Invisible Force of Self Gravity: A Gap Area of Investigation in Life Science

Corresponding Author:
Dr. Iresh R Bhattacharjee,
Principal Scientist, Institute for Instrinsic Gravitation Biology (i3GB) {Assam Agricultural University}, 84,GMCH Road, Anandanagar, Dispur, Guwahati-781 005 India {C/O L.Dr.G.C.Bhattacharjee, Longai Road, Karimganj-788712, India}, 781005 - India

Submitting Author:
Dr. Iresh R Bhattacharjee,
Principal Scientist, Institute for Instrinsic Gravitation Biology (i3GB) {Assam Agricultural University}, 84, GMCH Road, Anandanagar, Dispur, Guwahati (C/O L Dr G C Bhattacharjee, Longai Road, Karimganj-788712, Assam, India), 781005 - India

Competing Interests:

There is no competiting interest.

Invisible Force of Self Gravity: A Gap Area of Investigation in Life Science

Author(s): Bhattacharjee IR

Abstract

On the principle of abductive reasoning through successive approximation on sporadic set of evidences, explanation is sought on the possible role of invisible force of self gravity in biological mass. For instance, phenomena of self organization in living cells are now considered epigenetic in origin. It is theorized that invisible force of self gravity may be responsible for self organization of macromolecules at and beyond organelles. Buoyant like force (neutral buoyancy) apparently reduce weight of living mass on counteracting stronger extrinsic gravitational force and facilitate self gravity's miniature free fall condition. Metabolism stops under reduced fluid level due to imbalance in gravitational-hydrostatic equilibrium within the cellular structure stressing the importance of metabolically inert infrastructure (MII) as cell's environment. It is also proposed that gravitational anchor is a criterion for manifestation as living. As central position is vital for compressive self gravitating body, nucleoid, nucleolis or nucleus act as the 'core' segment of the self gravitating interior of living cell and under neutral buoyant condition, central attraction could change concentric to eccentric nucleus. Energy producing organelles or sites (mitochondria, chloroplast etc.) is thought to be located away from the central load of the gravitating body. Physical parameters influenced by self gravity determine biological growth rate. Quantity of mass is assumed to be important criteria towards structural sophistication, in generating metabolic energy, in manifestation of all morphological symmetries. Self gravity also seems to mimic miscellaneous role including isostatic balance, rhythmic growth on identical astrophysical principles of larger mass.

Content

Introduction

I. Physical property of self gravity

1. Self organization- intrinsic property of self gravity
2. How self-gravity could be strong at miniature scale?
3. How binding action of self gravity could be a reckonable stronger force in biomass?

II. Buffering pad maintains self gravity's free fall condition

4. Mechanism of separation from extrinsic gravity
5. Relative three tier reference frame
6. Buoyant like force maintain self gravity's free fall condition
7. Reduced fluid level stop metabolism
8. Neutral buoyancy apparently reduce weight and facilitate self gravity's playing ground
9. Buffering action through repelling electrostatic force
10. Importance of metabolically inert infrastructure (MII) as cell's environment

III. Metabolic energy and self gravity

11. Whether gravitational anchor is a criterion for manifestation as living?
12. Energy producing organelles or sites located away from the centre
13. Some anomalous hypothecations in health science
14. Body Mass Index (BMI)
15. Body Surface Area (BSA)
16. Basal Metabolic Rate (BMR)

IV. Centre of self gravity

17. Why central position is vital?
18. Nucleoid, nucleolis or nucleus tend to remain in central position
19. Centrosome and microtubule organization
20. Inner cell mass (ICM) influences potency in stem cells?
21. Metacenter and floating principle
22. Neucleus and neucleolus- 'core' segment of the self gravitating interior
23. Change in concentric to eccentric nucleus under neutral buoyant condition

V. General property of self gravity

24. Self organization due to self gravity
25. Formation of twin centre of mass on decrease in mutual attraction

VI. Morphometry and self gravity

Introduction

Biological science is passing through a major crisis over issue on forming 'self organization' in the cell. A living cell is not an aggregate of molecules but an organized pattern, structured in space and in time. Harold M Franklin[1] in 2005 made extensive reviews on the spatial organization of cells, including the arrangement of cytoplasmic constituents and the cells' global form, which is not explicitly spelled out in the genome. Genes specify only the primary sequences of macromolecules, portions of which are indeed relevant to the localization of those molecules in space. But cell architecture, for the most part, arises epigenetically. What could be the invisible epigenetic mechanism that could be the driving force and builds up organic complexity in a membrane-bound, structured setting and lead to spontaneous self-emergence of spatially organized systems from where molecules come to life?

Working on range of paradoxes in biology, on critically examining various reported works on these aspects, on undertaking strategic experimentations and observing on diverse living organisms randomly but in a purposeful meticulous way for last 40 years from ab initio stage to intermediate and final status, during intact state (in vivo), under removed condition (ex vivo) as well as in vitro culture of various living organisms and on carefully avoiding over-interpretation that may not lead to erroneous conclusions, I came to the approximation that presence of intrinsic gravity or in other words, self gravity, an invisible binding force that holds the body structures in place or is responsible primarily for 'self organization' is difficult to ignore. The reality of the cellular interior is determined by the equilibrium between self gravity and hydrostatic pressure including molecular/atomic forces that resist gravitational compression. But major problem is that how to perceive gravity in common day to day bio materials? This is similar to question for a blind man who is to be described presence of luminosity of photon in electromagnetic force. Hence on the principle of abductive reasoning through successive approximation on sporadic set of observations have to be resorted to explain at least in prima facie manner the possible role of invisible force of self gravity in complex biological mass. Presence of electromagnetic force is already established in living bodies, but presence of gravity has continued to be ignored, for no tangible reason, when all know that without 'mass', a living body cannot exist and gravity works only on 'mass'.

As per concept of molecular biology, DNA sequences are transcribed into RNA and then translated into amino acid chains; the latter fold spontaneously into functional proteins. But genesis of spatial architecture, including how molecules find their proper location in cell space, the origins of supramolecular order, cell morphology are not yet satisfactorily answered. Harold M Franklin[1] therefore concluded that "We urgently need a plausible and experimentally fertile hypothesis that starts with a driving force and builds up organic complexity in a membrane-bound, structured setting. No satisfying hypothesis of this kind is presently on the books, and in its absence holistic explorers of deep

time have been unable to initiate a research tradition that can thrive in today's intellectual and fiscal climate. But I have no doubt that this is the way to go; for only through the emergence of spatially organized systems can molecules come to life".

I. Physical property of self gravity

1. Self organization- intrinsic property of self gravity

To understand nature of self gravity, Prof. J.V. Narlikar[2], eminent astrophysicist, used an imaginary episode from the life of Aladdin. The Arabian Nights story of Aladdin and the magic lamp ends with Aladdin living "happily even after" with his princess and his magic lamp. But one hot summer's day, Aladdin, while on a tour of the Arabian Desert suffered sunstroke. He summoned the genie of the magic lamp and issued command "Take the Sun apart and distribute its bits and pieces far and wide so that it is completely destroyed". Genie started chipping off bits and pieces from the surface of the Sun. He has to work against the force of gravity (GxM^2/R, where G is the constant of gravitation; M is mass and R is radius). Aladdin began to have a second thought. He realized how essential the Sun was to the inhabitants of the Earth, including himself. So, while the genie was in the process of completing the job, Aladdin issued his next command: "Put all the bits of the Sun back together". The poor genie went back to execute the command. However, this time, to bring all the constituents of the Sun together, the genie no longer had to work against the gravity. In fact, while the genie had been temporarily called away by Aladdin to issue his second command, the bits and pieces left in space by the genie had already began to fall back together. Self gravity, which had been a opposing force for the first job, had now turned into an ally. And to put the Sun back together, the genie had to do no work. Instead, the amount of work, which the genie had earlier expended on the first job against the force of self gravity, would now be done by the force of self gravity to put the Sun back together (illustration 1). So from the imaginary story above it is clear that the self gravity is the natural inward compressive force for which genie had nothing to do to put sun in position. We will demonstrate how self gravity would be the binding force even at cellular level.

2. How self-gravity could be strong at miniature scale?

Gravity is the invisible building block of the universe.

Among the basic forces (nuclear, electro-magnetic & gravity), gravity acts on 'mass as action at-a-distance'. Living organism without "mass" cannot be imagined. So effect of gravity in living mass cannot be ignored. Biology starts in the particle hierarchy in non-Newtonian state, with accumulation of 'mass' at organelles or cell level[3,4,9] (illustration 2). The particle hierarchy shows sub-atom, atom, molecule, compound, organelles, cells, tissue, organ, organ system, and organism. Here we are to compare vital question on presence of competitive forces like electromagnetic, nuclear and elastic forces that could act as binding force at miniature scale. Both gravity and electromagnetism obey the inverse-square law, i.e. their strength declines by the square of the distance between interacting systems. In other respects, however, they seem to be very different. For instance, the gravitational force between two electrons is 42 orders of magnitude (10^{42}) weaker than their electrical repulsion. The reason electromagnetic forces do not completely overwhelm gravity in the world around us is that most things are composed of an equal amount of positive and negative electric charges whose forces cancel each other out. Whereas electric and magnetic forces are clearly bipolar, gravity is generally assumed to be always attractive so that no analogous cancellations occur. Gravity works on mass without any time frame, as if relatively constant like physical structure of a house. Electromagnetic force works on 'charges' in time bound manner, as if a relatively variable like an electric bulb based on off and on switch. All time supremacy of self gravity on mass therefore cannot be ignored.

On the other hand, theoretical calculation shows that exertion of gravitational forces which follows inverse square law gets increased from 0.0007 to 6.6726 dynes when quantity in two masses increase from 10^{-4} to 10^{-2} grams under same separation distance of 10^{-6} centimeter (illustration 3 Table 1). Similarly when separation distance is decreased from 10^{-6} centimeter to $10^{\wedge-10}$ centimeter for the same two masses of 10^{-4} grams each, the gravitational force is increased from 0.0007 to 66,726 dyne (illustration 4 Table 2).

Let us assume that a prokaryotic cell of *E.coli* is about 2 μm or $2x10^{-6}$ m long, 1 μm wide, diameter 0.8 um, wet weight $1x10^{-15}$ kg or $1x10^{-12}$ g, dry weight $3.0x10^{-16}$ kg or $3.0x10^{-13}$ g. Viruses range in between 30 to 300 nm or 300 to 3000 A^0 in size. The protein comprising a prion has a molecular weight between 50,000 to 100,000, corresponding to a particle size that is 100 times smaller than the smallest virus. Micoplasmas range in size (diameter) from 0.25 to 0.1 μm. Even with such miniature size, force of gravity cannot

become extinct. Then why to ignore basic force of gravity in living organism in presence of competitive forces?

3. How binding action of self gravity could be a reckonable stronger force in biomass?

Gravity is customarily considered as long distance force acting on massive body. But in fact, biology starts in non-Newtonian state as soft condensed matter in which the viscosity changes with the applied shear stress. Unlike fluid (say, water) which could return back to its original position after withdrawal of stress, soft matter displays a range of fascinating generic properties such as ability to 'self assemble' into complex structures, a large number of internal degrees of freedom, weak interactions between structural elements, and a large thermal fluctuations at room temperature, a wide variety of forms, sensitivity of equilibrium structures under metastable states to external conditions. The Newton's inverse-square law would be valid if there is no additional dimension. However, if we imagine that there are two additional dimensions, the dependence of the gravitational force would change from $1/r^2$ to $1/r^4$, or the gravitational potential could take the form, as illustrated in equation (1) and (2)[67]. If dividing by $1/r^{\wedge 2}$ is a small number, dividing by $1/r^{\wedge 4}$ (twice of $1/r^{\wedge 2}$) can make the corresponding gravitational force much stronger[5,6]. In item No. 8 below, the matter is again discussed at length. Therefore ignoring intrinsic gravity in living organism, as negligible force, is difficult under the present scenario. Gravity is not an instant force like others. Its manifestation is visible only at the later stage.

II. Buffering pad maintains self gravity

4. Mechanism of separation from extrinsic gravity

Arguments came from physicists that stronger earth's gravity would swamp the intrinsic gravity of small biomass. But moon, being self gravitating body could retain its identity even being swamped by the gravitational field of the earth, solar system or the universe. On close examination, clue can be found on keeping distance for intrinsic from extrinsic gravity. An egg floats on saline water, on working against earth's gravity, due to buoyant force (illustration 5a). Buoyancy acts against the force of gravity and so makes objects seem lighter with respect to gravity, as shown in equation (3) [67]. So we can extend that administering isotonic normal saline/fluid or amniotic fluid help to correct not only electrolytic balance but

also work against inertial gravity[7,8,9] (illustration 5b,5c).

5. Relative three tier reference frame

Spaargaren (1994) coined the term 'metabolically inert infrastructure' (MII) that consists of total body mass (body water, dissolved substances, mineral and organic deposits) and serves as storage of nutrients, transport and distribution of these materials. To act independently as living body, we propose that MII provide structural support to the organism with density-gradient buoyant force against intrinsic and extrinsic gravitational attraction for the biological mass.

Let us assume that self-gravitating biomass/ embryo, being powered by metabolic energy (ME) be in the accelerated reference frame, manifesting its physiological and genetic functionality. 'Metabolically Inert Infrastructure (MII)' is placed in the co-moving non-accelerated reference frame that are relatively stationary or at constant velocity, or non-aligned or acting in opposite direction of the energized accelerated self gravitating biomass or of the steady state supporting inertial reference frame at the specific point of time[11,12,13].

The situation is similar to children playing ball within a compartment of a running train. Here ball is in the accelerated reference frame and compartment is in the non-accelerated reference frame which is pivoted through wheels over inertial reference frame of the ground earth. While playing, children cannot distinguish whether they are playing in the running compartment of train or in the stationary ground.

6. Buoyant like force maintain self gravity's free fall condition

We consider self gravity, central attractive force acting on mass under free fall condition. A membrane bound living cell has three-dimensional region composed of cytoplasmic matrix and other organelles. Under hydro-gravitational suspension, pressure gradient in the fluid is not uni-directional. Archimedes principle estimate buoyancy on the basis of density of the solid and the density of the fluid and is valid only when the pressure gradient in the fluid is uni-directional and can be reduced to the constant of the form ? p = ?g, where ? is the average density of the fluid displaced by the submerged object and g is the gravity acceleration vector in the direction of the free fall of the object [14,15,16]. Only then the buoyancy force F becomes equal and opposite to the weight of the displaced fluid W = ?gV . For a comparatively semi-solid macromolecules surrounded by near spherically symmetric pressure gradients (such as a cellular nucleus suspended in cellular interior, as if a

planet within planet) the estimation of the buoyancy force in living mass must include explicit integration of all pressure forces that act on the entire submerged surface of that object. The divergence theorem (also called Gauss's theorem) [14] states that the total expansion of the fluid or gas inside some three-dimensional region W equals the total flux of the fluid or gas out of the boundary of W. In living cells, the definition of the divergence therefore follows naturally by noting that, in the absence of creation or destruction of matter, the density within a region of space can change only by having it flow into or out of the region. By measuring the net flux of content passing through a surface surrounding the region of space, it is therefore immediately possible to say how the density of the interior has changed. This property is fundamental in physics, where it goes by the name "principle of continuity." We propose that in biology, especially in living cell, such principles of continuity also operate. Divergences at a given point also describes the strength of the source or sink in the flow of fluid or gas representing expansion (positive) or compression (negative) of the vector field. While integrating the field's divergence over the interior of the region it should be equal to the integral of the vector field over the region's boundary. Therefore for near spherically symmetric pressure gradients (such as a cellular nucleus suspended in cellular interior) the estimation of the buoyancy force must include explicit integration of all pressure forces that act on the entire submerged surface of that object. It is a gap area of investigation to find appropriate pressure acting on macromolecules at particular growth stage.

7. Reduced fluid level stop metabolism

The cytosol or intracellular fluid (or cytoplasmic matrix) is the liquid found inside cells. The entire contents of a eukaryotic cell, minus the contents of the cell nucleus, are referred to as the cytoplasm. Most of the cytosol is water, which makes up about 70% of the total volume of a typical cell[17]. In eukaryotes this liquid is separated by cell membranes from the contents of the organelles suspended in the cytosol, such as the mitochondrial matrix inside the mitochondrion. The entire contents of a eukaryotic cell, minus the contents of the cell nucleus, are referred to as the cytoplasm. In prokaryotes, most of the chemical reactions of metabolism take place in the cytosol, while a few take place in membranes or in the periplasmic space. In eukaryotes, while many metabolic pathways still occur in the cytosol, others are contained within organelles. The cytosol has no single function and is instead the site of multiple cell processes. Studies in the brine shrimp have examined how water affects cell functions. It was found that reducing the amount of water in a cell below 80% of the normal level inhibits metabolism, with this decreasing progressively as the cell dries out and all metabolism halting at a water level about 30% of normal [18].

Why depth of fluid (below 80% of the normal) is important? Density (d) is defined as the ratio of an object's mass (m) to its volume (v): $d = m/v$. The specific gravity of a substance is defined as the ratio of the density of the substance to the density of water (1 gram/cm^3). This ratio is a convenient physical property since it has no units and is therefore independent of the system of measure used to determine it. Again the Pascal's law [19] invites the presence of entity of two bodies; first one is to dip on the other and pressure by it is to be applied to the enclosed liquid to express in transmitting equally to every part of the liquid. Effect of change in height in the cytosol or fluid column within living architecture, as in Pascal's law can be considered as gap areas of investigation. Is it what Harold M Franklin[1] prompted to say that "of cellular morphogenesis … we know much but understand little."

8. Neutral buoyancy apparently reduce weight and facilitate self gravity's playing ground

Neutral buoyancy is said to be a condition in which a physical body's density is equal to the density of the fluid in which it is immersed. This offsets the force of extrinsic gravity that would otherwise cause the object to sink. An object that has neutral buoyancy will neither sink nor rise. The actual mass of the human brain is about 1400 grams; however, the net weight of the brain suspended in the cerebrospinal fluid (CSF) is equivalent to a mass of 25 grams [20] i.e. what is 56 gm in human body will appear to be 1 gram only under neutral buoyant condition of the brain. Under such neutral buoyant condition with cerebrospinal fluid (CSF), brain is allowed to maintain its density without being impaired by own weight, which otherwise, would cut off blood supply and kill neurons in the lower sections (CSF) [21].

We know what is 6 kg on earth is 1 kg weight at moon. When a person arrives at moon, he will be acting as per external gravitational force of the moon and not as per that of earth. Accordingly a person when reaches moon feels lighter. A normal weight of a human child

at birth is say 3200 gm on earth but at moon its weight would be 531 gm. Let us examine embryonic and placental growth during gestation with the depth of fluid available in its surroundings to clear the contentions. Amniotic fluid index (AFI) is a rough estimate of the amount of amniotic fluid [22] and is an index for the fetal well-being. It is considered as a part of the biophysical profile. But real biophysical profile is not yet specified. AFI is the score (expressed in cm) given to the amount of amniotic fluid seen on pregnant uterus and calculated by a ultrasonograph. To determine the AFI, doctors use a four-quadrant technique [23, 24], when the deepest, unobstructed, vertical length of each pocket of fluid is measured in each quadrant and then added up to the others, or the so called "single deepest pocket" technique[25]. The linea nigra is used to divide the uterus into right and left halves. The umbilicus serves as the dividing point for the upper and lower halves. The transducer is kept parallel to the patient's longitudinal axis and perpendicular to the floor. The deepest, unobstructed, vertical pocket of fluid is measured in each quadrant in centimeters [26]. The four pocket measurements are then added to calculate the AFI. An AFI between 8-18 is considered normal. Median AFI level is approximately 14 from week 20 to week 35, when the amniotic fluid begins to reduce in preparation for birth. An AFI < 5-6 is considered as oligohydramnios. The exact number can vary by gestational age. The fifth percentile for gestational age is sometimes used as a cutoff value. An AFI > 20-24 is considered as polyhydramnios. What is the biophysical purpose of AFI?

Literatures on apparent weight under neutral buoyant force of amniotic fluid and utero as well as ex utero measurements are scanty. However, let us concentrate our attention to the works of Junwu Mu et al[27] who made in vivo quantification of embryonic and placental growth during gestation in mice using micro-ultrasound and pair-wise comparisons of in utero and ex utero measurements. They reported that when gestational age of mice reaches 16.5 days, the non-invasive predictive body weight remains to 0.792 gm in average. The crown-rump length (CRL) and abdominal circumference (AC) was reported to be the function of gestation age (illustration 6). The CRL and AC remain to be 16.22 mm and 23.4 mm respectively at that growth stage of mice. The average radius of the fetus can thus be considered to be roughly 9.9 mm.

Let us extend theoretically the fetal weight floating over amniotic fluid on the same principle of loss of brain weight in cerebrospinal fluid (CSF). Ignoring difference in the value of neutral buoyancy in cerebrospinal and amniotic fluids, due to differential presence of salt and other matters, the neutral buoyant weight of mice embryo of 0.792 gm would appear to be 0.014gm. The acceleration due to gravity on earth is about 9.8 m/s^2, whereas at moon it is 1.62 m/s^2. However, if we calculate acceleration due to (self) gravity under free fall condition in 0.792 gram of biomass at 16 days of gestational age of mice with radius 9.9 mm, separated by neutral buoyant force, as provided by Junwu Mu et al[6], using standard formula $g(s)= GM/R^2$, it comes to be about 5x10^-9 m/s^2. That is free fall acceleration to the tune of 5 nanometer per second square in a massive body of the planet may be negligible, but in an isolated living mass of the size 9.9 femtometer (9.9x10^-12 meter), acceleration of 5 nm/s^2 is quite a significant force.

For example, Soccer is being played by all ages. Playing standard, materials, circumference or weight of ball may age wise differ. For youth/adult, ball may be of leather having 70 cm circumference and 450 gram weight. For high school level students, circumference and weight of the ball may be reduced to 62 cm and 396 gram respectively. For kids, weight could be less than 100 grams. Everyone will play as per individual capabilities. Similarly action of self gravity on earth can result an apple to fall on earth, or that of moon can cause a person to move easily when at moon. Similarly free fall acceleration at nanometer level would be tremendous for protein, fat or any macromolecule of femtometer size and should not be overlooked in tiny fetal body. As such importance of operation of neutral buoyancy at cytosol or intracellular fluid (or cytoplasmic matrix) at cell level or amniotic fluid at mammalian level as mechanism for buffering pad to maintain self gravity's free fall condition or playing ground is difficult to ignore. However it is gap area of investigation.

9. Buffering action through repelling electrostatic force

Lipid bilayer is a universal component of all cell membranes (earlier it was designated as cell surface coat). The structure is called a "lipid bilayer" because it composed of two layers of fatty acids organized in two sheets. The lipid bilayer is typically about five nanometers to ten nanometers thick and surrounds all cells providing the cell membrane structure. With the hydrophobic tails of each individual sheet interacting with one another, a hydrophobic interior is formed and this acts as a permeability barrier [28]. The hydrophilic head groups interact with the aqueous medium on both sides of the bilayer. The two opposing sheets are also known as leaflets. Due to electrostatic force,

these double bonds inhibit "packing" of the molecules (in solids). Therefore in limited manner, the lipid bilayer may act as cushion or buffering pad for separation between gravity barriers of two gravitating bodies (self gravity and extrinsic gravity) under simultaneous operation and thereby possibly provides opportunity for unhindered action of the self gravity.

10. Importance of metabolically inert infrastructure (MII) as cell's environment

Cytoplasm is composed mainly of water. As stated earlier 'metabolically inert infrastructure'(MII)[10] describe liquids in the cell. In unicellular organisms, cell's environment- viz. a substratum beneath it, a liquid medium around it and neighboring cells beside it; whereas in multicellular organisms, aggregation of cells and tissues with sufficient intra and extra-cellular matrix in totality affect 'life', due to co-moving non-accelerated position of the metabolically inert infrastructure (MII) that are relatively stationary or at constant velocity, or non-aligned or acting in opposite direction of the energized accelerated self gravitating biomass or of the steady state supporting inertial reference frame at the specific point of time. Thus MII seems to play anti (self) gravitational role. Without adequate MII support death occurs.

We propose few more examples of metabolically inert infrastructure, the exact role of which is so far not specified in biological science. Algae, for instance, cannot multiply unless they get an adequate depth of liquid media. Bacteria cannot survive outside the cultural media. Virus cannot survive without the support of any living host. Transfer a gene from one chromosome to other is to be carried through plasmid or bacteriophage which is said to act as vehicle. In biotechnologies, an enzyme is to be coated in a porus gel or fixed to a solid support which acts as media. Similarly solid support that contains substance usually a gel such as agar embedded in it for bacteria and yeast, nutrient broth (liquid nutrient medium) or Luria Bertani medium (LB medium or Lysogeny Broth); extracellular matrix components ; calf serum; suspension cultures; polyacrylamide gels, collagen gels, and basement membrane gels at cell–substrate interface for glioblastoma; organotypic cultures; etc are some other examples that appears to maintain invisible separation between self gravity and mutual gravity. Intravenous drip of 'isotonic saline' to an ailing patient seems not only corrects disturbances in water and electrolytic balance but also provides buoyancy to various life supporting organs or systems against gravitational pressure. Mucilaginous jelly which surrounds the embryo in amphibians such as frogs, toads as well as in insects possibly acts in a similar way. Hence it can said that role of metabolic infrastructure towards operation of self gravity is a vital gap area of investigation in biological science.

III. Metabolic energy and self gravity

11. Whether gravitational anchor is a criterion for manifestation as living?

It is theorized that a single cell is difficult to survive under natural condition without being self-gravitationally anchored or attaining steady state condition or under multi-assembled single cell condition. A single cell can survive in isolated exceptional way, when it is pivoted over fluid or similar other substance, appropriately anchored. But this is not a generalized phenomenon. In plant tissue culture, unless a callus of say above 500 mg or suspension of cultures of say, 3-4 cubic centimeter (in terms of packed cell volume) is used, it is difficult to maintain continuity of life and growth from individual cells. Similarly in the final volume for cell culture, maintaining cell density as low as 3×10^5 to high of more than $10–15 \times 10^6$ cells/ml of inoculums are required. Why a minimum mass is required for cell culture under multi-assembled single cell condition. Is it for anchorage? There is a literary proverb that "A Rolling stone gathers no moss". This is possibly not only a literary proverb but based on scientific observation and fact of the commoners.

As self gravity possesses potential energy, gravity has the characteristic that it would act or anchor as if entire biomass is concentrated at the centre or at the equilibrium point. Thus we can theorized that unless a biomass is anchored or pivoted in a steady state condition through the action of self gravity, attainment of accelerated condition would be difficult. This is similar to frictional force (force resisting the relative motion of two surfaces in contact) between feet and ground in steady state condition required for smooth walking. Mitochondria sometimes described as "cellular power plants" i.e. primary energy producer in the cell, generate most of the cell's supply of adenosine triphosphate (ATP), which are used as a source of chemical energy. Mitochondria constantly changes its shape, i.e. it remain in motion. Electron transport chain would be away from central core of a self gravitating cell, as the intensity of gravitational energy gets reduced from the core to the periphery when it can be overpowered by electrostatic force. Therefore we can propose that biomass with

generation of metabolic energy at "cellular power plants" on being anchored starts manifestation in an accelerated reference frame to recognize as living organism.

12. Energy producing organelles or sites located away from the centre

Normally carbohydrate is considered as main source of energy for biological mass. One gram of carbohydrate on oxidation in the body during respiration gives about 17000 joules of energy, whereas 1 gram of fat gives about 37000 joules of energy. However, it can be marked that energy producing organelles or sites is located generally away from the centre of self gravity of a cell or away from the central axis of the biomass in a reference frame at that point of time, which derves to studied in details in proper perspective (illustration 7).

13. Some anomalous hypothecations in health science

We have noticed some anomalous hypothecation in health science on describing mass or weight viz. in describing Body Mass Index (BMI), Body Surface Area (BSA), Basal Metabolic Rate (BMR), Resting Metabolic Rate (RMR); Physical Activity Level (PAL), Lean Body Mass (LBM) etc. These are explained in details below with the invitation for formulating correct hypothecation in the light of self gravitation bio.

14. Body Mass Index (BMI)

Body Mass Index (BMI) or Quetelet index [29], remains a controversial statistical measurement of health. Body mass index is defined as the individual's body weight divided by the square of his or her height. {BMI= Weight (kg)/ height^2 (m^2)}. The WHO regards a BMI of less than 18.5 as underweight and may indicate malnutrition, or other health problems, while a BMI greater than 25 is considered overweight and above 30 is considered obese[30]. BMI determine risk of developing heart disease and other health problems such as diabetes. BMI <17.5 is an informal criterion for the diagnosis of anorexia nervosa.

As per 'Self Gravitation Bio', BMI is nothing but weight/ height or mass/volume = density of the body mass. It gives indication for quantum of self gravitational attraction, as density of the mass is important determinant of gravitational attraction. Age, an influencing factor of BMI, could be taken as the capacity to generate internal metabolic energy. Other influential factors include gender and accumulation of fat (adipose tissue) in individual body is primarily a reflection of differences in body mass and density. Once presence of self gravity is resolved in individual body, other factors can automatically be laid to rest on

meticulous study in right perspective.

15. Body Surface Area (BSA)

Body Surface Area (BSA) is used to measure renal function- glomerular filtration rate (GFR), to calculate cardiac index (cardiac output/BSA), Chemotherapy & Glucocorticoid dosing. Body surface area (BSA) is considered "normal"- 1.7 m², average (men) 1.9 m², (women) 1.6 m²; child (9 years): 1.07 m², (10 years) 1.14 m²; (12-13 years): 1.33 m²; neonate: 0.25; 2 year: 0.5 m². But in all those equations as detailed in equations (4) to (9)[67] encompasses 'weight' in their formula. Weight can be a measure for gravitational force over a mass. It cannot be a measure for 'surface area'.

  Therefore there should be a correction in our concept on body surface area with self gravitation bio.

16. Basal Metabolic Rate (BMR)

Basal metabolic rate (BMR) is the amount of energy expended while at rest in a neutrally temperate environment, in the post-absorptive state (meaning that the digestive system is inactive, which requires about twelve hours of fasting in humans). The release of energy in this state is sufficient only for the functioning of the vital organs, such as the heart, lungs, brain and the rest of the nervous system, liver, kidneys, sex organs, muscles and skin. BMR decreases with age and with the loss of lean body mass. Increased muscle mass can increase BMR. Aerobic fitness level, a product of cardiovascular exercise, while previously thought to have effect on basal or resting metabolic rate (RMR), has been shown in the 1990s not to correlate with BMR. BMR is measured under very restrictive circumstances when a person is awake, but at complete rest. An accurate BMR measurement requires that the person's sympathetic nervous system not be stimulated.

In absence of proper viewing perspective over the definition of 'mass', as measure of gravitational force, calculation of metabolic rate remains controversial from 1880 as illustrated in equation (10) to (13) [67]. Mass is synonym of gravitational force. No effort has been made to understand that 'mass' is an abstract substance whose presence can possibly be felt also taking into account intrinsic and extrinsic 'gravitational force'; with resting metabolic rate (RMR) for meeting most of the demands of working against self gravity; where as physical activity level (PAL) could mostly to meet demands for working against extrinsic gravitational force. Hence through appropriate simulation incorporating concepts of self gravitation bio, the present day vague controversy could be

straightened with satisfaction of all corners. Once the presence of self gravity in biological mass is accepted it would be a precursor of various new researches in biological science including health of human, animal, plant and microbes.

IV. Centre of self gravity

17. Why central position is vital?

The central position in a gravitating system would be as if the entire mass in the sphere of influence would have been concentrated at that point, a distinguishable features of gravitational force from other basic forces viz. electromagnetic forces or any other local forces like surface tension, elastic forces etc.

18. Nucleoid, nucleolis or nucleus tend to remain in central position

Nucleoid in prokaryote and nucleolis or nucleus in eukaryote, all which are made of swarm of macromolecules and little denser in the spatial distribution than the surrounding cytoplasmic matrix, attempt to remain in central position of the cell.

19. Centrosome and microtubule organization

As regard centrosome and microtubule organization, it can be seen that microtubules in most cells extend outward from a microtubule-organizing center, in which the minus ends of microtubules are anchored. In animal cells, the major microtubule-organizing center is the centrosome, which is located adjacent to the nucleus near the center of interphase (non-dividing) cells. During mitosis, microtubules similarly extend outward from duplicated centrosomes to form the mitotic spindle, which is responsible for the separation and distribution of chromosomes to daughter cells. The centrosome thus plays a key role in determining the intracellular organization of microtubules, although most details of its function remain a mystery.

Centralized arrangement of microtubules under inverted colour of the photograph taken on using green fluorescent protein (GFP) tagged proteins by Jeremy Simpson and Rainer Pepperkok 43are presented in illustration 8. Microtubules are the dynamic networks of protein filaments that give shape to cells and power cell movement. Picture possibly demonstrates the operation of invisible binding force of self gravity in living cell.

20. Inner cell mass (ICM) influences potency in stem cells?

Inner cell mass (ICM) influences potency in stem cells? For instance, pluripotent, embryonic stem cells

originate in inner cell mass (ICM) cells within a blastocyst44. Why inner cell mass or central position is an important location as non-potency stage for regeneration or differentiation in stem cells? Compared to periphery, attractive gravitational pull/ force towards core or central position are higher. Therefore potency for regeneration/ differentiation might begin when bio materials are displaced from the central position to the periphery. In central position (at core), inertial force of self gravity is strongest. Metabolic or other circumstantial energy working against it possibly fails to act in required differential function against the self gravity.

21. Metacenter and floating principle

Under floating condition, locating central position is dependent not only on the mass in question, but also on the density of the materials over which such mass floats. For a floating object to be stable, the center of gravity must be below the center of buoyancy. The metacenter is a line that intersects both the center of gravity and the center of mass. The center of gravity may push the mass downward while the center of buoyancy may push the mass upward. When a fish, for example, is being rocked back and forth, center of gravity and center of buoyancy would come closer together thus decreasing the metacenter; when center of buoyancy gets lower than center of gravity, the fish in water is going to flip.

22. Neuclues and neucleolus- 'core' segment of the self gravitating interior

Neuclues and neucleolus under inverted colour of the photograph taken on using green fluorescent protein (GFP) tagged proteins[43] shows that neuclues and neucleolus in vitro condition can be designated as the 'core' segment of the self gravitating interior of the living cell. (illustration 9)

23. Change in concentric to eccentric nucleus under neutral buoyant condition

Deviation from centre or not having same centre is known as eccentricity. For instance, plasma cells are large lymphocytes with a considerable nucleus-to-cytoplasm ratio. They have basophilic cytoplasm and an eccentric nucleus[45]. Why such eccentric nucleus? Such eccentric nucleus is possible only when gravity-buoyancy equilibrium of a macromolecular solid core of nucleus deviates from the centre of the inertial frame of reference. Gravitational attraction provides the restoring force that acts to return the eccentric core to its concentric position. Magnitude of the gravity force is proportional to the displacement so long as the density of the outer fluid is constant in the integrated

volume and the density distribution of the fluid in the remaining part of the vessel remains spherically symmetric as well as the average density of the core and the average density of the fluid that surrounds the core[46]. Gravity is the force that helps to stabilize the central equilibrium position of the inner macromolecular spherical core. The Archimedes principle provides not valid but only an average approximation for the buoyancy force of comparatively solid nucleus submerged in cytoplasmic fluid when the size of the nucleus is much smaller than its distance away from the center of the surrounding matrix.

V. General property of self gravity

24. Self organization due to self gravity

We have already explained that self organization is the intrinsic property of self gravity. Biology cannot be exception, once we recognize the existence of self gravity in biology. In a glass, of different liquids viz. honey, water, oil, alcohol can be organized one above other- thanks to earth's gravity induced density gradient. Similar to aforesaid example of stratification of liquids in presence of extrinsic gravity, we can draw a hierarchy of biomaterials in a membrane-bound cell under the influence of self gravity. DNA sequences are transcribed into RNA and then translated into amino acid chains; the latter fold spontaneously into functional proteins. But genesis of spatial architecture, including how molecules find their proper location in cell space, the origins of supramolecular order, cell morphology are not yet satisfactorily answered[1]. The sequence of macromolecules> molecular self-assembly> pushing denser macromolecules outward> formation of twin centre of mass with decrease in mutual attraction can be theorized in the following. Molecular self-assembly or self organization of denser materials at central location might be due to self gravity with energy producing organelles like mitochondria, chloroplast etc. little away from central position, as projected in illustration 10.

It is common to see that nucleoid in prokaryote and nucleolis or nucleus in eukaryote- all are made of swarm of macromolecules under symmetric pressure gradients. They could lie in the central position due to inward attraction of self gravity at the initial stage of cell growth. Biological macromolecules subsequently become lighter than the equivalent volume of cytoplasmic fluid due to concentration of salts, matrix and therefore could float away to the outward periphery from the central position of self gravity due

to side thrust generated by the co-moving denser fluids. Denser macromolecules are pushes outward due to hydrostatic or turgor pressure under near spherically symmetric pressure gradients. With the decrease in mutual attraction due to increase in distance, twin centre of mass forms, each exhibiting individual gravitating body as sketched in illustration 11.

25. Formation of twin centre of mass on decrease in mutual attraction

The centrosome is called the "microtubule organizing center". Centrosomes in animals contain two orthogonally arranged centrioles. The organelle located near the nucleus in the cytoplasm divides and migrates to opposite poles of the cell during mitosis. Pushing of denser macromolecules outward might be due to hydrostatic or turgor pressure develops during course of time. (illustration 12). Gravitational force is a function of the radial distance from the core. With decrease in mutual attraction, twin centre of mass, as if two gravitating bodies, one outside the other's gravity barrier could be formed. Location of pin-pointed centre of self gravity might be more defined in animal than in plant cell, where, in case later, effect of self gravity might be overshadowed by other local forces.

VI. Morphometry and self gravity

26. 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 (Illustration 13).

27. 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. Introduction of the concept of self-gravity (intrinsic) and its interaction with earth's gravity (extrinsic) possibly can crack the mystery behind such phenomena. Unless sensitive detecting device is evolved to detect feeble force of self-gravity, we will have to be contented with indirect evidences. 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 individual self-gravitating entity seems goes on changing with consecutive accumulation of mass. The resultant force operating at different angles involving self-gravity (variation may be due to any local perturbing effect) and its interaction with extrinsic gravity, possibly pulls down the canopy of the neighboring plants to a single spherical entity with taller plant in the middle (illustration 14). 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.

28. 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. 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.

29. Bilateral symmetry and convectional morphogenic development in animals

The explanation of the developmental genetics[47] 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[48] 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[49] 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 under symmetric pressure gradients. 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. Possibly 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 possibly produces a fountain type convectional flow pattern[50] within the bounds of self gravity, depending upon respective polymeric constitution and rheological (soft condensed matter) property of the fluid. At neurula stage, the ectoderm could give rise to the central nervous system in convectional flow pattern. Sensory organs and the brain are connected at the fore-end. Mesoderm could give rise to a regular flow of circuit in blood vascular system in a convectional manner. Other organs including limbs, eyes could be formed in same convectional manner (illustration 15).

30. 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[51].

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.

31. 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[51].

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 it's 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 type force as internal energy transport mechanism in living world based on mass. In illustration 16, 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 type transport mechanism from high density to low density as comparatively warmer and from low density to high density mass as comparatively cooler. Hence it can be considered as gap area of investigation to explore morphological variations in the living world.

32. 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.

33. 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[9], heart, the first body organ to be functional, occupying the central position, acts possibly as core. (illustration 17a). 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 17b). 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 hinders pump in and pump out action of the heart.

34. 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) [52]. 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 possibly compensated by continued growth towards human leg- an isostatic balancing act of self gravity around central position (illustration 18). 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 possibly occurs through balance between majority of roots and shoots alternately, though root growth dominates during early period (illustration 19). Roots are comparatively denser than shoot on equal volume basis.

35. 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[53] found that phloem loading responds to changes in sieve tube turgor. Minchin et al[54] 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 possibly 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. 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[55]. Compensatory action of self gravity is also available among yield components of annual grain 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[56].

On the other hand, for plant of smaller mass, say wheat of 300 gram, spacing is 10-15 cm, where as for plant of higher mass, say mango tree of 1 ton weight, larger plant to plant distance of 6-8 meter is to be maintained. As per traditional knowledge, competition for sunlight, nutrient etc. are commonly attributed as factors for plant spacing. But considering interactions of self gravity with that of mutual gravity, it can be shown that with increase in mass per unit area due to closure spacing, gravitational pressure would increase, resulting in lower yield. Plant spacing is therefore connected with mutual gravitational phenomena.

VII. Miscellaneous role of self gravity

36. Centrifugation and bio analytical protocol in laboratories

As per bio analytical protocol in laboratories, differential centrifugation[57] 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. The centrifuge operates on the principle of centrifugal force, and the particles in the sample separate in the tube based on density as the sample spins at high speeds. The amount of acceleration to be applied in the sample is often quoted in multiples of the acceleration due to gravity at the earth's surface. Presence of two gravitational entities therefore can be visualized in the process. Pre-centrifugation materials are arranged as per density gradient influenced by the major external gravitation field. Post-centrifugation order of succession possibly depicts in vivo sedimentation or natural setting of living organism in presence of central force of self gravity. Therefore it can be a gap area of investigation on the presence of two gravitational entities.

37. 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. The fundamental cause of obesity is still unknown[58]. It has already stated that we have conceived an idea wherein embryo develops out of metabolic energy in a 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 20. 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 as shown in illustration 21, instead of top, midle and bottom respectively, due to gravitational sorting of the earth. We explained earlier that convectional type of 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[59].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 material 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 cause of central obesity as shown in illustration 22.

38. What is the proper order of human growth?

Proper order of human growth, as per concept of self gravitation bio is the chronological sequence of growth, similar to a mechanical system of order of vibration, 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 is an important criterion for increase in order. From the example of accumulation of visceral fat in the central position, one should meticulously view the development from the initial growth order (say, from embryonic stage) while understanding morphological development.

39. '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 anomaly. Crowding contribute significantly to the high viscosity of the cytoplasm, a concentrated protein/sugar solution. Ellis RJ.[60] pointed out that macromolecular crowding is obvious but underappreciated. Weiss et al [61] 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 also in the light of operation of Pascal's law, especially under near spherically symmetric pressure gradients, as crowding of mass and hydrostatic pressure surrounding the mass are intimately related.

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

Kelvin-Helmholtz contraction hypothesis in astrophysics[62] 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 apparently observed, though actual reason is yet 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.

It seems that 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) as shown in illustration 23.

Biological growth generally 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 generally 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.

In plant, growth occurs in three steps or phases viz. formative, enlargement and differentiation. In annual plants, after rapid sprouting stage of seed, there is retardation. Growth increases slowly till mature seedling stage. Thereafter there is rapid growth up to most active tillering stage after which the growth slows down coinciding vegetative lag-phase. The growth rate again increases and then finally decelerates-ceasing when generative growth phase ends. Why all these rhythm? Rhythm is an associative property of keeping balance between inward and outward pressure in all gravitating bodies. Life science possibly cannot be exception.

41. 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 24). 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[47] '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 possibly 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.

42. 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[63]. 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*[64] 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[65]. 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, energy of self-gravity would starts dominating over metabolic energy, thereby seems limiting/ decreasing membrane surface area, pathways and cell size, out of pressure of the increasing self gravity, leading to per cent decrease in growth. Therefore, we can say that adults are in equilibrium between metabolic and gravitational energy where as infant and old are in non-equilibrium stage- former with higher metabolic energy and lesser gravitational energy and later is in its opposite.

VIII.

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 and it works only when a body is bounded by finite membrane. While investigating self gravity in biology, I have to make a long journey on studying mass from microscopic to macroscopic 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.. Classical physics adequately describes the observed effects of gravity over a range of 50 orders 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 apparantly dominates, the presence of classical gravity is being ignored. Hence the study was directed

to various gravitational phenomena at mesoscopic scale in the line of macroscopic scale.

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 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. Up to this stage, concept of self gravitation bio was therefore theorized to be based on identical astrophysical principles of larger mass on three broad features:

(i) Invisible Compressive energy of self gravity on accumulated biomass serving as foundation,

(ii) Metabolically inert infrastructure separating self gravitating body from external gravitational field; and

(iii) Metabolic energy in opposition resulting functions of 'life'.

The effect of self gravity has been conceptualized to manifest in various biological phenomena, viz. centre, central obesity and isostatic balance between heavier and lighter mass around centre of self gravity; self organization phenomena in cells, bilateral morphological symmetry arising from convectional surge, mass balance in plants; and mimics of contraction-expansion phases of larger gravitating bodies.

IX. Conclusions

Abductive validation is common practice in hypothesis formation in science. To draw conclusions, to make predictions, or to construct explanations in present day research, three methods of reasoning are chosen viz. deductive, inductive, and abductive approaches [66]. 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 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. 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. Attention is invited to the cross disciplinary experts to various gap areas of investigation on the role of invisible force of self gravity in biological science. Any suggestion/ advice/rectification to improve upon the concept is highly welcome.

Acknowledgement

References

1. Harold M Franklin: Molecules into Cells: Specifying Spatial Architecture. in American Society for Microbiology. Microbiol. Mol. Biol. Rev. December 2005 vol. 69 no. 4544-564. http://mmbr.asm.org/content/69/4/544.full doi: 10.1128/MMBR.69.4.544-564.2005

2. Narlikar, J.V: The Lighter Side of Gravity. 1-188. (1982)ISBN 0-7167-1344-6

3. Bhattacharjee, I.R.: Self-Gravity Dictates Biological Growth-in Myth or in Reality?:Proc.(Abstr.ID 327 General Biological Physics): 6th International Conference On Biological Physics (ICBP 2007), Montevideo, Uruguay, 27-31 August, 2007. http://icbp2007.congresoselis.info/resumenAmpliado.php?idTL=455

4. Bhattacharjee, I.R. Biomechanics of Intrinsic gravity: Self-Gravity Dictates Biological Growth. Proc. Joint 52nd Annual Meeting of the Biophysical Society and 16th IUPAB International Biophysics Congress, 2-6 February, Long Beach, California, USA) 2008. http://www.cell.com/biophysj/archive/issue?pii=S0006-3495(08)X7185-1

5. Newman, R: Current searches for non-Newtonian gravity at Sub-mm Distance Scales. Matters of Gravity 15, p18, (2000)

6. Chiaverini,J, Smullin,S.J, Geraci,A.A, Weld,D.M, Kapitulnik,A: New Experimental Constraints on Non-Newtonian Forces below 100 microns in High Energy Physics - Phenomenology (hep-ph) :Phys.Rev.Lett. 90:151101: arXiv: hep-ph/0209325v3 (2003)

7. Bhattacharjee,I.R.:Proc. (Abstr. Agril. Sciences):Part IV:76th session: Indian Science Congress:Madurai, 7-12 Jan, 1989.

8. Bhattacharjee,I.R.: Gravity Dictates Life-Death and Biological Growth (also agricultural productivity) Introductory Concept: ISBN-13: 9788170193203.March 1988.

9. Rajan Kashyap, Sagarika Bhattacharjee and I.R.Bhattacharjee. Mathematical approach on embryogenesis in the light of self gravitation bio. Proc. 17th International Biophysics Congress (IUPAB), Beijing, China. Oct. 30th - Nov. 3rd, 2011 (http://www.17ibc.org)

10. Spaargaren, D.H. Metabolic rate and body size- A new view on the 'Surface Law' for basic metabolic rate. Acta Biotheoretica. 42, (4). 263-269. 1994.

11. Bhattacharjee, I.R. Thoughts on biomechanics of intrinsic gravity: Proc. 96th Indian Science Congress Part II (Abstracts) Section XII (45): New Biology (including Biochemistry, Biophysics and Molecular Biology & Biotechnology) p38: 3-7 January, Shillong, Meghalaya. 2009.

12. Bhattacharjee, I.R., Rajan Kashyap and Shaptadvipa B. Intrinsic gravity versus metabolically inert infrastructure and basal metabolic rate in living mass: Proc. 7th European Biophysics Congress 11 -15 July, Genoa, Italy 2009.Eur Biophys J (2009) 38 (suppl.1):S35-S212. DOI 10-1007/s00249-009-0478-1

13. Bhattacharjee,I.R.: Self gravitation bio: Revolutionary concept depicting physics of life. Proc. The 17th International Biophysics Congress (IUPAB) The 12th Chinese Biophysics Congress. Abstract S22-05. P.136. Oct.30-Nov 3, 2011. Beijing. China.

14. Kreyszig E., Advanced Engineering Mathematics, John Wiley & Sons Inc., 8-th edition, 1999. ISBN 978-81-89866-48-8

15. http://mathinsight.org/parametrized_surface_orient

16. Noback, Charles; Norman L. Strominger, Robert J. Demarest, David A. Ruggiero (2005). The Human Nervous System. Humana Press. p. 93. ISBN 978-1-58829-040-3.

17. Luby-Phelps K (2000). "Cytoarchitecture and physical properties of cytoplasm: volume, viscosity, diffusion, intracellular surface area". Int. Rev. Cytol. 192: 189–221. doi:10.1016/S0074-7696(08)60527-6. ISBN 978-0-12-364596-8. PMID 10553280.

18. Clegg JS (February 1984). "Properties and metabolism of the aqueous cytoplasm and its boundaries". Am. J. Physiol. 246 (2 Pt 2): R133–51. PMID 6364846.

19. Bloomfield, Louis (2006). How Things Work: The Physics of Everyday Life (Third Edition). John Wiley & Sons. pp. 153. ISBN 0-471-46886-X.

20. Noback, Charles; Norman L. Strominger, Robert J. Demarest, David A. Ruggiero (2005). The Human Nervous System. Humana Press. p. 93. ISBN 978-1-58829-040-3.

21. Saladin, Kenneth (2007). Anatomy and Physiology: The Unity of Form and Function. McGraw Hill. p. 520. ISBN 978-0-07-287506-5.

22. Tom C Winter; Sanders, Roger C. (2006). Clinical Sonography: A Practical Guide. Hagerstown, MD: Lippincott Williams & Wilkins. pp. p502. ISBN 0-7817-4869-0.

23. http://www.fetalsono.com/teachfiles/Poly.lasso

24. http://www.perinatology.com/Reference/glossary/A/Amniotic%20Fluid%20Index.htm

25. Carr, Phyllis L.; Ricciotti, Hope; Freund, Karen M.; Scott Kahan (2003). In a Page Ob/Gyn & Women's Health (In a Page). Cambridge, MA: Blackwell Publishers. pp. p105. ISBN 1-4051-0380-9.

26.http://www.americanpregnancy.org/pregnancycomp

lications/lowamnioticfluidoligohydramnios.htm

27. Junwu Mu, John C Slevin, Dawei Qu, Sarah McCormick, and S Lee Adamson: In vivo quantification of embryonic and placental growth during gestation in mice using micro-ultrasound   Reprod Biol Endocrinol. 2008; 6: 34. Published online 2008 August 12. doi: 10.1186/1477-7827-6-34 PMCID: PMC2527569

28. http://www.sparknotes.com/biology/cellstructure/cellm embranes/section1.html

29. http://en.wikipedia.org/wiki/Body_mass_index

30. "BMI Classification". World Health Organization. http://www.who.int/bmi/index.jsp?introPage=intro_3.ht ml

31. DuBois D, DuBois EF. A formula to estimate the approximate surface area if height and weight be known. Arch Int Med 1916 17:863-71

32. Mosteller RD. Simplified calculation of body-surface area. N Engl J Med 1987;317:1098. PMID 3657876.

33. Haycock GB, Schwartz GJ, Wisotsky DH Geometric method for measuring body surface area: A height-weight formula validated in infants, children and adults J Pediatr 1978;93:62-66

34. Gehan EA, George SL, Cancer Chemother Rep 1970; 54:225-235:

35. Boyd E. The growth of the surface area of the human body. Minneapolis: University of Minnesota Press, 1935. (From: http://www.ispub.com/journals/IJA/Vol2N2/bsa.htm)

36. Rubner, M. Zeitschrift fur Biologie 19, 536–562. 1883.

37. Kleiber, M. Hilgardia 6, 315–353. 1932.

38. Brody, S. Bioenergetics and Growth (Reinhold, New York) 1945.

39. Harris J, Benedict F. "A Biometric Study of Human Basal Metabolism". Proc Sci U S a 4 (12): 370–3. 1918. doi:10.1073/pnas.4.12.370. PMID 16576330.

40. MD Mifflin, ST St Jeor, LA Hill, BJ Scott, SA Daugherty and YO Koh. A new predictive equation for resting energy expenditure in healthy individuals. American Journal of Clinical Nutrition, Vol 51, 241-247, 1990.

41. Basal Metabolic Rate- Wikipedia. http://en.wikipedia.org/wiki/Basal_metabolic_rate.

42. McArdle W, Katch F, Katch V. Enviromental factors and exercise. In: McArdle W, Katch F, Katch V (eds). Essentials of Exercise Physiology. Lea and Febiger: Philadelphia, pp 423–448, 1994.

43.http://www.molecularstation.com/molecular-biology-images/504-cell-biology-pictures/20-protein-gfp-localiz ation.html.

44. http://en.wikipedia.org/wiki/Inner_cell_mass

45. http://en.wikipedia.org/wiki/Plasma_cell

46. Tom J. Chalko Estimating Eccentricity of Planetary and Stellar Cores. NU Journal of Discovery, NUjournal.net, Vol 4, 2004, page 1

47. Pritchard, D.J: Foundations of Developmental Genetics.15-285.(1986) ISBN 0-85066-287-7

48. http://en.wikipedia.org/wiki/Arthur_Holmes

49. http://suite101.com/article/understand-plate-tectonics-continental-drift-a93735

50. H. Mavridis, A. N. Hrymak, and J. Vlachopoulos The effect of fountain flow on molecular orientation in injection molding. J. Rheol. 32, 639 (1988); http://dx.doi.org/10.1122/1.549984

51. Hansen, Carl J.; Kawaler, Steven D.; Trimble, Virginia (2004), Stellar Interiors (2nd ed.), Springer, ISBN 0-387-20089-4

52. http://en.wikipedia.org/wiki/Isostasy

53. Smith JAC, Milburn JA. 1980. Osmoregulation and the control of phloem sap composition in Ricinus communis L. Planta 148, 28-34.

54. Minchin, P. E. H., M. R. Thorpe, J. F. Farrar and O. A. Koroleva 2002. Source–sink coupling in young barley plants and control of phloem loading. Jr. Exptl. Bot., Vol. 53, No. 374, pp. 1671-1676

55. Richard W. Harris. Root-shoot ratios. Journal of Arboriculture 18(1) 39-42: January 1992

56. Bhattacharjee I.R. (1978) Note on seed rate as cultural method of weed control for Direct Seeded Short duration Paddy (Pusa 2-21): Science & Culture: Vol. 44 No.11. 504-505.

57. http://en.wikipedia.org/wiki/Differential_centrifugation

58. http://en.wikipedia.org/wiki/Abdominal_obesity

59. http://en.wikipedia.org/wiki/Gastrulation

60. Ellis RJ. "Macromolecular crowding: obvious but underappreciated". Trends Biochem. Sci. 26 (10): 597–604 (October 2001). doi:10.1016/S0968-0004(01)01938-7. PMID 11590012.

61. Weiss Matthias, Markus Elsner, Fredrik Kartberg, and Tommy Nilsson. Anomalous Subdiffusion Is a Measure for Cytoplasmic Crowding in Living Cell. Biophysical Journal.:87: 3518–3524: (2004)

62. Patrick G. J. Irwin. Giant Planets of Our Solar System: Atmospheres, Composition, and Structure. (2003). Springer. ISBN 3540006818.;

63. Groeneveld P, Stouthamer AH, Westerhoff HV. Super life--how and why 'cell selection' leads to the fastest-growing eukaryote. FEBS J. 2009 Jan; 276(1):254-70. PMID: 19087200

64. Chien AC, Hill NS, Levin PA. Cell size control in bacteria. Curr Biol. 2012 May 8;22(9):R340-9. Epub 2012 May 7. PMID: 22575476: PMC3350639

65. Patrick G. J. Irwin (2003). Giant Planets of Our Solar System: Atmospheres, Composition, and

Structure. Springer. ISBN 3540006818.
6 6 .
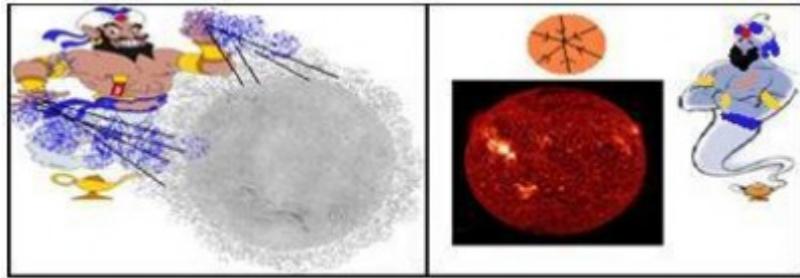http://butte.edu/departments/cas/tipsheets/thinking/rea
soning.html
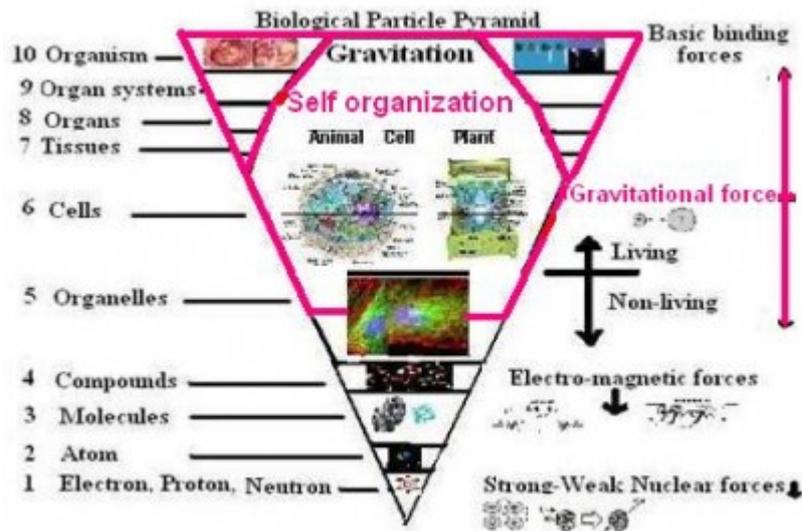67. Illustration 46. Eqn. (1) to (13)

Illustrations

Illustration 1

Illustration 1. Working against self gravity of the Sun was laborious for the Genie whereas keeping Sun intact, the Genie had no work. Self organization is the intrinsic property of self gravity.

Illustration 2

Illustration 2. Biological particle hierarchy and domain of various basic forces

Illustration 3

Table 1. Increase in gravitational force with increase in mass under same separation distance in miniature scale.

Mass$_1$ (gm)	Mass $_2$ (gm)	Distance (cm)	Gravitational force F (dyne)
0.0001	0.0001	0.000001	0.0007
0.001	0.001	0.000001	0.0667
0.01	0.01	0.000001	6.6726

Illustration 4

Table 2. Increase in gravitational force under same mass but with decrease in separation distance in miniature scale.

$Mass_1$ (gm)	$Mass_2$ (gm)	Distance (cm)	Gravitational force F (dyne)
0.0001	0.0001	0.000001	0.0007
0.0001	0.0001	0.00000001	7
0.0001	0.0001	0.0000000001	66,726

Illustration 5

Illustration 5 (a.b.c). An egg floats on saline water, on working against earth's gravity, due to buoyant force (illustration 3a). Similarly administering isotonic normal saline/fluid or amniotic fluid inside inertial womb/anatomical structure of mother might help to work against extrinsic gravity, apart from other functions as solvent etc. (illustration 5b, 5c).

(a)   (b)   (c)
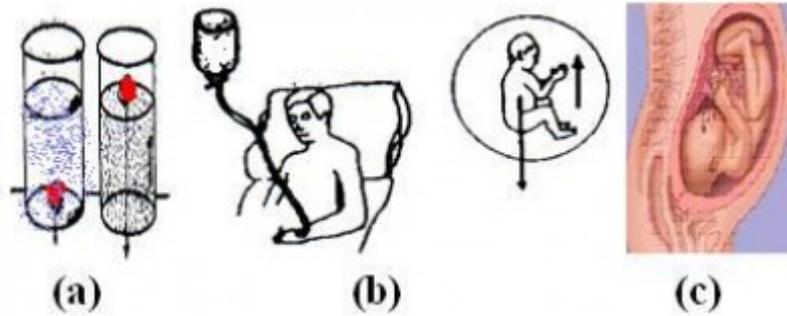
Illustration 6

Illustration 6. Pair-wise comparisons of in utero through ultrasound and ex utero measurements of CRL and abdominal circumference in mice (reproduced from Junwu Mu et al)27.
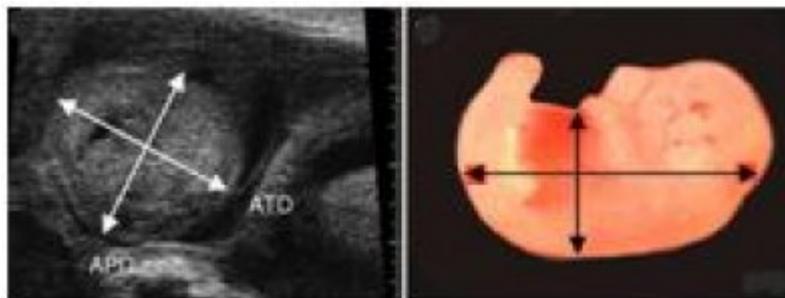
Illustration 7

Illustration 7. Energy producing organelles and mechanisms are away from the centre of self gravity of a cell or away from the central axis of the biomass in a reference frame in animal (illustration 7a), plant (illustration 7b) and prokaryotic bacterial cell (illustration 7c).
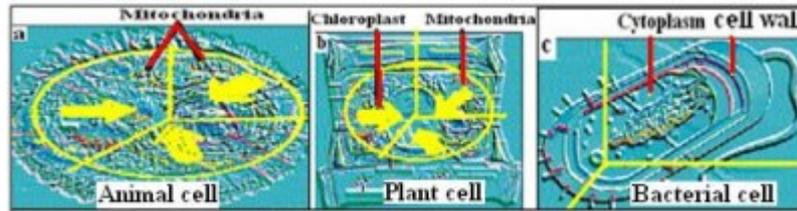
Illustration 8

Illustration 8. Pictures showing centralized arrangement of microtubules (a) taken on using green fluorescent protein (GFP) tagged proteins43 (photos with permission from Jeremy Simpson and Rainer Pepperkok) and under inverted colour (a') respectively. Microtubules are the dynamic networks of protein filaments that give shape to cells and power cell movement. Pictures possibly demonstrate the operation of invisible binding force of self gravity in living cell.
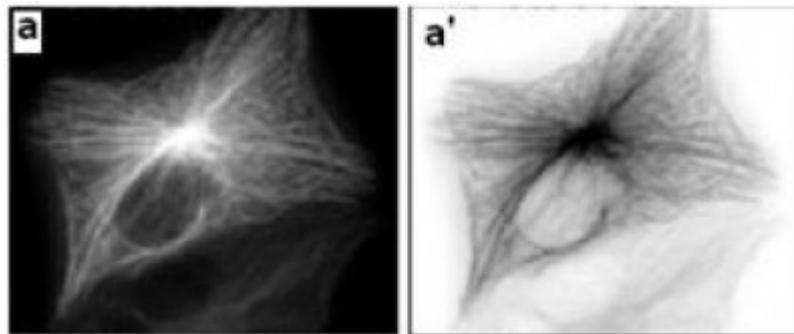
Illustration 9

Illustration 9. Pictures showing (a) neucleus and (b) neucleolus taken on using green fluorescent protein (GFP) tagged proteins43 (photos with permission from Jeremy Simpson and Rainer Pepperkok) and under inverted colour (a', b') respectively. Neucleus and neucleolus can be designated as the 'core' segment of the self gravitating interior of the living cell.
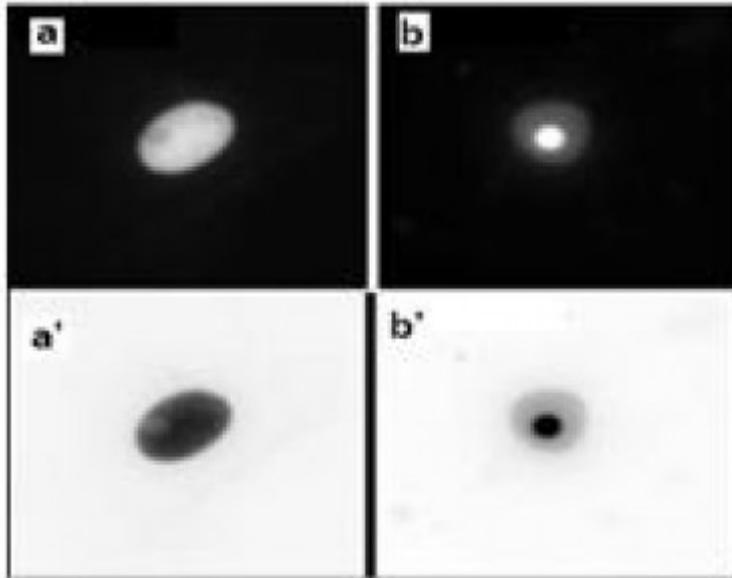
Illustration 10

Illustration 10. Picture showing mitochondria (a) using green fluorescent protein (GFP) tagged proteins43 (photos with permission from Jeremy Simpson and Rainer Pepperkok). Energy producing organelles mitochondria are little away from central position.
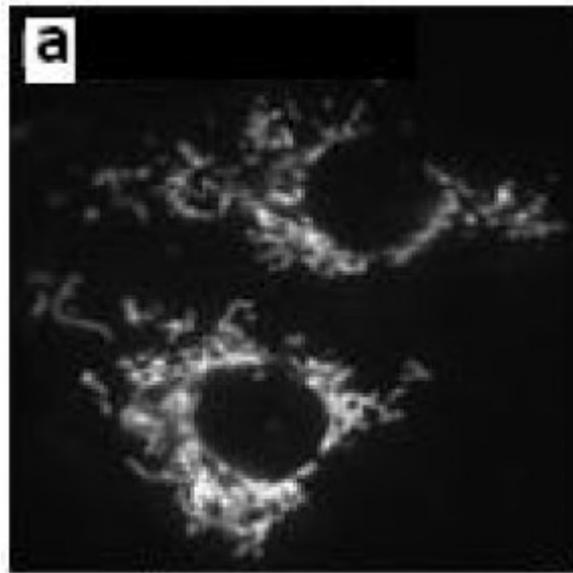
Illustration 11

Illustration 11. In a membrane-bound cell, hierarchy of biomaterials are shown with the sequence of (i) DNA> (ii) RNA> (iii)Protein> (iv)Macromolecules> (v)Molecular self-assembly> (vi) Pushing denser macromolecules outward> (vii) With decrease in mutual attraction, twin centre of mass forms.
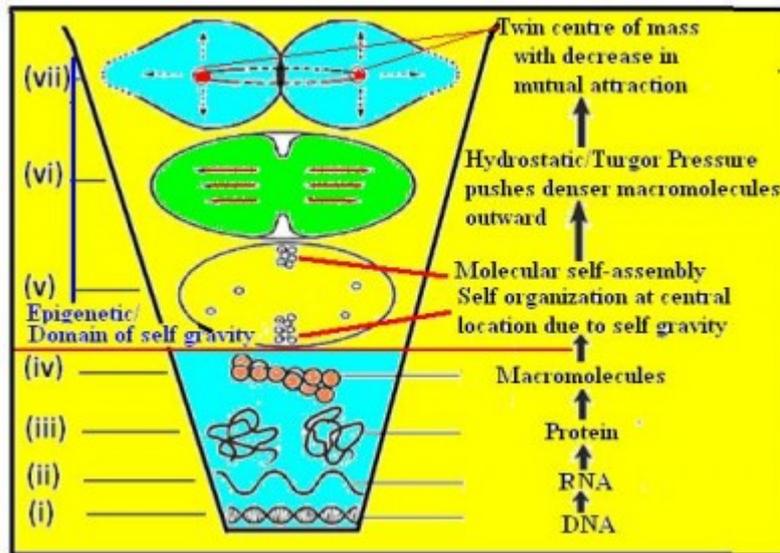
Illustration 12

Illustration 12. Picture showing centrosomes using green fluorescent protein (GFP) tagged proteins43 (photos with permission from Jeremy Simpson and Rainer Pepperkok). Centrosomes migrate to opposite poles of the cell during mitosis, possibly due to outward hydrostatic/ turgor pressure.
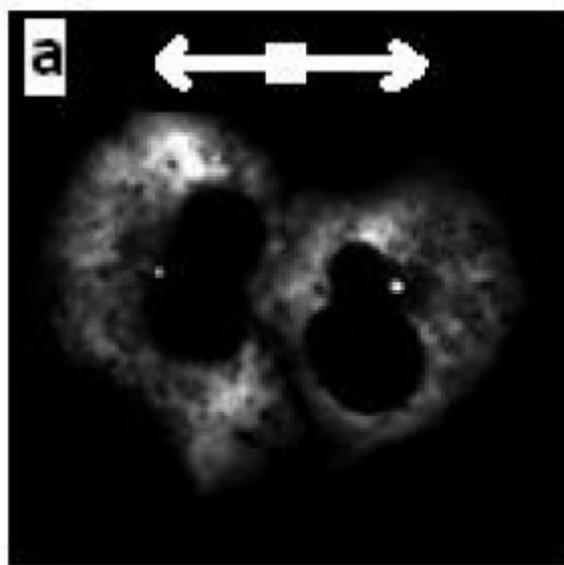
Illustration 13

Illustration 13. Why round? Why not squire? Why all living species are in spherical symmetry? 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 14

Illustration 14. Individual rice plants in a bunch develop in orchestrated manner with middle one taller. Why? The resultant force operating at different angles involving self-gravity and its interaction with planet's extrinsic gravity, possibly pulls down the canopy of the neighboring plants to a single spherical entity with taller plant in the middle.

Illustration 15

Illustration 15. Bilateral symmetry and convectional morphogenic development in animals is evident from the 'fountain effect' in frontal region.
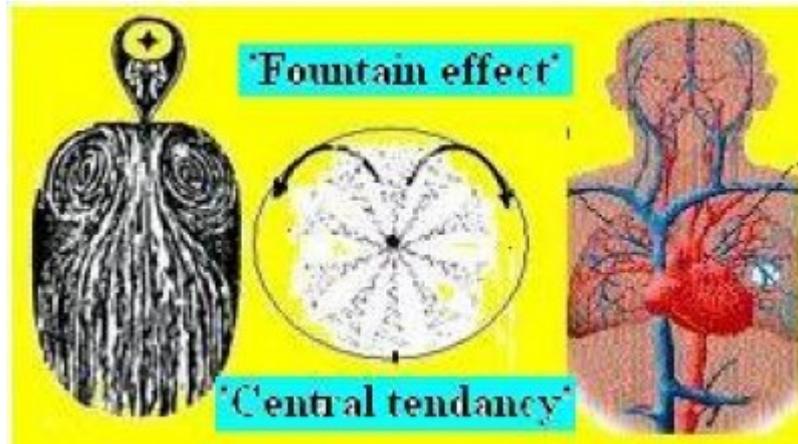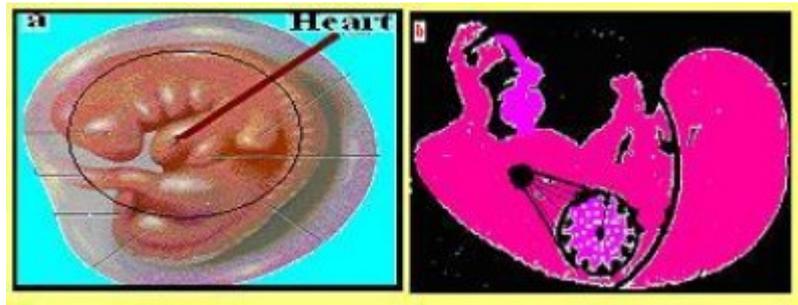

Illustration 16

Illustration 16. Variation in internal and morphological symmetrical structure depends on quantity of mass. In small mass, there is no 'fountain effect'- only 'central tendency' in overall structure, but in intermediate and high mass there is fountain effect as well as central tendency. Why?
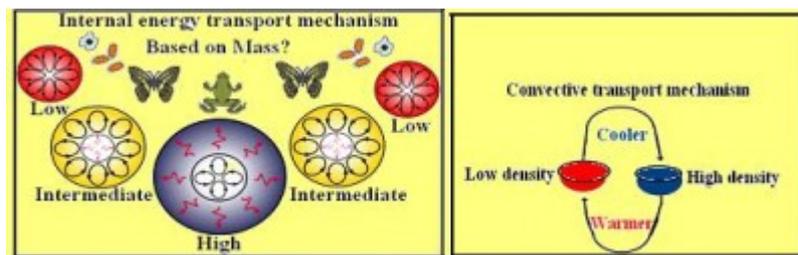
Illustration 17

Illustration 17a & 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). Can it be a clue to find relation between obesity and cardiovascular disease?
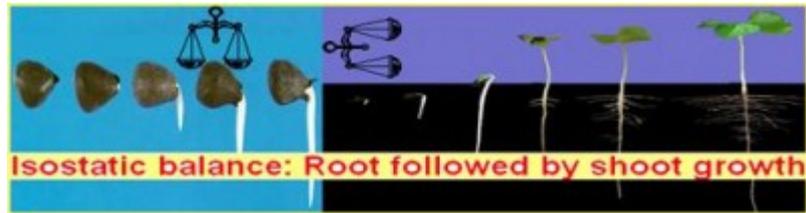

Illustration 18

Illustration 18. Isostatic balance: head is proportionately larger in infant. There is continued growth of leg during rest period.
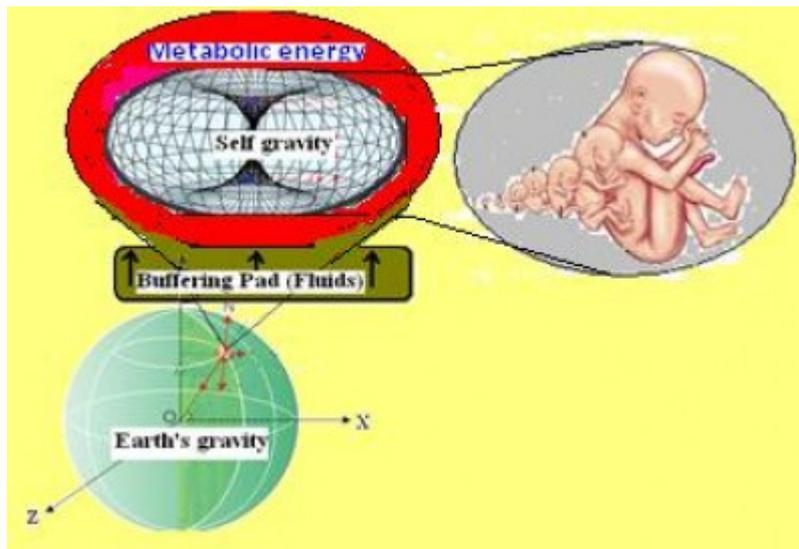
Illustration 19

Illustration 19. 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.
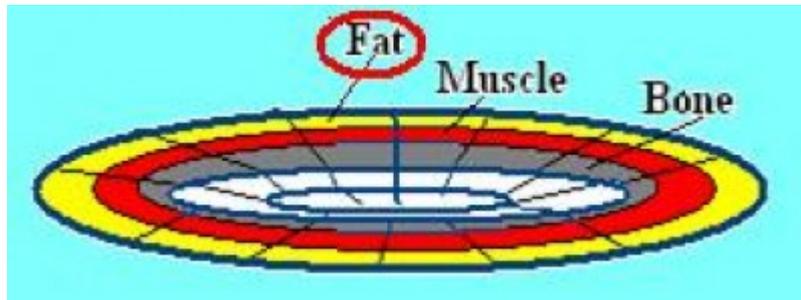

Illustration 20

Illustration 20. Embryo develops in self gravitating environment when it is apparently separated by buffering pad (amniotic fluid) from the stronger extrinsic earth's gravity.
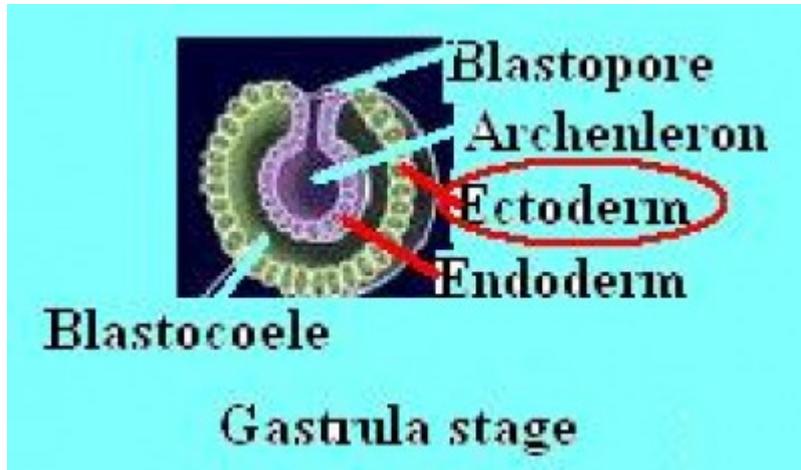
Illustration 21

Illustration 21. 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.
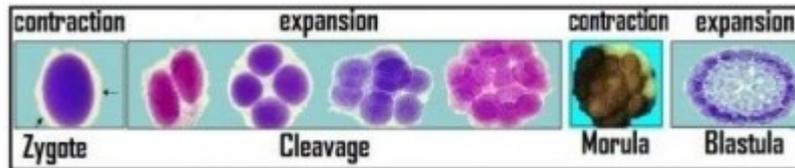

Illustration 22

Illustration 22. At gastrulation (blastula phase) stage, ectoderm remains in periphery and endoderm 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.
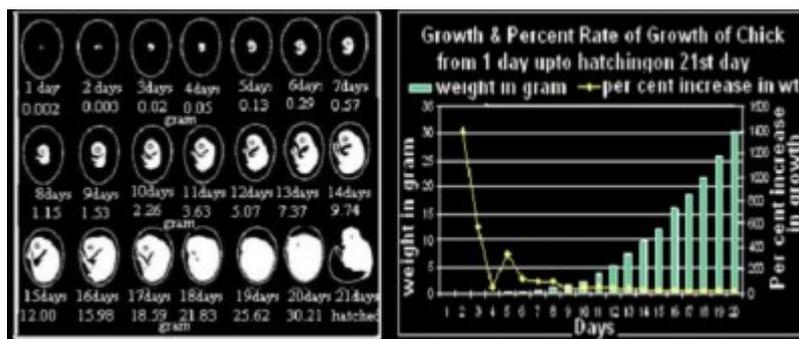
Illustration 23

Illustration 23. Thematic contraction-expansion phases in embryonic growth.

Illustration 24

Illustration 24. 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, can such unknown limiting factor be explained?

Illustration 25

Reference Equation (1-5)

Reference (equations)

67. **Illustration equation (1):** $F(r) = - G \,^\wedge_{4+n} \, m_1 \, m_2 \, / \, r \,^\wedge_{n+1}$ $r \ll R$ (Non-Newtonian)

68. **Illustration equation (2):** $F(r) = - G$ $m_1 \, m_2/r$ $r \gg R$ (Newtonian)

69. **Illustration equation (3) :** Buoyant mass m_b represents effective <u>mass</u> of the object with respect to gravity where $\mathbf{m_{object}}$ is the true (vacuum) mass of the object, whereas $\mathbf{\rho_{object}}$ and $\mathbf{\rho_{fluid}}$ are the average densities of the object and the surrounding fluid, respectively. Thus, if the two densities are equal, $\mathbf{\rho_{object}} = \mathbf{\rho_{fluid}}$, the object appears to be weightless. If the fluid density is greater than the average density of the object, the object floats; if less, the object sinks.

70. **Illustration equation (4):** BSA remains controversial starting in 1916 with the Dubois & Dubois formula [31],

$$x = (71.84 \times weight \; (\text{kg})^{0.425} \times height \; (\text{cm})^{0.725})/10000$$

71. **Illustration equation (5):** A commonly used formula is the Mosteller formula [32], published in 1987: (area in sq m from weight in kg and height in cm):

$$x = \sqrt{\frac{weight \times height}{3600}}$$

Illustration 26

Reference equation (6-9)

72. **Illustration equation (6):** Haycock formula (in children) [33]:

$$x = 0.024265 \times weight \ (\text{kg})^{0.5378} \times height \ (\text{cm})^{0.3964}$$

73. **Illustration equation (7):** Gehan & George formula[34]

$$S = 0.0235 \times height \ (\text{cm})^{0.42246} \times weight \ (\text{kg})^{0.51456}$$

74. **Illustration equation (8):** Boyd's formula[35]:

$$S = 0.0003207 \times height \ (\text{cm})^{0.3} \times weight \ (\text{g})^{(0.7285 - 0.0188 \log_{10} weight(\text{g}))}$$

75. **Illustration equation (9):** National Cancer Institute

$$x = (weight \ (\text{kg})^{0.425} \times height \ (\text{cm})^{0.725})/139.315$$

Illustration 27

Reference equation (10-11)

76. **Illustration equation (10) and (11):** Max Rubner (1880)[36] reported that mammalian BMR is proportional to Mass $^{2/3}$. Kleiber (1932) [37] supported by Brody (1945) [38] modified proportionality to Mass ¾. Several other prediction equations exist. Historically most notable was Harris-Benedict equation[39], which was created in 1919 an represented in equation (10) and (11).

for men,

$$P = \left(\frac{3.7516m}{1kg} + \frac{5.0033h}{1cm} + \frac{6.7550a}{1year} + 66.4730 \right) \frac{kcal}{day}$$

for women,

$$P = \left(\frac{9.563m}{1kg} + \frac{1.8496h}{1cm} + \frac{4.6756a}{1year} + 655.0955 \right) \frac{kcal}{day}$$

where P is total heat production at complete rest, m is the weight, h is the stature (height), and a is the age, and with the difference in BMR for men and women being mainly due to differences in body weight.

Illustration 28

Reference equation (12-13)

77. **Illustration equation (12):** It was the best prediction equation until recently, when MD Mifflin and ST St Jeor in 1990[40] created new equation:

$$P = \left(\frac{9.99m}{1kg} + \frac{6.25h}{1cm} + \frac{4.29a}{1year} + s \right) \frac{kcal}{day}$$

where s is +5 for males and −161 for female.

78. **Illustration equation (13):** During the last 100 years, lifestyles have changed and a survey in 2005 [41]showed it to be about 5% more accurate. These formulae are based on body weight, which does not take into account the difference in metabolic activity between lean body mass and body fat. A more accurate formula is the Katch-McArdle formula[42] based on lean body mass:

$$P = 370 + \left(\frac{21.6\ LBM}{1kg} \right)$$

Where LBM is the lean body mass in kg.

Disclaimer

This article has been downloaded from WebmedCentral. With our unique author driven post publication peer review, contents posted on this web portal do not undergo any prepublication peer or editorial review. It is completely the responsibility of the authors to ensure not only scientific and ethical standards of the manuscript but also its grammatical accuracy. Authors must ensure that they obtain all the necessary permissions before submitting any information that requires obtaining a consent or approval from a third party. Authors should also ensure not to submit any information which they do not have the copyright of or of which they have transferred the copyrights to a third party.

Contents on WebmedCentral are purely for biomedical researchers and scientists. They are not meant to cater to the needs of an individual patient. The web portal or any content(s) therein is neither designed to support, nor replace, the relationship that exists between a patient/site visitor and his/her physician. Your use of the WebmedCentral site and its contents is entirely at your own risk. We do not take any responsibility for any harm that you may suffer or inflict on a third person by following the contents of this website.