the middle and not surface tension.

From the aforesaid observations, it appears that site specific localized cell-surface-adhesion like talin-integrin interactions etc., for instance, cannot be a substitute to the invisible binding action of self gravity, so far biological objects as a whole are concerned.

3. Symmetry in morphological structure in plant and animal

All animal cells are composed mainly of a protein called actin (often referred to as one of the muscle proteins). Actin is a polymer of polymers. Globular actin polymerizes and stabilizes to form semi-rigid filamentous actin which exists in high concentrations in the cell cortex. The cell cortex gives the cells their rigidity, while its deformation plays a crucial role in helping the cells to move along surfaces. In case of plants, the situation is little different. Ferulic acid (Trans-4-hydroxy-3-methoxycinnamic acid) a phenolic compound is present in the cell wall. It promotes formation of side bonds between different chains in polymer cell wall, which increases the adhesion between neighboring components. Cross-linking

provides good "sticking power" between primary cell walls. The capacity of adhesion of plant cells with more rigidity and strength could possibly make all the difference in morphology of plant and animal[3]. Direct effect of geophysical force predominates in the expression of the root development of plant making the plant symmetry of a cone in contrast to bilateral (mirror) symmetry in animals[4,5] (*Illustration 3*).

4. Bilateral symmetry and convectional morphogenic development in animals

The explanation of the developmental genetics[6] is that "bilateral symmetry is 'necessary' for balance with respect to gravity and for coping with resistance by the medium-air, water or the land surface through or over which the animal moves". Such explanation is difficult to digest considering 'other necessities' of the animal for coping with nature like having 'third eye for visibility of the rear scenario or a hand in the back side for multipurpose works'. Such anomalous hypothecation cannot be accepted as there should be a physical cause for each and every development.

Though dictated by gravity, the earth is not completely round or spherical; there are continents, ridges, trenches, ocean and mountains. The British geologist Arthur Holmes[7] was among the first to propose that thermal convection active in the mantle of the solid earth as the driving mechanism for continental drift, the evolution of oceanic ridges and trenches, formation of mountains and other geo-morphological structural features of the earth. The modern unified theory based on convection flow[8] provides explanations for almost all the major crustal processes of the earth. In biological system, mimics of convectional flow have been observed.

Before tissue hardening in plants or before formation of bones and cartilages in animals, a species pass through rheological fluid or soft condensed matter state. Stored chemical energy in the living cells might provide requisite heat energy. Similar to development of geomorphic structural features of gravitating body like earth due to convectional currents, thermal convection active in the embryo can be thought to be the driving mechanism for development of bilateral symmetry.

Similarly thermal convection active in the embryo can be theorized as the driving mechanism for development of bilateral symmetry and morphogenic development in animals. During gastrulation phase of embryonic development in animals, there are two or more layers of cells. These are ectoderm externally, the mesoderm next to this and the endoderm on the inside. The rearrangements by which these germinal

layers come to occupy these positions vary considerably between animal groups. The ectoderm is the origin of the epidermis and the nervous system, the mesoderm is the source of muscles, the circulatory system, the lining of the body cavities and sex organs, excretory system and most of the skeletons. The endoderm forms the gut and its associated digestive glands and a variety of other organs. At certain temperature difference between inner and outer, more specifically between different layers of cells in the germinal layers, the motion of the soft condense matter sets in, as the thermal expansion lowers the density of the inner fluid from the neighboring portion. Warmer and comparatively lighter fluid produces a fountain type convectional flow pattern[9] within the bounds of self gravity, depending upon respective polymeric constitution and rheological (soft condensed matter) property of the fluid. Formation of irregular shaped vertebral column occurs in animal which can be explained through application of principles of rheological engineering. During phase transition from fluid to solid, more specifically due to time-temperature shifting property on shearing, the extrusion flow instability occurs when velocity of fluid flowing in a tube like structure exceeds certain critical value leading to what is called 'melt fracture instability' in rheological engineering[10]. At neurula stage, the ectoderm gives rise to the central nervous system in convectional flow pattern. Sensory organs and the brain are connected at the fore-end. Mesoderm gives rise to a regular flow of circuit in blood vascular system in a convectional manner. Other organs including limbs, eyes are formed in same convectional manner (*Illustration 4*).

5. Why quantity of mass is important in manifestation of all symmetries?

In small mass, there is no 'fountain effect'- only 'central tendency' in overall structure. Is there any similarity in the differential transport mechanism of internal energy in the stars according to variation in the quantity of mass in the star can be extrapolated in the variation of structure in the living world? Let us examine the energy transport mechanisms in stars. Different layers of the stars transport heat up and outwards in different ways, primarily convection and radiative transfer, but thermal conduction is important in white dwarfs. Convection is the dominant mode of energy transport in stars when the temperature gradient is steep enough so that a given parcel of gas within the star will continue to rise, as if it rises slightly via an adiabatic process. In this case, the rising parcel is buoyant and continues to rise if it is warmer than the surrounding gas; if the rising particle is cooler than the

surrounding gas, it will fall back to its original height[11]. In regions with a low temperature gradient and a low enough opacity to allow energy transport via radiation, radiation is the dominant mode of energy transport.

6. Sequence of internal structure of living body depends on mass

In solar mass stars (0.3–1.5 solar masses) have radiative cores with convective envelopes in the outer portion of the star. In massive stars (greater than about 1.5 solar masses), have a radiative envelope. The lowest mass main sequence stars have no radiation zone; the dominant energy transport mechanism throughout the star is convection. Giants are also fully convective[12].

Therefore, it can be seen that various transport mechanisms in a star is dependent on the quantity of mass as per gradation as low mass, intermediate mass and high mass stars. Can there be any possibility of generating such possibility in the mesoscopic world where the materials are mostly soft condensed matter at the formative stage? This needs thorough examination in the light of presence of intrinsic gravity in biological micro world.

At least various circumstantial evidences support the idea, especially in case of exothermic and endothermic living organisms. Endothermic animals are able to generate their own heat to keep themselves warm while ectothermic animals rely on the sun to keep themselves warm. It is to be noted that because of historical accident, people encounter a source of possible confusion between the terminology of physics and biology. Whereas the thermodynamic terms "exothermic" and "endothermic" respectively refer to processes that give out heat energy and processes that absorb heat energy, in biology the sense is effectively inverted. The metabolic terms "ectothermic" and "endothermic" respectively refer to organisms that rely largely on external heat to achieve a full working temperature, and to organisms that produce heat from within as a major factor in controlling their bodily temperature. An exothermic organism is cold- blooded and it's body temperature shifts depending upon the temperature of its surrounding environment, for example a fish. An endothermic organism is a warm blooded organism that maintains a certain temperature inside the body no matter what its surrounding environments temperature is, for example humans.

So we invite a thorough study on the issue of thermal convection as internal energy transport mechanism in living world based on mass. In *Illustration 5*, we have tried (at least arbitrarily through pictorial means) to

establish internal energy transport mechanism in living world, categorizing frog as high mass, butterfly as intermediate mass and bacteria, amoeba as low mass, considering convective transport mechanism from high density to low density as warmer and from low density to high density mass as cooler. Hence it can be considered as gap area of investigation to explore morphological variations in the living world.

7. Genetic sophistication varies with mass and volume- parameter for gravity

Genetic sophistication of the biological bodies is influenced by 'mass and volume', a parameter of self-gravity. In bacteria and blue-green algae, the nuclear material is not separated from the cytoplasm by a discrete membrane whereas it is so in majority of multicellular organisms. The entire virus consists primarily of viral genetic material enclosed in a proteinaceous envelope. Viroids, very small particles, appear to consist of genetic material alone and lack enclosing membranes. The prion which is about 100 times smaller than the smallest viruses, contain a spherical shell of protein only. Prion can reproduce in the living cell, yet no DNA or RNA has been found in them.

8. Whether a living organism is a gravitating body or not?

Primary characteristic of self-gravitating body is its centre having a boundary of attraction, as gravitational force is a function of the radial distance from the core. In thirty one day human embryo, heart, the first body organ to be functional, occupying the central position, acts as core. (*Illustration 6a*). Human cardiovascular system consists of the "pump" (heart), "pipes" (blood vessels), and "control system" (nerves, hormones, and local factors). Pump in and pump out action can therefore be expected from the stress exerted on and away from the core of a gravitating body. Central position (core) changes from heart to abdominal portion with consecutive accumulation of mass with passing of age (*Illustration 6b*). Pump system of the heart once commissioned remains intact for life. It could give a clue that why there is a strong correlation between central obesity and cardiovascular disease. Because due to disproportional increase in mass at the central position (abdomen) disturbs the gravitational load bearing capacity that pump in and pump out action of the heart carry forward.

9. Isostatic balance in a gravitating body also operates in living bodies

Isostatic balance i.e. balances between lighter and heavier mass in relation to centre of self-gravity is a common phenomenon in all gravitating bodies including earth. The basis is the Pascal's law and particularly its consequence that, within a fluid in static equilibrium, the hydrostatic pressure is the same on every point at the same elevation (surface of hydrostatic compensation) [13]. Therefore in general terms, subduction in an area is compensated by formation of mountain on other side due to action of self gravity of the earth. In biological growth, isostatic balance also happens around self-gravity (ignoring minor circumstantial exceptions). Head (especially back) consists of solid mass of brain, muscle, and bone which is much heavier (greater specific gravity) than water on equal volume basis or than of bone and muscle or fatty and air-containing body tissues. During and after embryonic growth, brain's higher weight is compensated by continued growth towards human leg- an isostatic balancing act of self gravity around central position (*Illustration 7*). As chest and abdominal cavity are mostly fat and air, shoulder blades could buoyed up above the surface by the air filled lungs readily than head or legs (consist mostly of bone and muscle) during swimming.

Similarly plant growth occurs through balance between roots and shoots alternately, though root growth dominates during early period (*Illustration 8*). Roots are comparatively denser than shoot on equal volume basis.

10. Mass balance and self gravity in plants

A type of compensatory mechanism plays in plant growth. 'Mass balance' i.e. matching change in export from the source leaves to roots, grain etc., is a term used in plant science to explain sustained carbon fluxes out of a source leaf that is equal the capacity of the sinks to utilize it. During the day, carbohydrate export from a source leaf is partially independent of the photosynthetic rate. Plant scientists could not yet ascertain about the signals linking sources and sinks coupling. Effect of warming and cooling of roots, fruits and other factors do not show consistent result. A characteristic element of phloem, which functions in the transport of food materials, such as sugars and proteins, synthesized within a plant. The general belief is that a change in source supply or sinks demand results in local changes in sieve tube solute concentration which alters the hydrostatic pressure gradient linking source and sink, resulting in changes in flow. A sieve-tube consists of elongated, thin-walled, living cells arranged in a longitudinal row and forming a connected series by means of perforations in their walls through which pass strands of cytoplasm. Both the solute concentration and hydrostatic pressure have the potential of acting as a signal. Smith and Milburn[14] found that phloem loading responds to

changes in sieve tube turgor. Minchin et al[15] pointed out that differences in the degree of source–sink coupling can probably be attributed to the amount of buffering capacity available within the source, sink and the linking phloem pathway. It can therefore, be contemplated that phloem loading of (solute-regulated) nutrients would be dependent on the magnitude of pressure of self gravity. With higher gravitation pressure, volume of phloem path would decrease, where as lower pressure of self gravity in phloem path would change the sieve tube turgor and hydrostatic pressure gradient- resulting in higher flow of nutrients (*Illustration 9*). However this is a gap area of investigation in physiology of plant science.

Shoot-root ratio is considered an indicator for plant health in terms of growth, survival, mortality and tolerance to stress condition. The root-shoot ratio is usually given as the ratio of the weight of the roots to the weight of the top of a plant. For most trees under normal conditions, the root-shoot ratio is 1:5 to 1:6; the top is 5 to 6 times heavier than the roots. If it were not for the weight of the trunk, however, the top and roots would weigh about the same[16]. Compensatory action of self gravity is also available among yield components of crop like higher tillering per plant is counterbalanced by decrease in length of panicle or number of grains per panicle or decrease in individual grain size[17].

Miscellaneous Role Of Self Gravity

11. Centrifugation and bio analytical protocol in laboratories

As per bio analytical protocol in laboratories, differential centrifugation[18] is the conventional technique, critical for separation of cells/ banding/ layering/ fractionating etc. through sedimentation equilibrium. Generally centrifugation is an inverse or opposite process of central attraction of gravitation on any mass. Differential centrifugation involving multiple centrifugation steps is generally used to separate cellular materials (known as homogenate in proteomics). Separation is based on size and density against a saturated sucrose pad. Nuclei and mitochondria (having nucleic acid) sequentially pellet (precipitate) at low speeds and short intervals such as velocities of 1,000 times the gravitational force on the surface of the earth for 5 minutes. For determination of molecular weight of protein, ultracentrifugation; i.e., spinning in a centrifuge at velocities up to about 60,000 revolutions per minute with centrifugal forces of

more than 200,000 times the gravitational force on the surface of the earth is applied. Smaller cell fragments and organelles that remain in the supernatant, require more force and greater times to pellet. Presence of two gravitational entities can therefore, be visualized in the process. Pre-centrifugation materials are arranged as per density gradient influenced by the major gravitation field of self gravity of the cell. Post-centrifugation order of succession possibly depicts in vivo sedimentation or natural setting as per earth's gravitational fields. Such succession of say, protein, chromosome, plasmid, and RNA/DNA fraction or into plasma, lymphocytes, basophil, eosinophils, Polymorphonuclear cells, and RBC possibly depicts in vivo sedimentation or natural setting of living organism in presence of central force of self gravity. Therefore there is enough evidence that in vitro sorting of biomaterials are graded as per order of the self gravity, while on centrifugation; the materials are aligned as per order of the extrinsic gravity (*Illustration 10*). Biologists may therefore rectify their viewing angle to recognize self gravity, as experimentally as well as in practice; it is a well established fact beyond doubt.

12. Why human visceral fat accumulate in the middle?

It is another paradox that has fascinated me from boyhood that why visceral fat accumulate in the middle, why not in the lower region due to attraction of commonly understood earth's gravity (*Illustration 11*). The fundamental cause of central obesity is still unknown[19].

It has already stated that we have conceived an idea wherein embryo develops out of metabolic energy in a secluded self gravitating environment when it is apparently separated by metabolically inert infrastructure or buffering pad (amniotic fluid) from the stronger extrinsic earth's gravity as shown in *Illustration 12*.

Density of human body fat is 0.918 gm/cc; muscle: 1.049 gm/cc or bone: 2.5 gm/cc. Fat being lighter floats on water whose density is 1 gm/cc. Naturally according to density gradient due to self gravity, fat would be in the periphery, muscles in the middle and bone in the core according to sorting of the self gravity of a mass (*Illustration 13*).

We explained earlier that convectional growth of circulatory, nervous and other system occurs at ecto and meso level centering the centre of self gravitating embryo at gastrulation (blastula phase) stage[20] .Though it could be a gap area investigation, how fat could reach in peripheral region in details but it could be seen that on the principle of sorting due to self

gravity, fat could move mainly in the peripheral ectoderm region, little on mesoderm and least on endoderm layer during gastrulation or process of embryonic differentiation. The accumulation of visceral fat in the mid region could therefore be the natural consequence of operation of self gravity that can explain the central obesity (*Illustration 14*).

13. Tour of the cell is not helpful- 4D Architectural Information Modeling required

Cells are poetically described as microscopic cities. But such descriptions are not helpful unless we explore who and when the various components are made. There is an urgent for 4D Architectural Information Modeling (4D AIM) to visualize the entire duration of a series of events. However let me read out the description on the tour of the cell, how beautiful it is. But for an engineer it carries no sense. It is stated that "cells have power plants (mitochondria), trash dumps (lysosomes), local government (the nucleus, with DNA serving as the legal charter), and many other activities going on inside their boundaries. They also have a border patrol in the form of a double-layered membrane that uses a series of protein-powered pumps, pores and channels to let nutrients in and keep other chemicals and substances out. Among the functional units, cell's command center is the nucleus. All eukaryotic cells have a nucleus. Chromosomes are housed in the nucleus, and they contain the DNA. The nucleus is surrounded by a nuclear membrane or envelope that protects DNA from accidental contact with toxins in the cytoplasm. DNA replicates inside the nucleus. It is also within the nucleus that mRNA is created from the DNA via transcription. The mRNA passes through the nuclear envelope. Once outside the envelope, the mRNA makes a protein. In this way DNA controls the cell's activities.

Second functional unit is the energy plant is the mitochondria. Both plant and animal cells have mitochondria. The mitochondria produce the cell's energy and it is here that the glycolysis and the citric acid cycle take place. The citric acid cycle is also known as the Krebs cycle. In addition to producing the cell's energy, mitochondria have their own circular-shaped genetic material. Third functional unit is the manufacturers called as ribosomes. Ribosomes occur in both eukaryotic and prokaryotic cells. After the mRNA has left the nucleus, it floats through the cytoplasm until it reaches a ribosome. The ribosome carries out the DNA's orders. Ribosomes may float freely in the cytoplasm or be attached to the endoplasmic reticulum. The ribosome translates the mRNA into proteins. Fourth is the protein

customization carried out by endoplasmic reticulum. Two types of endoplasmic reticulum (ER) exist in the cell, rough and smooth. Ribosomes attach to the ER as part of the protein-making process. The ribosomes attach on the rough endoplasmic reticulum, giving it a knobby appearance. Smooth ER does not have ribosomes attached. Proteins move along the ER from rough to smooth, being modified along the way. From the ER, proteins are deposited into the Golgi complex. The fifth functional unit is golgi apparatus and vesicles which help in transportation. Both plant and animal cells have Golgi and vesicles. The Golgi complex, which looks like a stack of pancakes, serves as the shipping terminal. It further modifies and packages proteins for transportation. In addition to transportation control, the Golgi also produces lysosomes. Vesicles, small, oval structures in the cytoplasm, transport proteins to where they are needed. Sixth one is lysosomes, the trash collector. The cell is not a closed system; trash and bacteria come in from outside. Also, toxic byproducts from cell activities build up in the cytoplasm. Lysosomes contain enzymes that help destroy foreign objects and toxins. Without them, the cell would become polluted and die. In plant cells in addition chloroplasts are available. Mitochondria and chloroplasts are similar. They both have their own DNA, and they make energy for the cell. While mitochondria use glycolysis, chloroplasts produce energy through photosynthesis. Animals require sugar; plants require sunlight. New cells are produced by cell division. The two new cells produced when a cell divides are called daughter cells. When two daughter cells have the same number of chromosomes as the original cell, the process is called mitosis. Meiosis is a special type of cell division that halves the number of chromosomes to create eggs and sperm. Daughter cells can be about the same size as the original cell, or a small portion can bud off, creating a smaller daughter cell. In either case, the genetic material has to be duplicated and the contents of the cell need to be divided." We may build a beautiful house, but unless we are having a three dimensional or four dimensional time based engineering structural information, it is difficult to conduct any investigation in true sense.

14. Time line on formation of living cell- a primary gap area of investigation

Simply describing all units in a cell[21] will not help much to understand underlying force working to form these functional units. Time line on formation of organelles, living cells as well as on configuration of subsequent complex structural system in multi-cellular living object is yet to be detailed out. Based upon physical laws

and empirical knowledge of the structural performance of different materials and geometries, structural engineering theory for living objects is to be developed. In life science such a study is not yet initiated, except on some phenomena in sporadic manner. Design on biological structural engineering could utilize number of simple structural elements to build complex structural systems. Annotating the model with 2D drafting elements, designing a living structure and its components in 3D, could then be improved upon with incorporation of time schedule for making 4D Architectural Information Modeling (4D AIM). It would thereafter enable to visualize the entire duration of a series of events including display of assembly and progression of construction activities in living bodies over time to explore options, manage solutions and optimize results for better management of health and well being of the living bodies under specific physical forces and environment. After such an exercise, contribution of potential energy of gravitational force and kinetic energy of metabolic energy on construction of the living structure will become more prominent.

15. What is the proper order of human growth?

Proper order of human growth, as per concept of self gravitation bio is the chronological sequence from initiation to final growth, similar to a mechanical system of order of vibration[22], generated around an equilibrium point. Accordingly there would be first order, second order, third order and so on growth, based on which progressive growth, differentiation (segregation) and development would proceed in a symmetrical manner. Accurate determination of equilibrium point over a relatively steady state inertial reference frame would be an important criterion for increase in order. For example, to understand accumulation of visceral fat in the central position, one could meticulously view the development from initial growth order (say, from embryonic stage) in morphological development.

16. 'Macromolecular Crowding' and 'Anomalous Sub-diffusion'

'Macromolecular crowding' phenomena dramatically affects cellular processes such as protein folding and assembly, regulation of metabolic pathways, and condensation of DNA. Diffusional movement of particles, such as macromolecules in the cytoplasm strongly decreases with an increasing radius of the tracked particle like various macromolecules, leaving particles with a radius >25–30 nm immobile. This kind of diffusion is known as anomalous subdiffusion and has been found in many different contexts in living cells; e.g., for the movement of lipids on model membranes, integral membrane proteins on organellar membranes and proteins in the nucleoplasm, solute transport in porous media, and the translocation of polymers. This anomalous subdiffusion has been shown to strongly influence the formation of spatiotemporal patterns as well as kinetic rates and the time course of enzymatic reactions. Thus it can be seen that in heterogeneous solution like cytoplasm such molecular crowding gives rise to an obstacle-rich environment having various degrees of anomality. Crowding contribute significantly to the high viscosity of the cytoplasm, a concentrated protein/sugar solution. Ellis RJ.[23] pointed out that macromolecular crowding is obvious but underappreciated. Weiss et al[24] provided strong evidence that molecular crowding causes anomalous subdiffusion in the cytoplasm of living cells. They also pointed out that such anomaly persists for intermediate times and that normal diffusion is reencountered for asymptotically large times. Such asymptotic i.e. renormalization behavior during the range of time or sequence with recurrent trough and crest events in iteration of the cytoplsmic molecules, though may be complicated, deserves to be studied in the light of operation of Pascal's law, especially gravity-hydrostatic equilibrium, as crowding could happen due to potential energy of self gravity and diffusion is intimately related to kinetic energy of hydrostatic pressure.

17. Living organism mimics contraction-expansion phases in gravitating bodies

Kelvin-Helmholtz contraction hypothesis in astrophysics[25] states that continued contraction of the Sun under its own gravity generates energy for radiation, converting gravitational energy into kinetic energy which turns to radiation energy. Describing equation of stellar structure, Sir Arthur Eddington states that the Sun or a star is held in equilibrium under the opposing forces of gravity and internal pressure. In various biological systems, mimics of contraction-expansion phenomena have been observed, though actual reason is not yet ascertained. If circadian or ultradian rhythms are allowed to be considered as of electromagnetic origin, mass related contraction and expansion, in biological mass possibly remain unanswered.

There is contraction-expansion phase in embryonic growth sequence viz. zygote and morula as contraction phase and cleavage and blastula as expansion phase in the order: zygote (shrinking phase) - cleavage (rapid rates of division) - morula (antagonism phase between periods of rapid cell division and cell movement) - blastula (cells in centre begin to lose contact with one another and a central

fluid-filled cavity, the blastocel forms) (*Illustration 15*).

18. Growth means expansion followed by recession rhythmically

If we examine critically, we find that the overall biological growth is not a steady increase in mass or weight. An expansion is followed by a recession alternately. Biological growth consists of lag, log or exponential, senescent and steady phase i.e. period of slow, maximum, declining and stationary growth respectively. Growth period in human includes five stages viz. prenatal, infantile, early childhood, juvenile and adolescent plus post-adolescent. There is rapid growth in prenatal and puberty period. There is retarded growth in juvenile and post-adolescent periods followed by little or no growth after the post-adolescent period.

19. Animal Growth: Why Rhythmic?

For instance, in mammals, growth begins slowly and then increases rapidly until the time of weaning, than the rate slows down. After a period of slow growth, there is another period of slow growth until puberty, when the rate slows down again. After another period slow growth, the rate increases and then finally decelerates-ceasing when adult size is reached.

20. Plant Growth: Why Rhythmic?

Similarly in annual plants, after rapid sprouting stage, there is retardation. Growth increases slowly till mature seedling stage. After slow growth, there is another period of rapid growth up to most active tillering stage after which rate slows down again. After another period of slow growth coinciding vegetative lag-phase, the rate increases and then finally decelerates-ceasing when generative growth phase is reached. In plant, growth occurs in three steps or phases viz. formative, enlargement and differentiation.

21. Growth of Stellar Bodies: Why Rhythmic?

If we look on the principles enumerated in the science of astrophysics, we find that this kind of inflation followed by recession in the process of growth of stellar bodies is a universal phenomenon. Even the closed model of the Universe has a contraction phase following the expansion phase. The famous contraction hypothesis of Kelvin and Helmholtz[25] showed that the continued contraction of the Sun under its own gravity generates energy for radiation[26] - corroborates our apprehension that such a situation can happen in case of physiological health of human or living organisms. So there is prima facie reason to believe that self-gravity can be controlling agent for biological growth, as the concept is approaching nearer to the scenario. This needs meticulous study. Rhythm is an associative property of keeping balance between inward and outward pressure in all gravitating bodies. Life science cannot be exception.

22. Why cell density increases before growth or heavier cells grow faster?

Cell growth comprises changes in both mass and volume. Understanding relationship among the cell's three basic physical parameters viz. mass, volume, and the ratio of the two, density, is important to the study the effect of invisible force of self gravity. Using buoyant mass, growth of single cells has recently been measured. With the suspended microchannel resonator (SMR), particles are weighed in real-time as they flow through a hollow cantilever. The microchannel resonant frequency is determined by the difference in mass of the particle with respect to that of the displaced fluid. Thus, the particle's density is determined by measuring its mass in two fluids of different densities[27]. Michel Godin et al[28] found that for individual cells of *Bacillus subtilis*, *Escherichia coli*, *Saccharomyces cerevisiae* and mouse lymphoblasts, heavier cells grew faster than lighter cells. Andrea K. Bryan et al[29] found that cell density increases prior to bud formation of the yeast *Saccharomyces cerevisiae*. To investigate the origin of this density increase, they monitor relative density changes of growing yeast cells. They focus on basic cell cycle questions in yeast, but they remain oblivious on the invisible force of self gravity. They found that the density increase requires energy, function of the protein synthesis. But they have not defined the required source of energy in appropriate dimensions. Let us analyze such energy in the perspective of potential energy of self gravity and kinetic energy.

We are going to demonstrate finally that hydrostatic balance or hydrostatic equilibrium is the law of biological growth, as with stellar bodies, though materials are different. We have already assumed that bio-matters/ cells are held together by gravity that tries to compress everything to the center. But to understand how things works cell by cell i.e. layer by layer, it is required to formulate an equation of state. Density, pressure, and temperature of bio-matters comprising solids, liquids and gas are related though it is very complex and little uncertain. Normally pressure is the amount of force/area. But in equation of state, pressure may be considered as a constant (K) multiplied by the mass density and the temperature divided by the molecular weight of the bio-materials. The molecular weight is the weighted mean of the different atomic types, taking into account the relative

proportions of the different types of atoms present in the bio-matters. Mass density is the amount of mass/volume. Temperature is a measure of the random motion energy (the average kinetic energy) of the solid and liquid particles so also gas to reckon. The higher the temperature, the more random is the kinetic energy of the materials. Warmer materials expand to create pressure on its surroundings.

Materials are compressed by gravity to smaller volumes and higher densities. Deeper layers have more gravity compression from the overlying layers of cells, as density as well as temperature is increased at the core. So they have greater outward pressure to compensate. Thus under equation of state, pressure gradient force or difference in pressure exceeding hydrostatic balance or hydrostatic equilibrium across a surface in each layer of cells causes a difference in force, which can result in acceleration according to Newton's second law, if there is no additional force to balance it. The resulting force is always directed from the region of higher-pressure to the region of lower-pressure. Hence it is natural to find that increase in cell density or increase in heaviness would foster growth of the living cells. Because difference in pressure across a surface causes a difference in force directed from the region of higher-pressure to the region of lower-pressure under different density gradient. This possibly results into heavier cells to grow faster than lighter cells or cell density to increase prior to bud formation or to exhibit similar other phenomena (*Illustration 16*). The matter will be clearer on directing appropriate research on system biology encompassing self gravity in threadbare manner.

23. Why cell adjust mass-to-volume ratio?

It is worthy to note that cells adjust their mass-to-volume ratio during important processes such as cell cycle progression[30], apoptosis[31, 32], differentiation [33], disease state[34, 35], and malignant transformation[36]. In biology and medical diagnostics, correlations of mass and density with disease and other physiological states have been established, e.g. in the various stages of malaria[37]. But these cellular-level parameters remain poorly investigated, especially as a system in relation to their self-gravitating environment under the equation of state as per hydrostatic equilibrium. Cell size is fundamental to cell cycle, cell type and cell state. Variation in cell density is related to changes to rates of mass and volume accumulation. During exponential growth, cells require coordination between growth and division to maintain the population's size distribution, but it remains unclear how cells monitor and regulate cell cycle entry in response to cell size. For instance,

concentration of critical regulatory proteins is considered as the key to cell cycle control. But such concentration should not be defined by expression levels only, as concentration is always dependent on volume. The volume of the cell needs to be coupled to mass and energy requirements. So as per equation of state, pressure is a constant (K) multiplied by mass density and temperature divided by molecular weight of the materials. Mass density is the amount of mass/volume. Any variation in mass density i.e. mass or volume will alter the equation of state. This could result into different cell type, cell density and cell cycle. These are not yet investigated in light of self gravitating environment. Hence this is a gap area of investigation.

William H. Grovera et al[38] had developed technique to measure single-cell mass, volume, and density. They had attempted to demonstrate this technique with four examples: identifying *Plasmodium falciparum* malaria infected erythrocytes in a culture, distinguishing transfused blood cells from a patient's own blood, identifying irreversibly sickled cells in a sickle cell patient, and identifying leukemia cells in the early stages of responding to a drug treatment. The ability to measure single-cell mass, volume and density would provide valuable insights into cell state for a wide range of biological processes, provided such study is also oriented towards understanding the equation of state encompassing invisible force of self gravity.

24. Why percent increase in growth decreases with age in living bodies?

Biological growth means either an increase in number of cells (hyperplasia) or increase in cell size (hypertrophy). Irrespective of expression, growth means increase in mass. However, growth does not occur in uniform arithmetic progression - there is retardation in the percentage increase (*Illustration 17*). The per cent rate of growth is afterwards slowed down in spite of best nutrient supplementation. Say a day one chick in embryo weighs 0.002 grams, on 7th day, it attains 0.57 gram and at day 14 and 20, it attains 9.74 and 30.21 grams respectively. Subsequently at 8 weeks it weighs about 1200 grams. It is still considered a puzzling feature in developmental genetics[6] 'how does genome appreciate that its activities need to be slowed down after the phenotypic task is over'. To bridge the gap in scientific understanding it is postulated that phenomena is due to building up of critical level of growth limiting substance at particular period of growth. What could be the critical growth limiting factors (and not substance)?

Therefore slowing down in the rate of growth by an

unknown factor could be explained with the introduction of the concept of self-gravity. Gravitation force increases with increase in Newton's mass. The gravitational mass is a 'charge': an object feels a gravitational force in proportion to its gravitational mass, just as it would feel an electromagnetic force in proportion to its electric charge. There would be an increase in gravitational force, for example, with increase in mass under same distance or under same mass with decrease in distance, even in miniature scale.

25. Physical parameters determine cellular growth rate

Latest research indicates that physical parameters like membrane surface area, pathways and cell size determine cellular growth rate. The increase in growth rate in fast-growing yeast *Kluyveromyces marxianus* can be explained by a dominant (80%) limitation of growth by the group of membrane processes including membrane surface area. Simultaneous activation of membrane processes may be what is required to accelerate growth of the fastest-growing form of eukaryotic life and may be of potential interest for single-cell protein production[39]. Similarly it was shown that nutrient-dependent pathway and cell size controls growth rate in the Gram-negative bacterium *Salmonella typhimurium* or Gram-positive model organism *Bacillus subtilis*[40]. From both these examples of latest research findings, it is clear that membrane surface area, pathways and cell size are those that can be manipulated by a compressive physical force like self gravity could be the major deciding factor for cell growth rate.

Retardation in percent increase in growth is common to all gravitating stellar bodies of the universe, where internal pressure opposes invisible self-gravity[41] (*Illustration 18a*). Miniature size of the biological bodies seems do not show hindrance to mimic gravitation phenomena. At infant stage, there would be higher metabolic energy but lesser gravitational energy. At adult stage, there would be equilibrium between metabolic and gravitational energy. At old age, there would be lesser metabolic energy and high gravitational energy. That is with accumulation of mass on passage of time, potential energy of self-gravity would starts dominating over kinetic metabolic energy, thereby limiting/ decreasing membrane surface area, pathways and cell size leading to per cent decrease in growth. Therefore, we can say that adults are in equilibrium between kinetic metabolic and potential gravitational energy where as infant and old are in non-equilibrium stage- former with higher kinetic metabolic energy and lesser potential

gravitational energy and later is in its opposite (*Illustration 18b*).

Interaction Between Intrinsic & Extrinsic Gravity

26. Plant spacing and law of gravitation

Interspecific allometric relationship between stand mass and plant population density is an important topic to an agriculturist. We wish to add plant spacing and law of gravitation which would be an unfamiliar combination for both agriculturists and physicist. Here we wish to project a common but so far unnoticed phenomenon on the existence of action of self (intrinsic) and its interaction with extrinsic (earth's) gravity on living organisms. Grain yield per annual plant decreases with overcrowding of plant population, in spite of providing extra nutrients, water, light, etc., for additional plants above stipulated critical limit. Two neighboring plants attract each other, as if they are situated within individual's gravity barrier. With adequate plant spacing, Newton's mass possibly remains optimum. Plants do not find difficulty to push photosynthetic mass to its optimum level, resulting in longer length of grain bearing ears or panicles in an annual crop. In an area, if the plant population is increased (*Illustration 19a,b*), Newton's mass is thought to increase with overcrowding. Consequently gravitational pull increases and photosynthetic mass cannot be pushed to its optimum level, i.e. sink component deceases as reflected by shorter length of grain-bearing ears or panicles. Therefore plant spacing is an important parameter in agronomical practices. Mango tree of one ton, for instance, requires 6 meter inter-plant spacing whereas annual plant of 500 grams like rice requires 15-20 centimeter spacing for their optimum growth and productivity. Plant spacing is thus seems linked with intrinsic and extrinsic gravitational forces with larger spacing for plants having higher mass and lesser spacing for plants of smaller mass.

But a ratio of mass by distance encompassing self gravity and mutual gravity is not yet recognized in plant science leading to testing of models after models under different environmental situations. For instance, Miguel Franco and Colleen K. Kelly[42] presented an a priori theoretical framework for the interspecific allometric relationship between stand mass and plant population density. Their model predicts a slope of -1/3 between the logarithm of stand mass and the logarithm of stand density. Their model rests on a heuristic separation of resource-limited living mass

and structural mass in the plant body. They pointed out that because of similar resource requirements among plants of different sizes; a nonzero plant mass–density slope is primarily defined by structural mass. Specifically, the slope is shown to be a result of the physical size-dependent relationship between stem width and height, foliage- dependent demands of conductance, and the cumulative nature of structural mass. Thus if all these are allowed to be defined in terms of gravitational interactions, the matter would be easier to understand.

27. Withdrawal effect of inertial gravitational anchor

Unless concept of operation of 'self-gravity' is not recognized, some of the spaceflight phenomena may continue to remain a mystery. Holton[43] pointed out that the human cardiovascular system consists of the "pump" (heart), "pipes" (blood vessels), and "control system" (nerves, hormones, and local factors). Fluid shift from the legs toward the head produces a puffy face and birdlike legs, when crews go into space. The increased chest fluid initially increases heart size (i.e., amount of blood), but regulatory mechanisms quickly kick in and return the fluid to an appropriate, lower level[44]. Upon return to Earth, many crew members have difficulty standing, usually due to the rush of blood to the feet that can cause fainting[45]. This re-adaptation to Earth's gravitational force following spaceflight could pose a problem if crews are expected to stand and function normally immediately after landing on any planetary body." With a low heart rate and relaxed muscles, the cardiovascular system does not immediately provide the resistance necessary to keep enough blood going to brain. Heart and blood vessels cannot respond to the sudden change in position and correct the situation[46].

Such dramatic response in living body to change in gravitational environment can be explained on interpolation of self gravity. We know that a variety of anions e.g. Cl^-, HCO_3^-, PO_4^{-3}, or many proteins and cations e.g. Na^+, Ca^{++}, K^+, Mg^{++} serve important nutrient or regulatory roles in the body through fluid balance between the volumes of intracellular fluid (ICF) and extracellular fluid (ECF), so that total volume of water in the body remain relatively constant. Largest volume of water (40% of body weight) by far lies inside the cells as intracellular fluid (ICF), 16% of body weight between cells as interstitial fluid (IF) and 4% of body weight fluid in the blood vessels as plasma. Volume of fluid in the body and the fluid pressures inside the veins and arteries are well-regulated by the various components of the renal/endocrine system. Under normal conditions, homeostasis (relative

uniformity of the body's internal environment) of the total volume of water in the body is maintained or restored primarily by devices that adjust urine output to compensate for greater or less fluid intake (drinking), and secondarily, by mechanisms that adjust fluid intake to respond to the fluid needs of the body. The body's chief mechanism for maintaining fluid balance is to adjust its fluid output so that, over time, average fluid output equals average fluid intake. This balance is maintained mainly through the kidney acting together with certain hormones in the body. Such 'fluid balance' seems primarily a non-gravitational factor. Adaptation of kidney and electrolyte fluid-regulating functions in microgravity might occur in two stages: an acute, rapid stage (hours to days) may be non-gravitating and an adaptive, longer-term stage (days to weeks) may be gravitating. On the other hand, under microgravity, tension of the muscle is said to be reduced that support the body against extrinsic gravity, resulting in a loss of muscle mass and an accompanying loss of muscle strength. Therefore in an integrated living system it is difficult to think in an isolated way.

In fact, effect of gravity is conspicuous on distribution of fluids inside the body. Fluids are normally pulled down towards the feet while on earth and upon entry into space (microgravity) these fluids redistribute towards the chest and the head after a catapult effect. This perceived increase in fluid volume in the upper part of the body causes multiple physiologic changes in the kidneys and associated fluid-regulating hormones, in the cardiovascular system, and in the red blood system. Such cardiovascular and erythropoeitic changes as well as overall renal/endocrine adaptation process in space is primarily a general response to a headward shift of body fluids, caused under the influence of isostatic balance operating within self gravity. Due to operation of convectional flow from heart (pump) within the bounds of self-gravity, the net work of blood vessels get relaxed from stretched condition on entry into space. This is reflected from the cross section of the blood vessel of rat[47] under earth-normal and space-normal (microgravity) where feed artery, first-order arterioles and basilar artery from brain are shown to be relaxed under sole influence of intrinsic gravity in space-normal (microgravity) condition (*Illustration 20*). Though the matter will be discussed subsequently in details, it can be stated that under earth-normal condition, there is balanced, isometric contraction in the artery where as in space-normal; arteries are in relaxed, imbalanced contraction. This is due to the fact that side vectors are pulled out from base vector of isosceles triangular vectors on

withdrawal from earth.

Thus we can say that while on earth, fluids inside the body are normally pulled down under stretched condition towards the feet. Head ward shift of body fluids occurs after a catapult effect. On entry into microgravity (space), tension within self gravitating closed mass get relaxed. Isostatic balance of self gravity then swung into action leading to space-normal condition. This space-normal condition is again challenged by the sudden return to planet-normal gravity resulting in rush of blood to the feet (*Illustration 21*). Unless action of self gravity is not interpolated, whole phenomena would continue to remain elusive. So factors that are induced by self gravity deserve to be studied in proper perspective to make space flight more convenient.

28. Adaptation of snakes after withdrawal of inertial gravitational anchor

Lillywhite[48] suggested that tree snakes might be more gravity tolerant than the other snakes as it did not have to carry blood over as great a distance from the heart to the brain. He centrifuged the animals and found that the sea snake had the least gravity tolerance (i.e. fainting with increased gravity), the tree snake had the most, and the land snake was intermediate[49].

The position of heart is different among the snakes from the centre of self-gravity and not from brain. Brain is the farthest point from the central position, the centre of self-gravity. Advantage to overcome withdrawal effect of extrinsic gravity, therefore would lie with the snake whose pumping system (heart) lies farthest from the centre of self-gravity, as the highest magnitude of gravitational force of self-gravity would be at the central position, as if the entire mass of the sphere of influence would be concentrated at that point. Snake whose pumping system (heart) lies near the centre of self-gravity would automatically experience higher load than the snake whose heart is farthest from the centre under equal exposure to gravitational force (*Illustration 22*). Hence, tree snakes could better adjust in microgravity. Distance from centre of self gravity to heart as the explanation of fainting while working against increased gravity is more rationale than that of distance between brain and heart. However this is a gap area of investigation.

29. Interaction of self gravity of living mass with planetary gravity

Let us consider the earth as $Mass_1$ and any biomass (say embryo or a cell) as $Mass_2$. With respect to $Mass_1$, $Mass_2$ as a whole is moving with an acceleration Gm/r^2, where m is the mass of $Mass_2$ and r is the distance

from the centre of $Mass_2$ to that of $Mass_1$. When parts of body (point A) lying on the surface of $Mass_2$ its weight will change owing to the action of $Mass_1$, as the acceleration with respect to $Mass_1$ is Gm/r_1^2 where r_1 is the distance from the parts of the body (A) to the centre of $Mass_1$. To find additional acceleration of the point A of $Mass_2$ with respect to $Mass_1$, it is necessary to subtract the value of Gm/r_1^2 from the value of Gm/r^2 as the geometrical difference at the indicated point of interest. The acceleration Gm/r_1^2 with respect to Gm/r^2 is directed parallel to the line joining their centers. The subtraction of a vector is equivalent to the inverse vector. Adding the vectors, the change in acceleration or resulting additional acceleration directed towards $Mass_1$ from point A will be equal to (*Illustration 36 equation 1*)

A body at point A will become lighter in absence of $Mass_1$. Bearing in mind that R is much smaller than r, the formula can be written as (*Illustration 36 equation 2*)

Discarding from the parentheses the relatively small magnitude R subtracted from the much larger magnitudes r or 2r, the formula becomes $2GmR/r^3$. A decrease in the attraction of $Mass_1$ at the side of $Mass_2$ would decrease in the free fall acceleration and the materials at point A become lighter.

The difference however turns out to be same in absolute value as at point A which can be written as (*Illustration 36 equation 3*)

This would result in weakening of the magnitude in the force of attraction. Hence influence of terrestrial mechanics on self gravity consists in a change in flexibility of elastic components of compressed living bodies in addition to minor changes in the apparent weight of bodies located under a buoyant like environment in planetary surface or in space microgravity (*Illustration 23*). The weight diminishes at the farthest points from $Mass_2$ but grows on the median line. At median line acceleration is directed at an angle to each other. The subtraction of the total acceleration Gm/r^2 of the $Mass_2$ by the $Mass_1$ and the acceleration Gm/r_1^2 would have to be carried out geometrically, as the vector difference between the accelerations would form base of the isosceles triangle. If r_1 and r are equal in magnitude, departure from median line may be insignificant. Consequently with addition to g at the median line on the $Mass_2$, the formula can be written as GmR/r^3. The r is considered as the distance from the centre of $Mass_2$ to that of $Mass_1$. But buoyant force and limitations of the Archimedes principle, as projected earlier would have to taken into cognizance while considering distance. Side vectors are pulled out from base vector of

isosceles triangular vectors in microgravity. Here we are constrained to repeat what we have said earlier that free fall acceleration to the tune of some nanometer per Second Square (10^{-9} m/s^2) in a massive body of the planet may be negligible, but in an isolated living mass of the size few femtometer (10^{-12} meter), acceleration of some nm/s^2 is quite a significant force.

30. Why loss of bone mass is rapid in space?

In microgravity, astronauts no longer walk to get to different parts of the spacecraft, they float. It is stated[50] that the bones in the lower part of the body that typically bear weight – the legs, hips and spine – experience a significant decrease in load bearing. This reduction leads to bone breakdown and a release of calcium, which is reabsorbed by the body, leaving the bone more brittle and weak [51]. To put it in perspective, postmenopausal women who are untreated for bone loss can lose 1 to 1.5 percent of bone mass in the hip in one year while an astronaut can lose the same amount of hip bone mass in a single month. Why loss of bone mass should be rapid in space?

As per Newton's Shell theorem[51], if distribution of mass in self gravitating body is very symmetric, it can be made of layers, like an onion, with each layer having constant density throughout,. A uniform spherical shell of matter attracts a particle that is outside of the shell as if all the shell's mass were concentrated at its center. A plumb bob hangs at the direction of such centre. If a heavy mass is concentrated in a part, or outside breaking the uniformity, then there will be anomaly in the hanging of plumb bob. The plumb bob will deflect towards the said heavy mass. Similarly human head is comparatively heavier than its other regions on regional volume basis. In absence of earth's gravity, centre of attraction momentarily gets changed. Calcium mediated disorder phenomena, as narrated above, then gets prominence. Thus there is a need to understand vector addition of gravitational forces within self gravitating body.

We have demonstrated earlier that density of human bone is 2.5 gm/cc compared to 1.049 gm/cc for muscle or 0.918 gm/cc for body fat. Naturally according to density gradient due to sorting of the self gravity, bone would remain in the core, muscles in the middle and fat in the periphery. With the subtraction of gravitation vector of the earth, vector force of self gravity gets modified and the compressive force loses its magnitude. This reduction in the inward centre force also might lead to rapid loss of bone mineral density. An interesting review has latest been made by Swanson R.L[52] wherein it has been demonstrated during osteopathic manipulative treatment, the architectural principles of tensegrity[53] can be applied to biological organisms (termed biotensegrity) as these principles can demonstrate the mechanical structure-function relationship at all size scales in human body. Biotensegrity at the cellular level is said to allow the cell to mechanically sense its environment and convert mechanical signals into biochemical changes. He pointed out that on holding an advanced back-bend yoga pose such as "The Wheel" (*Chakrasana*- arched body resembles the rim of a wheel), the spinal column does not function mechanically as a "column" (*Illustration 24*). How far this apparently inverted foetus posture of opposite order for biochemical changes can make impact on osteopathic manipulation or in other physiological disorders is a matter of investigation. But which natural force could initiate spontaneous mechanical signals leading to biochemical changes. Let us discuss the biotransegrity in details.

31. Biotensegrity or pull-push a self gravitating mechanism in living mass

Over the last 3 decades, the concept of biotensegrity expanded markedly and today it is being applied at the molecular, cellular, tissue, organ, and organ system levels, revealing the true biotensegrity architecture of biological organisms. Also it is shown that each "level" is intimately linked to the next in a hierarchical organization, or systems within systems within systems (*Illustration 25*). But for initiating a motion of mechanical nature, there should be a basic or spontaneous force at each level of hierarchy.

Swanson R.L.[52] pointed out that the idea of such building blocks of the biological world is governed by the principles of tensegrity[53] architecture. Interestingly Donald Ingber[54-60] who introduced tensegrity architecture got inspired from sculpting. He recognized that a prestressed cell would be ready to convert mechanical information into biochemical changes. Today, research into mechanotransduction is growing exponentially and is claimed to be proving to play an important role in fields ranging from developmental biology to pathology. But which force could initiate prestressed condition? So there is a dire need to understand the principles of biotransegrity and mechanotransduction in the light of principles of self gravitation bio.

In biomechanics, tensegrity or tensional integrity is said to be a property of objects with components that use tension and compression in a combination yielding strength and resilience beyond the sum of their components. Unlike typical man-made structures that are said to be stabilized by gravitational compressive forces, tensegrity systems are claimed to be stabilized

by continuous tension, with discontinuous compression[61,62]. Animals and other biological structures are made strong by their tensioned and compressed parts. The muscular-skeletal system, for instance, is a tensegrity of muscle and bone, the muscle provides continuous pull, the bones discontinuous push. This kind of strength is stated to exist also at the cellular level when push and pull have a win-win relationship with each other. The pull is continuous and the push is discontinuous. The continuous pull is said to be balanced by the discontinuous push producing integrity of tension and compression. Within sphere-type closed objects, tensile forces of tensegrity would be transmitted throughout the structure as a continuous network in the participating materials. Its effect towards distribution of mass would however, be conspicuous within two diagonally opposite staradian (the solid angle that covers an area on a sphere equal to the radius squared) mass with radius from a common central point. It is speculated that under tensegrity mechanism, pull force might be due to potential energy of the compressive force of self gravity and that's why it remains continuous with mass. Push force is discontinuous which might be due to kinetic energy linked to internal outward force developed by collision among individual molecules against the compressing action of self gravity. Resting tension or prestress thus provides structural integrity. On the other hand, as regard adhesion dynamics, it is to be remembered that both the composition and the morphology of the focal adhesion change. Initially, small focal adhesions called focal complexes (FXs) are formed. Many of these focal complexes fail to mature and are disassembled. However, some focal complexes mature into larger and stable focal adhesions, and recruit many more proteins. Once in place, a focal adhesion remains stationary with respect to the extracellular matrix, and the cell uses this as an anchor on which it can push or pull itself over the ECM. We have already discussed unless some critical mass gets assembled, self gravitational anchor is not possible. As the cell progresses along its chosen path, a given focal adhesion moves closer and closer to the trailing edge of the cell. At the trailing edge of the cell the focal adhesion must be dissolved. The mechanism of this is stated to be poorly understood[63]. In *Illustration 26*, we have extended prestressed transegrity model within the bound of a self gravitating circle. The junction of tension elements with a compression-resistant element can be viewed as a prestressed tensegrity model of a focal adhesion (FA) complex within the cell, considering focal adhesion being central to the three dimensional transegrity

model. This possibly prompted to say[64] that a central tenet of tensegrity is the balance of prestress between tensile cytoskeletal elements that link to structural elements that resist compression; the interplay, or push–pull, between these mechanical forces allows cells to respond to chemical and environmental cues. Mechanical living cell deformation studies have demonstrated that mechanical loads are borne by microtubules, which are balanced by tensile forces in contractile elements of the cytoskeleton[64]. In fact, it is apprehended that self gravitating cells exposed to microgravity can undergo a reduction in prestress due to withdrawal of extrinsic gravitational vectors (pulling out side vectors from base vector of the triangular vectors). Unless self gravity is not brought to the scenario, such relaxation in prestress phenomena in space would remain inadequately explained.

32. Flow of blood directly influenced by gravity

As per National Space Biomedical Research Institute[46] (vide Earth Physiology- Blood pressure), the flow of blood in the body is directly influenced by gravity. When a person is standing, (earth's) gravity helps pull the blood downward to the lower extremities. Without (earth's) gravity, blood tends to remain closer to the heart. The force of (earth's) gravity also makes it more difficult for the blood to flow upward to return to the heart and lungs for more oxygen. In a human body, leg muscles function as secondary pumps as cardiac input to help in the process of venous return which is blood flow back to the heart. During walking or other leg movements, the muscles contract, forcing blood up through the veins of the calf toward the heart. The valves in the veins are arranged so that blood flows only in one direction. Thus blood flow back to the heart or cardiac input through venous return depends on 'contract' and 'relax' position of calf muscle in the lower part of the body (*Illustration 27*).

33. Mountain sickness vis-à-vis normalcy in airplane or balloon

High altitude cerebral edema or acute mountain sickness (AMS)[66] generally occurs after a week or more at high altitude usually above 8,000 meters. If not treated quickly, severe cases can result in death. Immediate descent by 600- 1200 meters is a crucial life-saving measure. It is to be pointed out that acceleration due to earth's gravity (g) decreases with elevation, but g-value is greater in mountain than at sea level, because of presence of higher mass in the vicinity. Simultaneously partial pressure of atmospheric oxygen decreases with altitude. A person in airplane or balloon at equivalent or higher height of mountain above sea level i.e. under equal oxygenation can remain normal and does not feel such sickness.

Hence higher g-value in mountain is the root cause of illness and not partial pressure of oxygen[2]. The capillaries are lined with endothelial cells. Endothelial tissue has small spaces between each individual cell so substances can move readily between the inside and the outside of the vessel. However, in the brain, the endothelial cells fit tightly together and substances cannot pass out of the bloodstream. So 'tight' and 'relaxed' condition of inter endothelial cell junction in the upper part in the brain[67] that control blood-brain barrier and vasogenic edema during acute mountain sickness is a gravity related phenomena (*Illustration 28*).   Hence altitude is not the factor for acute mountain sickness. It is a clear evidence of interaction between earth's and self gravity. Most interesting fact is that acute mountain sickness generally occurs after a week or more at high altitude. Being a mass dependant force, gravity is comparatively slow moving one. Hence it requires a weeklong stay in mountain. This slow moving property is an indication that the acute mountain sickness is primarily gravity induced one.

34. Lever and fulcrum forces vis-à-vis 'tight' and 'relaxed' mechanism

Kelly forceps is a hand-operated instrument having two levers pivoted on a single fulcrum. Half-serrated jaw of the levers or arms slide against each other to clamp off vessels that control blood flow. Similarly the 'tight' and 'relaxed' condition of the calf muscle in the lower part and inter endothelial cell junction in the upper part (brain) seems to be an integrated process. The 'tight' and 'relaxed' conditions working like a Kelly forceps having fulcrum at the centre wherein inwards vector force of self gravity geometrically added or subtracted by the vector force of extrinsic gravity in addition to other local vector forces. Such relation of venous orifice at calf muscle with cardiac input-output in microgravity and reduced or increased space of lumen within inter endothelial cell junction in case of vasogenic edema during mountain sickness is primarily triggered by the variation in the external gravitational attraction on the potential energy of self gravity acting on biological soft matter. It can be compared with the lever and fulcrum forces of Kelly forceps (*Illustration 29*). As per law of the lever[68], the power into the lever must equal the power out of the lever. As the lever rotates around the fulcrum, points farther from this pivot move faster than points closer to the pivot. Therefore a force applied to a point farther from the pivot must be less than the force located at a point closer in, because power is the product of force and velocity. It is to be noted that stress due to increase in potential gravitational energy is more at the

centre and breaking point of a closed system lies at the weakest points farthest from the centre, hemorrhagic strokes or cerebrovascular accident resulting from rupture of a blood vessel on atherosclerosis commonly occurs on hardening of an artery of aged person. Hence this needs a meticulous study as a gap area of investigation involving both potential and kinetic energy of self gravity and its interaction with earth's gravity.

35. "Headward fluid shift" under microgravity

The living body is an integrated system[46] where renal/endocrine system works in conjunction with the cardiovascular system apart from fluid balance between the volumes of intracellular fluid (ICF) and extracellular fluid (ECF). On Earth, gravity affects the distribution of fluids inside the body by pulling the various body fluids down towards the feet. Upon entry into space, the virtual absence of gravity causes these fluids to redistribute upwards towards the chest and the head. This perceived increase in fluid volume in the upper part of the body causes multiple physiologic changes in the kidneys and associated fluid-regulating hormones, in the cardiovascular system, and in the red blood system. The reason is obvious for a self gravitating body and its interaction with external gravity.

36. Calf muscle atrophy during prolonged space flight

The calf muscle atrophy (loss of mass and strength) during prolonged space flight is a matter of major concern for forthcoming space mission to Mars[46]. On earth also muscle tissue tends to lose elasticity in older people. It seems that gravity is working as brake, because with older people, density of mass increase resulting in generation of higher gravitational potential energy. Even if crewmembers adhere to a strict exercise regime, the muscle atrophy continues throughout a crew's mission. Structural changes of muscle fiber involve myosin, a protein "molecular motor" that drives muscle contractions and cell divisions, enzymes, and substrates. Motor proteins convert chemical energy using ATP hydrolysis into mechanical work that powers their movements along cytoskeletal tracks, thus generating force and movement. The most striking variety of such movement is muscle contraction. Two muscles in the calf, the gastrocnemius (largest muscle in the lower leg, able to extend the foot and bend the knee) and the soleus (flat muscle located under the gastrocnemius that flexes the foot) determine size, structure and performance of individual cells within the muscle. We have already discussed the issue in Part-I while describing 'muscle tone' about alternate

'half-bulging' structure of the muscles in the periphery with potential and kinetic energy and relation of maintenance of constant angle between radius from the common centre and tangents over intercepted arcs from central angle. Such exercise can probably answer calf muscle atrophy and its remedial measures during prolong space flight.

37. Self gravity friendly postures might ease out space journey

Diagonally opposite parity in physical mechanisms is possible only in case of self gravitating body. Hence there is ample opportunity for adjustment of isostatic pressure through modification of posture. It has been reported by some physiotherapists that there are certain pressure points (not trigger points or muscle knots as pain reliever) to activate certain muscle fiber. To avert such "headward fluid shift" on orientation of body in the head-down, legs-up launch position, let us propose foetus (*Gorbhasan*), child's pose (*Balasana*) or similar other Indian yoga posture. Living body is well adopted with foetus (*Gorbhasan*), child's pose (*Balasana*) posture under secluded condition during beginning of life process with least interference of external gravity, as activation of pressure points (*Illustration 30*). Hence it can be a matter of investigation on adoption of child's pose (*Balasana*), foetus (*Gorbhasan*) or similar other exercises depicting self gravity friendly postures during prolonged space flight. Investigation should also include duration of daily routine exercise on remaining in such postures. It is assumed that such self gravity friendly postures would probably ease out space journey on effectively dealing with renal/ endocrine system that works in conjunction with the cardiovascular system including fluid balance between the volumes of intracellular fluid (ICF) and extracellular fluid (ECF). However to ease out the movement of limb and other movable body parts for such exercises, convenient Launch and Entry Suit (LES) may have to be redesigned to house pressurized buoyant space for providing pure oxygen for breathing.

38. Long-lived animal vis-à-vis 'self gravity-friendly' load distribution and posture

Under buoyant force of sea water, the bowhead whale lives 200 or more years[69]. The bowhead whale has a massive bow-shaped skull which is about 30-40% of their total body length (*Illustration 31*left). Blue whale and bowhead whale both live in the environment of buoyant force, but comparative geometry of both shows that geometry of bowhead whale is more congenial to create self gravity friendly environment than that of blue whale (*Illustration 31* middle).   On the other hand, the highest long-lived land animal on

earth is turtle. Geometry and spread of protective armor of the turtle is congenial to create self gravity friendly environment (*Illustration 31*right). Load of massive bow-shaped skull in bowhead whale and protective armor in turtle possibly helps to redistribute potential energy of self gravity for operation of kinetic energy for longer duration. Both the animals are however known for their slow movement.

39. Theory of increasing gravity

In the year 1988, I came out with the concept of increasing gravity over geologic time as after initial higher speed, the earth's rotation had slowed down and continues to slow down mainly because of brakes applied by the moon due to tidal friction in the ocean. Tidal bulge is due to gravity and inertia caused by gravitational pull of the moon. Consequently size of the evolutionary living species in the earth is diminishing progressively along with slowing down of the earth's rotation because of increase in extrinsic gravitational pull through geologic time[1] resulting in stretched condition for the self gravity (*Illustration 32*).

Thwaites, William and Frank Awbrey[70] proposed that earth's rotation is slowing at a rate of about 0.005 seconds per year per year. This extrapolates to the earth having a fourteen-hour day 4.6 billion years ago. The rate at which the earth is slowing today is higher than average because the present rate of spin is in resonance with the back-and-forth movement of the oceans. Fossil rugose corals preserve daily and yearly growth patterns. From this it is shown that the day was about 22 hours long 370 million years ago, in rough agreement with the 22.7 hours predicted from a constant rate of slowing[71,72]. Stephen Hurrell[73] supported the concept of expanding earth with the publication of his book 'Dinosaurs and the Expanding Earth'. Conference on The Earth Expansion Evidence: A Challenge for Geology, Geophysics and Astronomy was held at Erice, Sicily, Italy on 2011[74]. However incorporation of self gravity and its interaction with earth's gravity is yet to take a shape in the discussion.

40. Giant size of animals under buoyant force of sea

Another overlooked aspect in evolutionary process is the effect of buoyant force on size of the living organisms. Life originated during Cambrian period of the Paleozoic era in the sea, when living organisms experienced lesser gravitational pressure as well as over buoyant like force under higher density of liquid medium (presence of salt in sea water). Present day world's largest animal, the blue whale (more than 109 tons & 30 m in weight and length respectively)[75], therefore could continue to maintain the macro-size

under buoyant force available in the sea. On the other hand the giant size of the land animal like dinosaur (sauropods) during Mesozoic period seems correspond to lesser gravitational force due to peak rotational force of the earth (*Illustration 33*). There is enough scope for investigation that dinosaur and rhinoceros both are of same land animals, except a difference in exposure in lower and higher gravitational force over long geologic period.

41. Interaction between intrinsic and extrinsic gravity in evolutionary processes

The evolution curve of the living species on earth is said to be of sigmoid shape. The biomass of living organisms increased over geologic period. Balancing act of adaptation of organisms is closely linked with gravitational pull and push of the planet earth during the particular geologic period. In the progress of evolution *Homo erectus* (i.e. human) came last. A simple example may explain the fact. Suppose a man wants to climb up a hill to reach the plateau above it. As per gradient of slope of the hill, he will have to first lean forward as he climbs the hill. Then he will have to further bend forward and use the support of his hand to climb the top of the hill, and then he will have to further bend forward and use the support of his hand to climb the top of the hill. Because while leaning forward, centre of gravity of the body also shifts forward and thus helps climbing. On reaching plateau, he can stand erect. Similarly for instance, in a well known ride like "wheel of laugh" having rotating system, radial acceleration outwards from the centre along the radius of the rim depends on the rate of revolution in a non-inertial frame of reference. The acceleration due to force exerted by radial gravity acting on a rotating wheel grows in proportion to the distance of a point from the centre of the wheel. As such it is difficult to keep balance and stand upright in a rotational disc when one remains farther from the centre, rather one would have to resort to crawling i.e. dragging the body along the ground with hand and knees. The vector characterizing additional radial force becomes shorter with the decrease in rotational speed. Similarly we can assume that the speed of the rotation of the earth had reached its plateau, in terms of geologic time, at the time when *Homo erectus* first appeared (*Illustration 34*). This rotational speed is at present decreasing; as such size of the living body is decreasing. Microorganisms, tiny microscopic size are therefore gaining fast momentum. Giant elephant has reduced to small elephant. Astronauts get a bit taller in space. On Earth, the disks between the vertebrae of the spinal column are slightly compressed due to gravity. In space, that compression is no longer present causing the disks to expand with the result that the spine lengthens, and the astronaut gets taller.

Gravity Ignored In Biology Without Reason

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42. Gravity ignored at mesoscopic length scale compared to macro and micro scale

While investigating self gravity in biology, I had to make a long journey on studying mass from macroscopic to microscopic length scale and then to the living word at mesoscopic length scale. Presence of gravity at macroscopic scale at $10^{0 \text{ to}} 10^{36}$ m, i.e. say from planet to universe is virtually understood through pioneering works of Newton, Einstein and others. Similarly presence of gravity at microscopic scale at $10^{-6 \text{ to}} 10^{-36}$ m is being felt through quantum gravity etc.[76,77]. I found that at mesoscopic length scale presence of self gravity is completely ignored, as if there is no self gravity except mutual gravity. Mutual gravity is now-a-days getting some attention after initiation of space research. Classical physics adequately describes the observed effects of gravity over a range of 50 order of magnitude of mass, i.e., for masses of objects from about 10^{-23} to 10^{30} kg. At mesoscopic length scale, expecially in biological soft matter where non-Newtonian physics apparently dominates, the presence of classical gravity is being ignored. The sudden absence of self gravity at mesoscopic length scale is impossible. Hence study should be directed to various self gravitational phenomena at mesoscopic scale in the line of macroscopic and microscopic length scale (*Illustration 35*).

Self Gravitation Bio- Genesis of the Concept

Why all living species are round? Why not square? Those natural phenomena had fascinated me from boyhood. I investigated meticulously from local forces like surface tension to basic forces like electromagnetic forces of nature. I failed to get appropriate answer. Then I concentrated my attention on gravity. I could figure out that every individual cell remains in the ambit of self gravity, an invisible force that holds the body structure in place. During the process I first published a book in 1988 entitled "Gravity dictates life-death and biological growth". In 1989, it was presented at the 76th session of the Indian Science Congress held at Madurai with wide appreciation to the novelty of thought culminating into

a monograph 'Self gravity dictates biological growth'. The Biophysical Society, USA at the Joint 52nd Annual Meeting of the Biophysical Society and 16th IUPAB International Biophysics Congress held on February 2-6, 2008 at Long Beach, California, USA was caused to introduce biophysics discipline with the nomenclature 'Self Gravitation Bio' modifying 'Biomechanics of Intrinsic Gravity', proposed by me. Strong interactions were made in different symposia, seminars apart from direct conversation with experts on cross disciplinary subjects, which would be a long list. "Finite element approach to understand self gravitational bio in embryological compact mass" was included in the 'New & Notable' Section as poster presentation in the 8th European Biophysics Congress, held at Budapest, Hungary on 23-27 August 2011. I got the opportunity to present my findings on "Self gravitation bio" in the triennial 17th IUPAB International Biophysics Congress & 12th Chinese Biophysical Congress, at Beijing, China from Oct, 30-Nov, 3, 2011. All cannot be equal to possess same insights, especially if it comes to express dissent against 'mainstream' theories. Hence elaborate studies need to be initiated on 'Self gravitation bio'.

Conclusions

Binding energy of self gravity and metabolic energy for performance of day to day work depend on 'mass', as if two sides of same coin. In astrophysical bodies application of such principle is abundant. Instead of metabolic energy, it is fusion energy. This simple aspect has so far remained unexplored in life science for no tangible reason. Theoretically exertion of gravitational forces in dynes gets increased by 96 percent when weight of two masses increases by one percent under same separation distance of 10^{-6} centimeter. Similar is the case when separation distance is decreased for the same two masses of 10^{-4} grams each. On the other hand, inertia is the resistance an object in its state of motion. A prokaryotic cell of *E.coli*, for instance is about 2 μm or 2×10^{-6} m long, 1 μm wide, diameter 0.8 μm, wet weight 1×10^{-12} g,. Apparently for an external viewer, it may be negligible or its movement would appear to mimic larger mass. But even for that purpose, it must have the opportunity to function independently on being in secluded condition. Fluids have great physical role of buoyant force that help to keep such secluded condition. Now whatever may be the quantity of mass, potential energy of self gravity and its inertia would play compensatory mechanism to put an organism at rest. However with arrival of kinetic energy of

metabolism, situation gets changed. Among the two categories of metabolism at any instant, catabolism breaks down organic matter to harvest energy in cellular respiration. Anabolism uses energy to construct components of cells. In anabolism, there is an increment in mass, whereas in catabolism there is a decline in mass. Thus there is alternate build up and break down of mass in living bodies, which naturally cause variation in potential and kinetic energy. Thus the concept of self gravitation bio has been theorized to be based on identical astrophysical principles of larger mass on three broad feature

(i) Binding force of self gravity acts universally on mass. Biomass accumulated through photosynthesis and other build-up mechanism within volume of secluded structure serve as anchor or foundation. Inertia resists changes in the state of motion.

(ii) Build up and break down mechanism through anabolism and catabolism of metabolic energy causes a change in the amount of mass per unit volume at particular instant leading to contraction out of gravitational potential energy and relaxation due to inertia plus kinetic energy of metabolic activity within volume of membrane bound mass. Self gravity attracts denser materials to its core leading to sorting and self assembling of mass according to density-gradient of macromolecules. Nucleic acid having higher density finds place as 'core', protein of medium density in intermediate and least dense fat in the periphery. Energy producing organelles (mitochondria, chloroplast) being source of kinetic energy remain away from central load. State of energy varies with gain or release of temperature. Such contraction-relaxation leads to develop pressure. Background tension within volume causes mass to move asynchronously at low frequencies and continues to function as 'life'.:

(iii) Metabolically inert infrastructure or buoyant force of fluids helps to create secluded condition as if separating self gravitating body from external stronger gravitational field and helps to maintain self gravity's free fall condition. With collapse of equilibrium between contraction and relaxation due to self gravity and inertia plus kinetic metabolic energy, stronger force of extrinsic gravity makes a living mass an inert non-living.s

Such variation in the potential and kinetic energy due to variation in mass is the source of power for giving background tension or tone to the body. Such background tension or tone is possible with astronomical body like Sun where internal pressure opposes self gravity. It is often said that Sun shines because of its gravity. Gravitational energy is

converted into kinetic energy and then into radiation energy. Here in life science nomenclature is little different. Here it is said that a person glow with health and under diseased condition such glow is lost. So there is need to understand why a person glow when in health and lost when in diseased.

Under the principle of abductive reasoning through successive approximation on sporadic set of observations, some roles of self gravity on identical astrophysical principles of larger mass have also been conceptualized. Demonstration has been given on various phenomena for instance, on centre, central obesity and isostatic balance between heavier and lighter mass around centre of self gravity; bilateral morphological symmetry arising from convectional surge, mass balance in plants; and mimics of contraction-expansion phases of larger gravitating bodies, slowing down of growth rate with age and other hundreds of phenomena. The physiological crisis encountered during prolonged space flight under microgravity can also be explored with the concept of self gravitation bio, especially with the advantage of self gravity-friendly foetus posture exercises in correcting various imbalances during space journey. The effect of self gravity is also conspicuous in dictating inter-specific allometric relationship between stand mass and plant population density and in evolutionary process towards changes in morphometry for living organisms.

Thus we can see that there is great consistency throughout all the workings of the universe, once the concept of self gravity is brought into the scenario of life science. Jayant V Narlikar, eminent astrophysicist[34] rightly said that "gravity is a basic force of the Universe. From the motions of ocean tides to the expansion of the Universe, a wide range of astronomical phenomena are controlled by gravity. Newton summed up gravity in his simple inverse-square law. Einstein saw in it something of deeper significance that linked it to space and time. The modern theoretical physicist is trying to accommodate it within a unified theory of all basic force. Yet, gravity remains an enigma today." However when people are accustomed with the word gravity as the binding force, let us initiate our study in life science, taking whatever knowledge gained so far towards gravity, keeping in abeyance for all those development likely to come in near future through intensive study in theoretical physics. It may happen that in future, objects in life science may be the model of experimentation for the theoretical physicists.

Lastly I wish to mention that to draw conclusions, to make predictions, or to construct explanations in present day research, three methods of reasoning may be chosen viz. deductive, inductive, and abductive approaches[78]. In deductive reasoning, conclusion is guaranteed and starts with the assertion of a general rule and proceeds to a guaranteed specific conclusion. In inductive reasoning, conclusion is merely likely. Abductive validation is the process of validating a given hypothesis through abductive reasoning. This can also be called reasoning through successive approximation. Under this principle, an explanation is valid if it is the best possible explanation of a set of known data. The best possible explanation is often defined in terms of simplicity and elegance. Abductive validation is therefore a common practice in hypothesis formation in science. I tried to give clue through need based successive approximation with occasional results of experimentation to observe role of invisible force of self gravity. If one gets accustomed with the concept of self-gravity as his viewing angle, I am sure; he can get real insight into the amazing world of biology. In fact there is an urgent need to design biological structure on making 4D Architectural Information Modeling (4D AIM) in order to enable to visualize the entire duration of a series of events including display of assembly and progression of construction activities in living bodies over time to explore options, manage solutions and optimize results for better management of health and well being of the living bodies. Attention is invited to the cross disciplinary experts to various gap areas of investigation including 4D AIM on the role of invisible force of self gravity in biological science. Possibly we require another Gray to rewrite the human anatomy in the current century on incorporating self gravity. Any positive suggestion/ advice or correction of mistakes to improve upon the concept is highly welcome, as biology is one of the most complex subjects ever we know.

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The study circumstantially has to be continued as individual initiative. Many of the photographs, sketches has to be incorporated to simplify the understanding of the concept. There may be lack of qualitative precision in the presentation, for which author expresses his deep regret and promises to improve upon on funding. The author expresses his gratitude to all those who contributed to advance the concept. No sketches or photographs have however, been brought in use to imitate or reproduce other's idea.

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Illustrations

Illustration 1

Illustration 1. Why all living species are in spherical symmetry? Why round? Why not square? The human body- head, hand, leg etc. are all in spherical pattern, starting journey from spherical shaped eggs/ embryo. Tips of fingers, flowers or inflorescences are all in spherical symmetries.

Illustration 2

Illustration 2. Individual rice plants in a bunch develop in orchestrated manner with middle one taller. Why? Neighboring plants attract each other, as if they are situated within the sphere of individual's gravity barrier. The angle between tangent and radius from the common centre of self gravity remains equal due to action of self gravity. Roots are denser than shoot on equal volume basis. Next phase of growth is on root to maintain isostatic balance (extreme right).
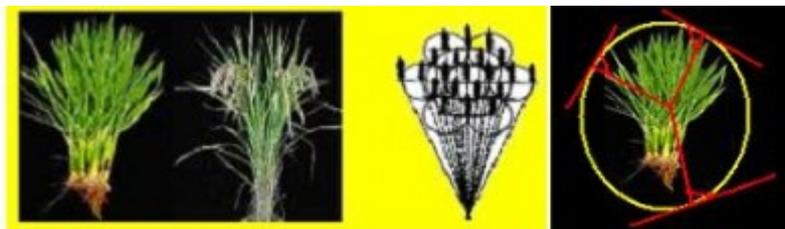
Illustration 3

Illustration 3. In contrast to bilateral (mirror) symmetry in animals, plants possess symmetry of a cone.
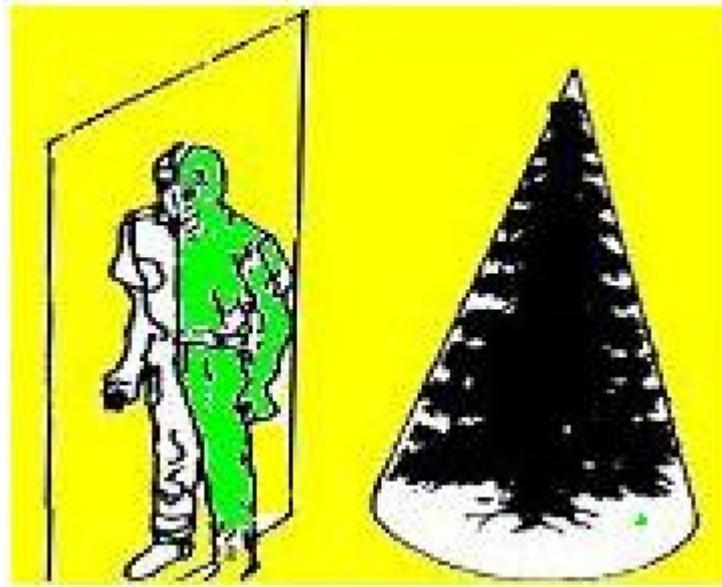
Illustration 4

Illustration 4. Bilateral symmetry and convectional morphogenic development in animals is evident from the 'fountain effect' in frontal region.
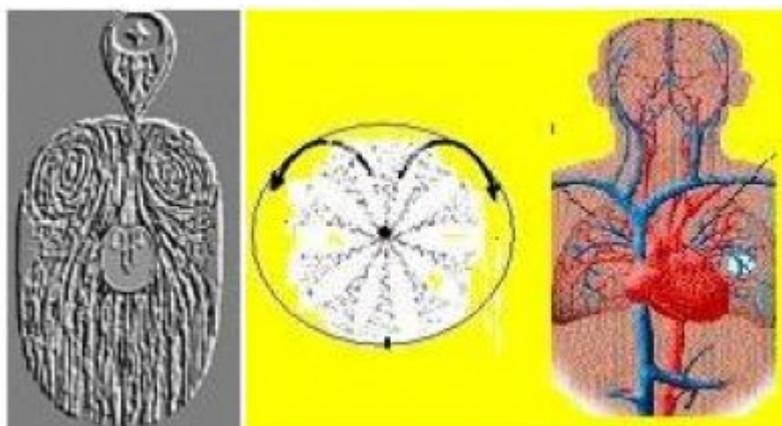
Illustration 5

Illustration 5. Convective transport mechanism from high density to low density leads variation in internal structure and morphological symmetry. For instance frog has high mass, butterfly intermediate and bacteria or amoeba have low mass. In organism having small mass, there is no 'fountain effect'- only 'central tendency' in overall structure, but in organism with intermediate mass there is fountain effect as well as central tendency.
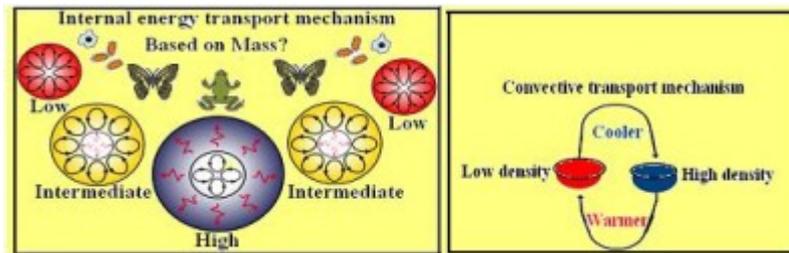
Illustration 6

Illustration 6a & b. Heart is the first body organ to be functional. At 31days, heart occupy core position (a) which changes with subsequent growth, though pump-in and pump-out function of the heart remains intact (b).
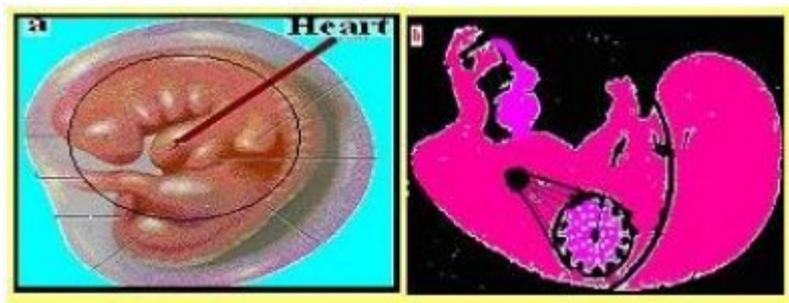
Illustration 7

Illustration 7. Isostatic balance: head is proportionately larger in infant. There is continued growth of leg during rest period.

Illustration 8

Illustration 8. Isostatic balance: root growth dominates the early growth of the plant followed by shoot growth. Roots are comparatively denser than shoot on equal volume basis.
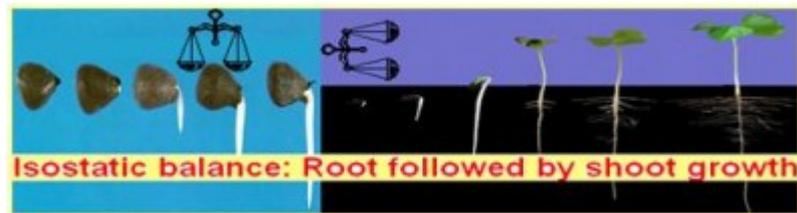
Illustration 9

Illustration 9. Turgor and hydrostatic pressure gradient in sieve tube is dependent on the orifice or inner volume, area of which would be influenced by the magnitude of external pressure acting on it. For lower gravitation pressure, volume of sieve tube and companion cell would be larger. Under higher gravitation pressure, volume would be smaller. Thus phloem loading of (solute-regulated) nutrients would be dependent on the magnitude of pressure of self gravity.
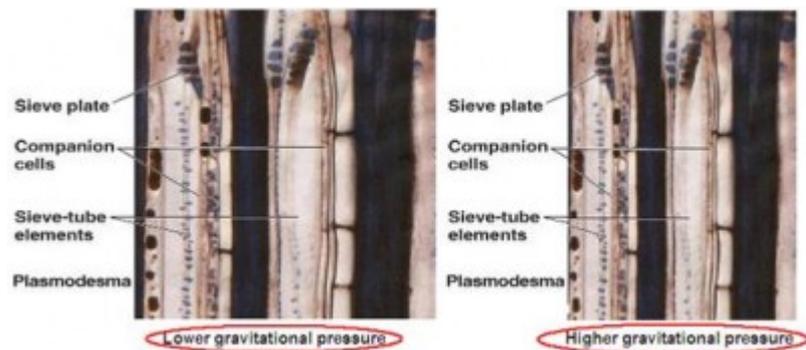
Illustration 10

Illustration 10. Pre-centrifugation materials are arranged as per natural settings of density gradient influenced by self gravity. Post-centrifugation order of succession of say, protein, chromosome, plasmid, and RNA/DNA fraction or into plasma, lymphocytes, basophil, eosinophils, polymorphonuclear cells, RBC possibly depicts in vivo sedimentation in presence of major external gravitation field. Centrifugation is an inverse process of central attraction.
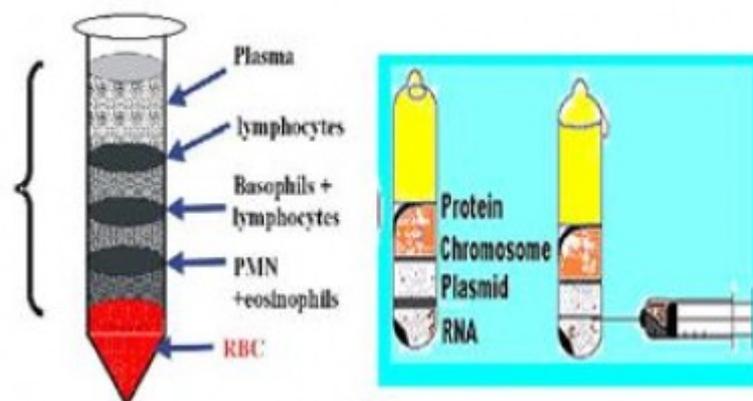
Illustration 11

Illustration 11. Why visceral fat accumulate in the middle? Why not it is going down due to strong gravitational attraction of the earth?
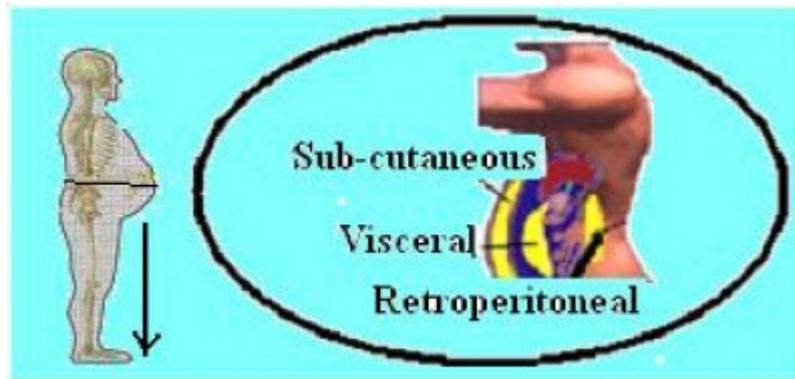
Illustration 12

Illustration 12. Embryo develops in a secluded self gravitating environment when it is apparently separated by buffering pad (amniotic fluid) from the stronger extrinsic earth's gravity.
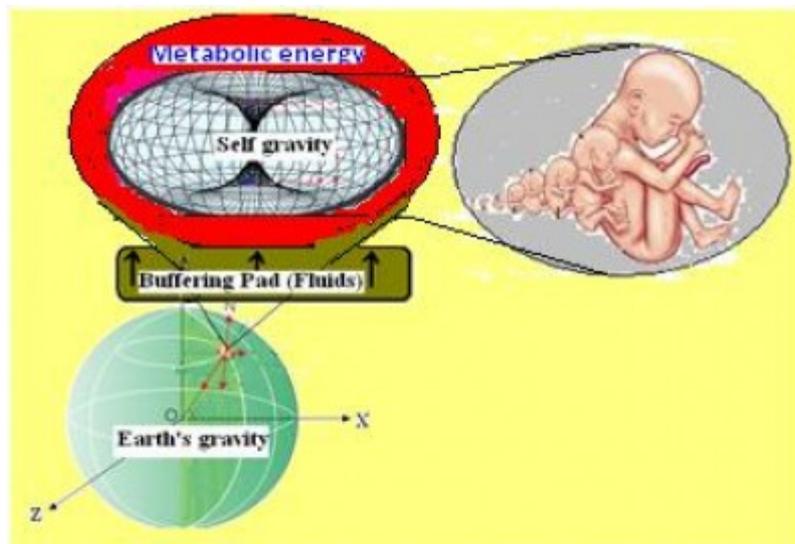
Illustration 13

Illustration 13. In a self gravitating environment, fat being less dense will occupy the peripheral position, muscle in the middle and bone being denser will occupy the central position.
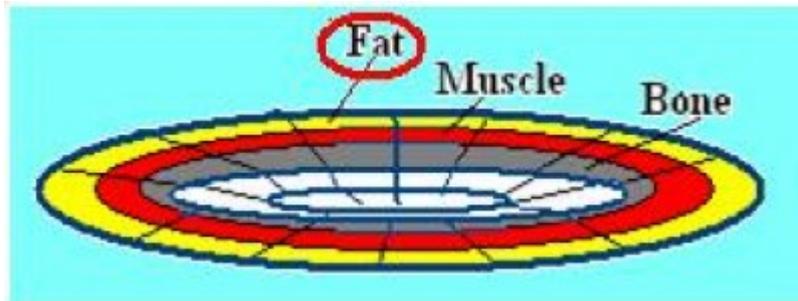
Illustration 14

Illustration 14. At gastrulation (blastula phase) stage, ectoderm remains in the periphery and endoderm remains in the inner region. As such due to sorting of self gravity, fat being less dense could move mainly in the peripheral ectoderm region, little on mesoderm and least on endoderm layer.
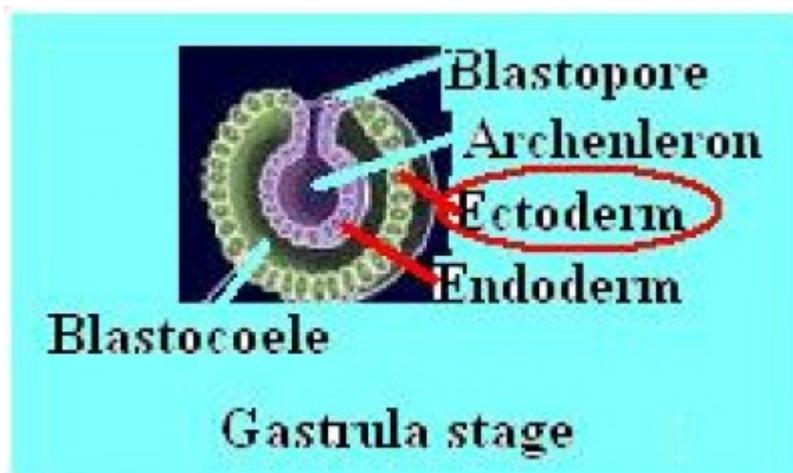
Illustration 15

Illustration 15. Contraction-expansion phases in embryonic growth
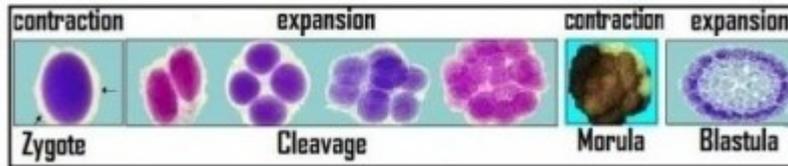
Illustration 16

Illustration 16. Deeper layers have more gravity compression than the overlying layers of cells, as density as well as temperature is increased at the core. So they have greater outward pressure to compensate. Difference in pressure across a surface under different density gradient causes a difference in force directed from the region of higher-pressure to the region of lower-pressure resulting heavier cells to grow faster or cell density to increase prior to bud formation.
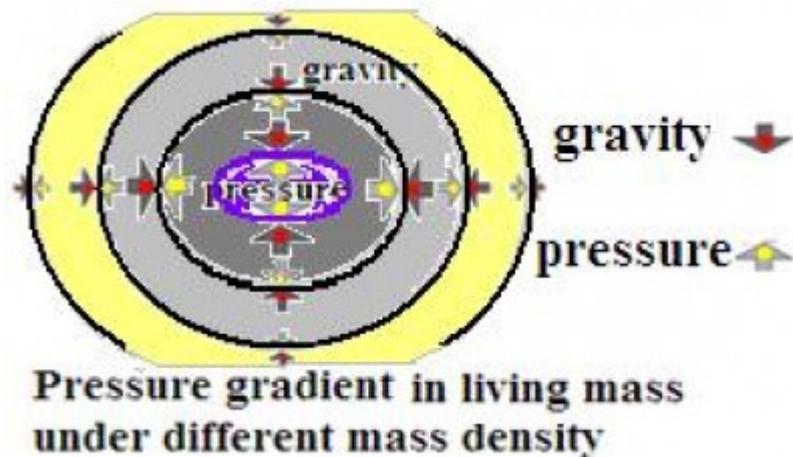
Illustration 17

Illustration 17. Growth and percent rate of growth of chick from day one up to hatching on twenty-first day. There is retardation in percent increases with times. Such retardation in percent increase in growth is common to all gravitating stellar bodies of the universe, where internal pressure opposes self-gravity. With the introduction of the concept of self gravity in biology, such unknown limiting factor can be explained.
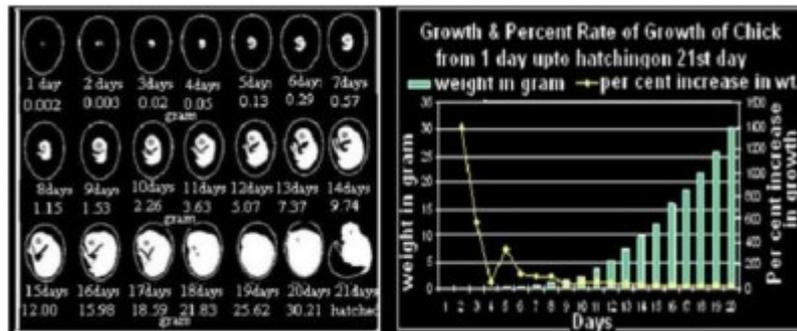
Illustration 18

Illustration 18a,b. Retardation in percent increase in growth is common to all gravitating stellar bodies of the universe, where internal pressure opposes self-gravity. At infant stage, kinetic metabolic energy is higher than potential gravitational energy. At adult stage, there would be equilibrium between kinetic and potential energy. At old age, there would be lesser kinetic metabolic energy and high potential gravitational energy.
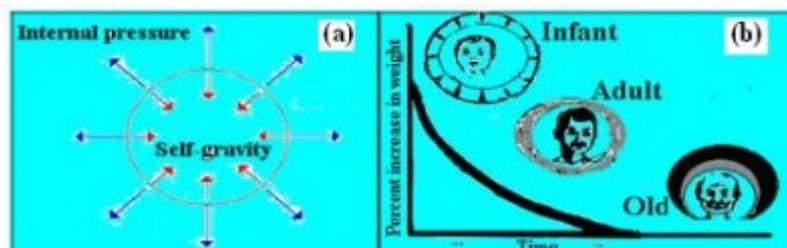
Illustration 19

Illustration 19ab. (a). With adequate plant spacing, interspecific allometric relationship between stand mass and plant population density remains optimum i.e. photosynthetic mass can be pushed to its optimum level, resulting in longer length of grain bearing panicles in crop. With overcrowding (b) gravitational pull is increased. Photosynthetic mass cannot be pushed to optimum level. Sink component deceases reflecting shorter length of panicles.
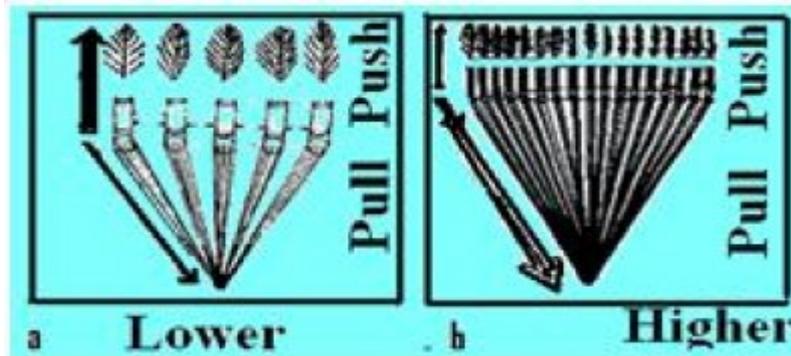
Illustration 20

Illustration 20. Cross section of blood vessel (feed artery, first-order arterioles and basilar artery from brain) of rat is relaxed under space-normal condition. In Earth-normal, there is balanced, isometric contraction in the artery. Influence of extrinsic gravity and its interaction with self gravity can possibly explain the phenomena, as shown in the vector diagrams represented in the left and right.
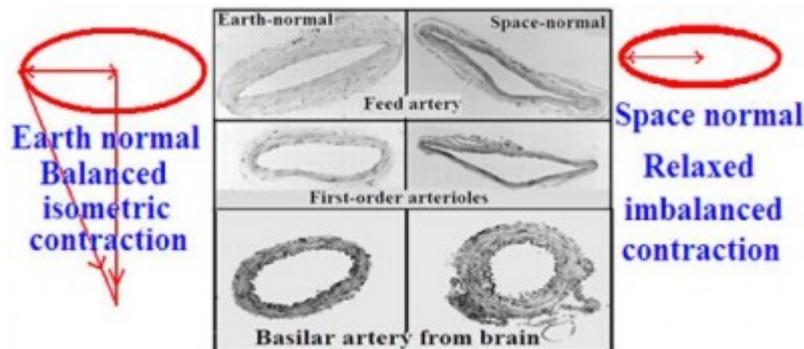
Illustration 21

Illustration 21. While on earth, fluids inside the body are pulled down towards feet. Head ward shift of body fluids occurs after a catapult effect. On entry into microgravity (space), tension within self gravitating mass get relaxed. Isostatic balance of self gravity then swung into action leading to space-normal condition. On return to planet-normal gravity, blood rushes to the feet.
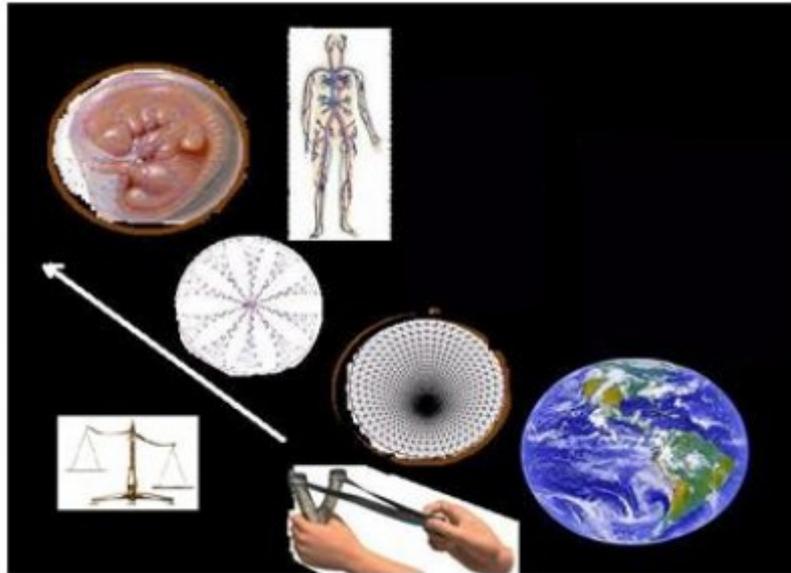
Illustration 22

Illustration 22. Sea and land snakes whose pumping system (heart) lies nearer the centre of self-gravity would automatically experience higher load than the tree snake whose heart is farthest from the centre. Distance from centre of self gravity to heart as the explanation of fainting while working against increased gravity is more rationale than that of distance between brain and heart.
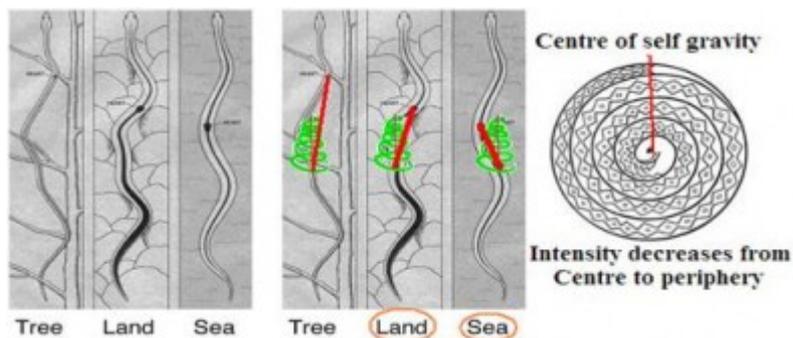
Illustration 23

Illustration 23. When positioned in planetary surface, there will be addition of vectors on self gravity at an indicated point of interest. With withdrawal of terrestrial attraction, there will be deduction of vectors at the point on self gravitating body. Side vectors are pulled out from base vector of isosceles triangular vectors.
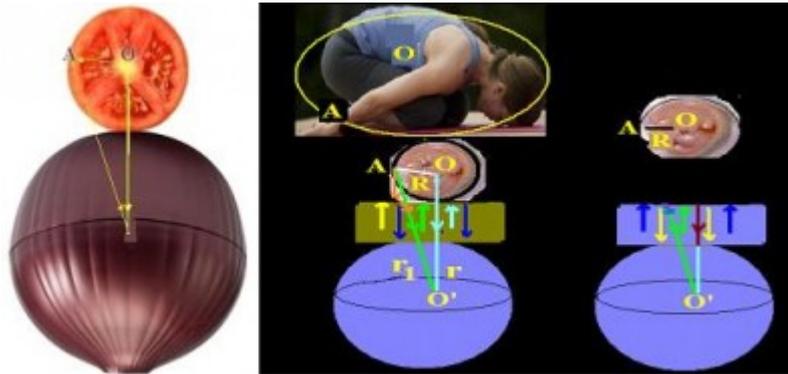
Illustration 24

Illustration 24. How far this apparently inverted foetus posture of opposite order can make impact on osteopathic manipulation or in other physiological disorders is a matter of investigation.

Illustration 25

Illustration 25. Researchers have devised model to show how a force that is applied to a larger biotensegrity structure can be transmitted throughout the biotensegrity structure at this level (A) and also to the biotensegrity structure at the next level down (B; e.g., a cell linked to its nucleus). But for initiating a motion of mechanical nature, there should be a basic or spontaneous force at each level of hierarchy.
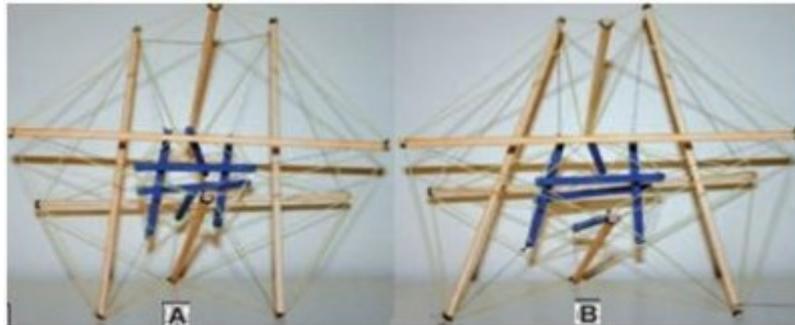
Illustration 26

Illustration 26. The junction of tension elements with a compression-resistant element can be viewed as a prestressed tensegrity model of a focal adhesion (FA) complex within the cell, considering focal adhesion being in the central to the three dimensional transegrity model.
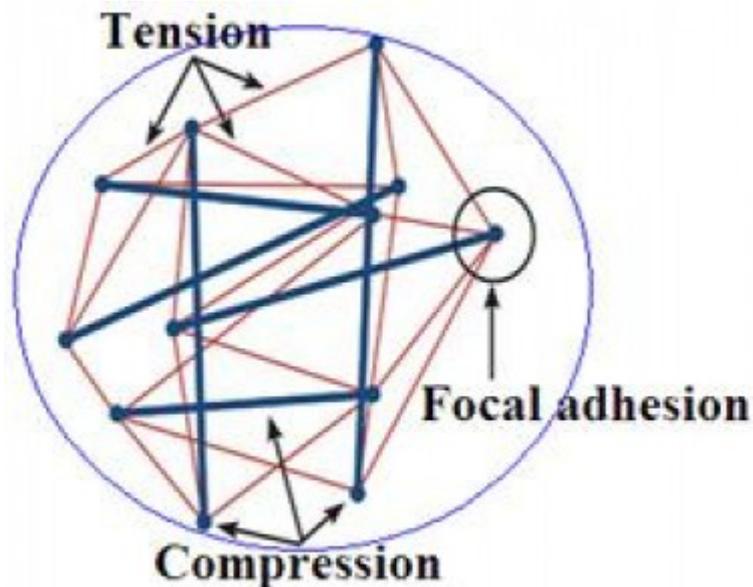
Illustration 27

Illustration 27. Blood flow back to the heart or cardiac inputs through venous return depends on contract and relax position of calf muscle in the lower part of the body.
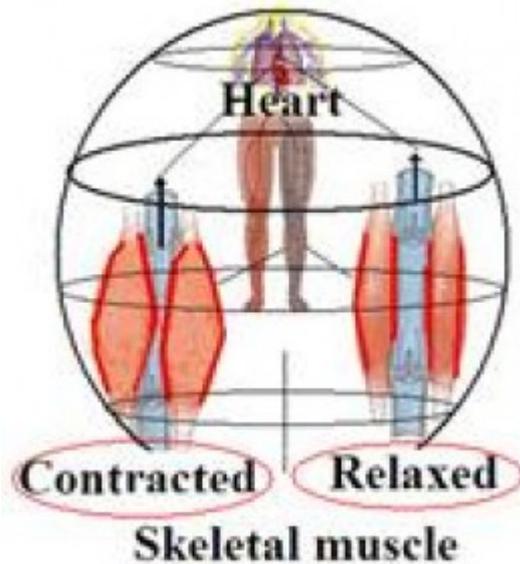
Illustration 28

Illustration 28. 'Tight' and 'relaxed' condition of inter endothelial cell junction in the upper part in the brain control blood-brain barrier and vasogenic edema during acute mountain sickness.
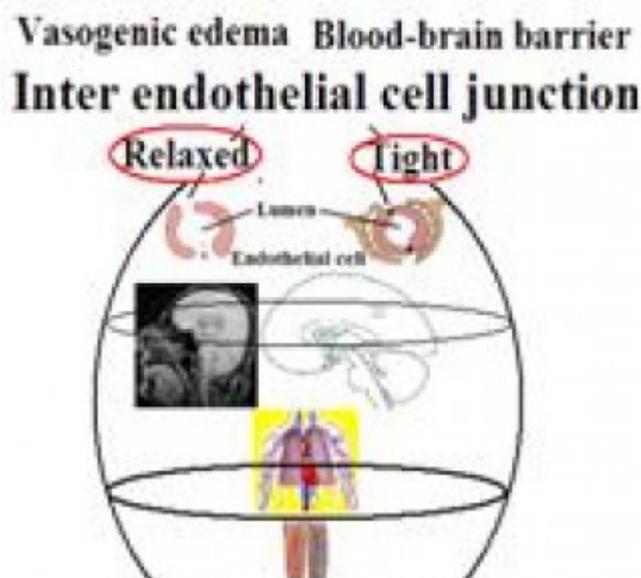
Illustration 29

Illustration 29. Tight and relaxation in the blood flow passage at the farthest points within the bounds of potential energy of self gravity might be triggered by the external gravitational attraction, similar to action of lever over fulcrum at the farthest points, as in Kelly forceps.
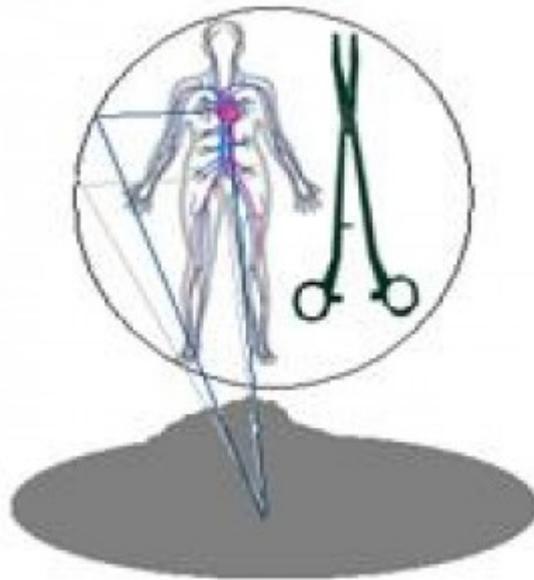
Illustration 30

Illustration 30. The launch position in the space shuttle: Existing practice (extreme left); foetus (middle) and proposed thematic self gravity friendly foetus postures (right). The foetus or similar yoga posture would probably ease out launching and landing stress. However it requires thorough investigation including daily duration of such exercises` as well as ancillary advantage and disadvantage of such postures.

Illustration 31

Illustration 31. Under buoyant force of sea water, the bowhead whale lives 200 or more years (left). Geometry of bowhead whale is more congenial to create self gravity friendly environment than that of blue whale (middle). Highest long-lived land animal on earth is turtle, having self gravity friendly posture (right)
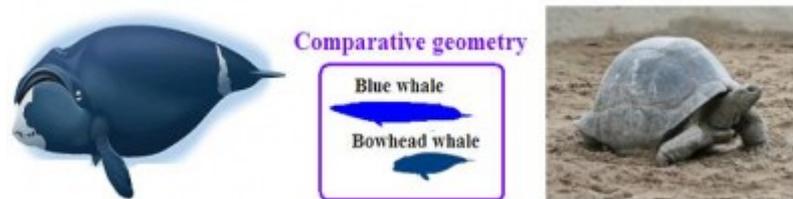
Illustration 32

Illustration 32. Earth's rotation is slowing down because of tidal bulge due to gravity and inertia caused by gravitational pull of the moon. Consequently extrinsic gravitational pull is increasing through geologic time resulting in a stretched situation for self gravity, resulting in diminish of the size of the evolutionary living species in the earth progressively.
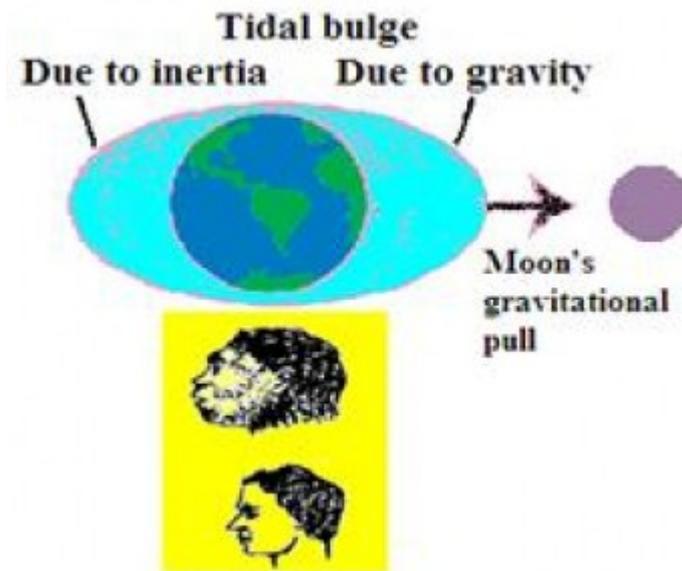
Illustration 33

Illustration 33. Due to buoyant force available in the sea, aquatic whale could maintain its macro-size, while land animal like dinosaur failed to maintain its giant size in the course of evolution. Dinosaur and rhinoceros both are of same land animals, except a difference in exposure in lower and higher gravitational force over long geologic period.
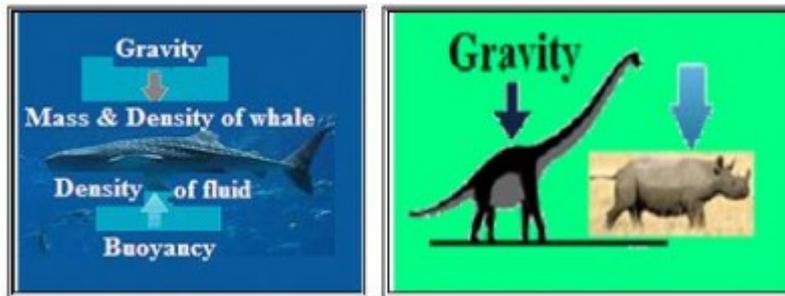
Illustration 34

Illustration 34. The evolution curve of the living species on earth is said to be of sigmoid shape. The speed of the rotation of the earth had reached its plateau, in terms of geologic time, at the time when Homo erectus first appeared, as in wheel of laugh.
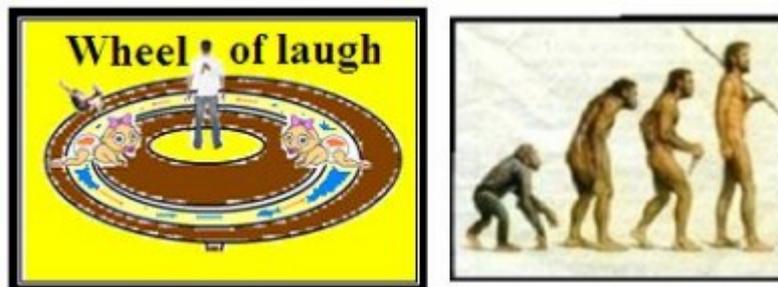
Illustration 35

Illustration 35. Gravity is the building block of the universe. It is omnipresent at microscopic, mesoscopic and macroscopic scale. Elaborate studies are being made at microscopic and macroscopic scale. Unfortunately such studies are completely ignored at mesoscopic scale, especially in biological science. This is a primary gap area of investigation in life science.

Illustration 36

Illustration 36 equation 1 to 3

$$(Gm/(r-R)^2) - (Gm/(r)^2) \tag{1}$$

$$(GmR(2r-R)/((r)^{(2)}) (r-R)^2)) \tag{2}$$

$$(Gm/(r+R)^2) - (Gm/(r)^2) = ((-2GRm)/(r)^3) \tag{3}$$

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