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REVIEW ARTICLE

GENOME MODEL OF LIVING-THINGS, DEFINITION OF A LIVING-THING, AND THE POSITION OF BIOLOGICAL VIRUSES AMONG LIVING-THINGS

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ABSTRACT

A genome is an organism's complete set of genetic material that contains all information needed to build and maintain/perpetuate that organism as well as to allow it to grow and develop. In every kind of living-thing the set of inheritable structural and functional differences from other living-things is caused only by the difference in the genome. Genome is the transformer of nutritive substances from one form into another among all living-things. The Cell Theory was identified false. Genome is the unit of both structure and function in all living-things. A living-thing is not yet defined until the emergence of this paper and it is globally stated to be a difficult task to develop the definition of living-things. As Toole G and Toole S have put & felt it, "it is strange to define that biology is the study of *living-things* and then to admit that we do not know what a *living-thing* is!!". Now, this paper imparts that a *living-thing* is defined as the product of reaction of its genome and its nutritive substances in its compatible environment. Biological viruses are certainly living-things. This is a giant and exceptional revolutionary advance in the history of both pure & applied biological sciences.

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INTRODUCTION

A genome is an organism's complete set of genetic material that contains all information needed to build and maintain that organism and also allow it to grow and develop. In other words, a genome is an organism's complete set of DNA/s or RNA/s in some viruses, including all of its genes. A genome of a living-thing (i.e., of an organism) may be a single molecule of DNA or it may consist of several molecules of DNA. The genome of each body cell is made of DNA/s [1, 2]. A single molecule of DNA is coiled up & covered with protein, forming a structure called chromosome (e.g., a human chromosome). Within human chromosomes, sections/segments of DNA are "read" together to form genes. Each species of all living-things has a unique genome. The human genome is composed of 46 molecules of DNA where each DNA molecule is covered by protein in each of the 46 chromosomes. The genome is also termed nucleic acid. We know that the study of living-things is biology, but we do not know what a living-thing is!! A living-thing is not yet defined. Of course, a living-thing is characterized by means of a specific organization, metabolism, movement, growth, reproduction, irritability and adaptation. But a characterization is not a definition. Definitions involve drawing a limiting boundry around some object, process or idea. A definition is an indicator which shows what something is by excluding other possibilities [3]. It is stated to be a difficult task to develop the definition of living-things [4-9]. AS Toole G and Toole S [10] have put & felt it, "it is strange to define that biology is the study of *living-things* and then to admit that we do not know what a *living-thing* is!!". Without knowing what a living-thing is we cannot state that the biological viruses are not living-things!!

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The key objectives of this study were:

- To construct a conceptual or verbal model of living-things,
- To state the definition of a living-thing,
- To set an equational formula of transformation of different nutrient substances into a living-thing,
- To determine or prove whether the biological viruses are living-things or not, and
- To investigate the biological structure that determines or completely controls the existence and continuing to exist of any one species of all living-things.

Review

Genome can be:

- A naked DNA (or RNA in some viruses) that enters a host cell and self-replicate,

- In a capsid protein of viruses or in a capsid protein that is additionally or secondarily enveloped by a two-layered lipid in some viruses,
- In a host cell,
- A single molecule of DNA being in a protein coat that constitutes a chromosome,
- Two or more molecules of DNA where each molecule of DNA is covered with a protein coat, forming a chromosome so that all of the DNA molecules found in all of the chromosomes are collectively referred to as the genome of the species. Example, 46 DNA molecules of man found in the protein covering (coat) of the 46 chromosomes form the genome of *Homo sapiens*. Here each of the 46 chromosomes contains only one molecule of DNA [1,2].

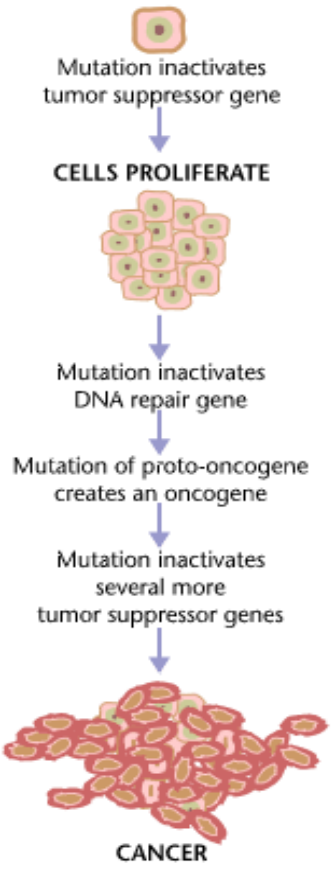
Nuclear genome and mitochondrial genome do exist as two different compartments in cells of many species. The majority of proteins present in mitochondria are encoded and transcribed by the nuclear genome. Over 200 nuclear genes are needed to replicate, transcribe, and maintain the mitochondrial chromosome and assemble the translation of proteins to express. It is generally believed that mitochondrial DNA is inherited exclusively from the mother. Although rare, the paternal inheritance of mitochondrial DNA may have a significant impact on disease development. Mitochondrial genes, other than being maternally inherited; they do not follow the Mendelian pattern of inheritance. Prokaryotes do not possess mitochondrion itself let alone the mitochondrial genome. Prokaryotes are living-things and capable of making specific copies of their own (replicate) as they possess their own specific genome for each species. Thus, the role of mitochondrial genome for the survival & replication of living-things does not exist among prokaryotes; therefore, the metabolic significance of the interaction between nuclear and mitochondrial genomes is elusive. At present, it is of scientific honesty to state that mitochondrial genome needs exerting more investigative study to understand its role in living-things although it does not exist at all in many species of living-things. When the role of the chloroplast genome is compared with that of nuclear genome, of the approximately three thousand proteins found in chloroplasts some 95% of them are encoded by genes of nuclear genome. The chloroplast is mostly under the control of nuclear genome. Chloroplast DNA as well as mitochondrial DNA is only maternally inherited. Why do mitochondria and chloroplasts require their own separate genetic systems, when other organelles that share the same cytoplasm, such as peroxisomes and lysosomes, do not? For maintaining these two separate genetic systems of organelles more than 90 proteins, including many ribosomal proteins, aminoacyl-tRNA synthesis, DNA and RNA polymerases, RNA-processing, and RNA modifying enzymes are encoded by genes of nuclear genome. This means that the nucleus must provide at least 90 genes just to maintain each organelle's genetic system. The reason for such a costly arrangement is not clear, and the the hope that the nucleotide sequences of mitochondrial and chloroplast genome would provide the answer has proved to be unfounded. Therefore, it is very scientific to be contained from confusion, leaving ample time for investigative research work on the specific roles of chloroplast and mitochondrial genomes [11].

Demonstrative and concrete evidences

Any collected set of data from a single-dimensioned experiment could not be enough to construct the genome model of living-things. As a result, it was the must to assemble an adequate and compatible data; and the source of such relevantly fit data had been found to be the accepted facts of biology in literature which were in turn used to interpret the nature of all forms of living-things in their natural environment by way of careful observation and integrative thinking. Based on these inputs, the following points are concrete evidences for the fact that the genome of a living-thing is the unit of both structure & function.

1. In every human race the set of inheritable structural & functional differences between a man and woman is caused only by the difference in genome; other than that they belong to the same species and race. In the genome of human male there is a different DNA molecule in one Y chromosome and not found in that of female, and the genome of female bears 2 DNA molecules as types in two X chromosomes whereas that of male bears only one DNA molecule as the type in one X chromosome. However, the genome in the male and the female contain the same number of DNA molecules (i.e., 46 DNA molecules represented as 46 chromosomes).
2. A cell in a person becomes a cancer cell due to change in its genome when it becomes a nondying cell with uncontrolled cell division.

Carcinogenesis



Cancers are caused by a series of mutations. Each mutation alters the behavior of the cell somewhat. Cancer is fundamentally a disease of tissue growth regulation failure. In order for a normal cell to transform into a cancer cell, the genes that regulate cell growth and differentiation must be altered, i.e., change must occur in the genome.

3. Down syndrome in humans happens when there is a change in the natural set of genome (the DNA molecule in chromosome 21 appears in 3 copies instead of 2 copies).
4. The cells of higher organisms can be infected by naked viral genome (nucleic acid), yielding normal virions (nucleocapsids) in the daughter generation. Naked viral genome has a much wider host range so as to replicate and result in several nucleocapsids than the unnaked viral genome (i.e., virions). The parent generation of the virus that enters the host cell is a naked genome without any protein coat called capsid, then the individual viruses of the daughter generation that emerge from the host cell must be naked ones without capsid because matter is neither created nor destroyed. But in this case, when the naked genome of the parent virus enters a host cell, the daughter individual genomes of the parent virus emerge, covered with capsid (virions) instead of being naked, from the host cell since the plan (coded information) to produce (synthesize) capsid protein covered virions/individual viruses that are like the original intact parent virus is contained in the sequence of nucleotides of the genome. This is the direct controlled proof/evidence for the fact that the non-genome parts/organelles or structures of every living-thing are produced by the coded information/plan of its genome from its nutritive substances in its compatible environment and does not contradict with the Law of Conservation of Matter which states that "matter is neither created nor destroyed". The genome is capable of self-replicating and thus can increase the number of molecules of itself together with the non-genome parts/organelles or structures of every living-thing by transforming its nutritive substances as raw materials/inputs into living-things in its compatible environment.
5. It is because the genome is the unit of both structure and function that the DNA Finger Print is used for the Accurate Identification at distinctive individual level.
6. Therapeutic genome editing:- has been found to be applicable in Agriculture and Medicine because it is the genome that forms (produces or makes) the biomass (the entire morphology & anatomy of the body) of the living-thing that contains it.
7. Genome has the code system of information that codes not only for structural & functional proteins, but also codes for the catalytic enzymes that catalyze the metabolic production or synthesis of all nonprotein biological molecules of the body such as cellulose, other polysaccharides, lipids, nucleic acids and vitamins. For instance, the envelope of bilayered lipid that encloses nucleocapsid in some species of biological viruses.
8. Genome is capable to self-replicate, being able to code for replication of itself from transformable nutritive substances of its compatible environment [12, 13]. Crick & Watson in their DNA Model for which they won novel prize have missed three very important points:

First, the concept of transformation of nutritive substances into several other daughter DNAs via self-replication was not realized by Crick & Watson. If the transformation of nutritive substances into daughter DNAs is not realized their concept of DNA Model will be in conflict with the "Law of Conservation of Matter". This concept is directly observed in the replication of genomes of the biological viruses in host cells of higher organisms.

Second, Crick & Watson failed to realize the fact that if there was no replication of genomes in all species of living-things, there would be no living-things on earth as there would be no cell division. Every mitotic cell division or every two rounded meiotic cell division is invariably preceded by replication of genome of the cell; in other words, all DNA molecules of the genome undergo replication in the interphase stage known as S-phase in cell cycle.

Third, Crick & Watson were not aware of the fact that all DNA molecules that form the full set of a genome replicate simultaneously to signal or to initiate the cell division of mitotic or meiotic type. It is only after genome replication has been completed that the two rounded meiotic cell division (meiotic division I and meiotic division II) including the mitotic division both in animals & plants can take place. In short, in any type of cell both mitotic and meiotic cell divisions can take place if and only if the replication of all DNA molecules of the genome is performed in the S-phase within the Interphase.

9. Gene Bank. Saving the genome of a species of a living-thing in a bank is saving that species so that it will be able to perpetuate against extinction. A single or a separated or an isolated gene for a single trait from its genome cannot be stored in bank of database with the technology of the present time and it cannot perpetuate the species either (like the full set of the genome it belongs to); actually, what is stored in the database of bank is the genome. A gene transfers only one trait of an organism to the next successive generations but a genome transfers all traits of the organism to the next successive generations and perpetuates the species of the organism against extinction by exerting its dictative control of replication to a countably indefinite number of generations. Therefore, the term Gene Bank must be corrected and be replaced by Genome Bank.
10. The chemical composition of genome from biological viruses to humans is the same, being phosphate, 5-carbon or pentose sugar and nitrogenous bases. This is why deletion or insertion of genes in genome editing and delivery of genes by viral vectors into host cells is practically possible at present. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T)/uracil (U). In the case of some viruses whose genome is RNA, the nitrogenous base instead of thymine (T) is uracil (U). Human DNA consists of about 3 billion bases, and more than 99 percent of those bases are the same in all people. The order, or sequence, of these bases determines the information available for building and maintaining an organism, similar to the way in which letters of the alphabet appear in a certain order to form words and sentences. DNA bases pair up with each other, A with T and C with G, to form units called base pairs. Each is also attached to a sugar molecule and a phosphate molecule. Together, a base, sugar, and phosphate are called a nucleotide. Nucleotides are arranged in two long strands that form a spiral called a double helix. The structure of the double

helix is somewhat like a ladder, with the base pairs forming the ladder's rungs and the sugar and phosphate molecules forming the vertical sidepieces of the ladder. The human Genome Project has estimated that humans have between 20,000 and 25,000 genes. Generally, in the kind of chemical composition a virus and a chromosome are the same as each of them is a nucleic acid coated (covered) with protein. In other words, a virus is a nucleoprotein (nuclocapsid) except a few viruses that possess additional envelope of lipid and a chromosome is also a nucloprotein. The exact repetitive building block of DNA or RNA (in some RNA viruses) molecule is a nucleotide. The wonderful cause for the differences of:

- genes in kind of trait they transfer, and
- genomes in the kind of species they perpetuate,

is the sequence of nucleotides in each of the DNA or RNA (in some RNA viruses) molecules. The only determinant (i.e., the exact) part of the nucleotide to cause the observable differences among genes in the kinds of traits they transfer or among genomes in the kinds of species they perpetuate by way of nucleotide sequence is the sequence of the nitrogenous base-pairs. This is true because in the nucleotide molecule the phosphate, and pentose sugar groups are identical in all nucleotides and cannot cause any difference in any kind of nucleotide sequence. The gene is defined as a segment of a DNA or RNA (in some RNA viruses) molecule.

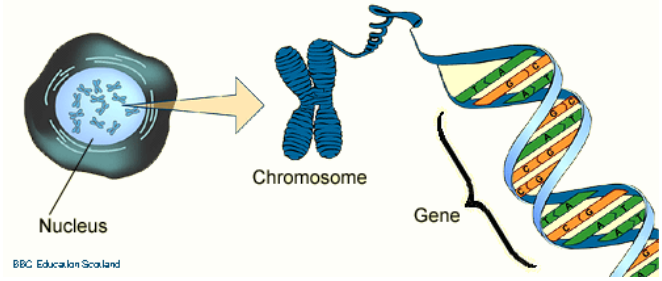


Figure 1. The gene showed where it is a segment of a DNA molecule drawn out from one of the two sister chromatids of a duplicated chromosome

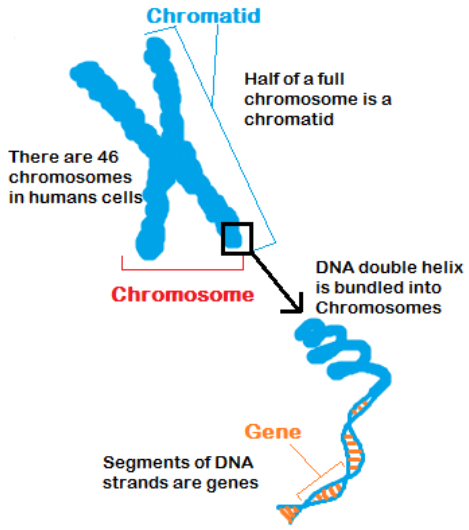


Figure 2. A gene located as a segment of a DNA molecule found in one of the two sister chromatids of a duplicated chromosome

This duplicated chromosome did not have two sister chromatids before its being duplicated and contained only one molecule of DNA. The cell with this chromosome is in the process of meiotic division I.

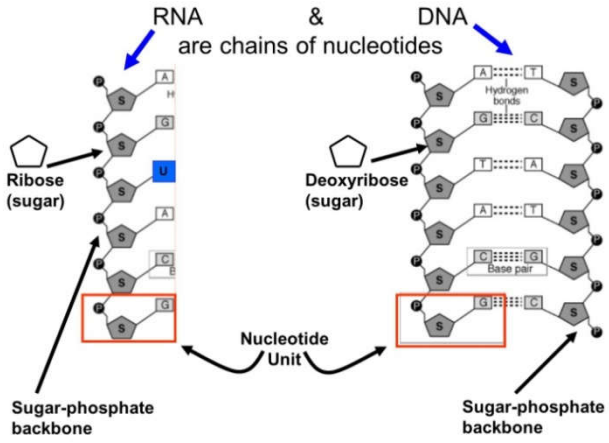


Figure 3. The structures of nucleotides displayed to show the fact that the phosphate, and sugar groups cannot cause any difference among genes or among genomes via the sequence of nucleotides because they are identical in all nucleotides from those of biological viruses to those of man

The nucleotides are shown both in **DNA** and **RNA** molecules.

11. Genome is the transformer of nutritive substances from one form into another among living- things. This is what is seen in food-chain of eating and being eaten. The nutritive substances eaten or absorbed are transformed into the individual organisms of the eater species which contained the transformer genome. When grass is eaten continually by sheep, the grass is transformed into several other sheep by the sheep genome. On the other hand, if the same grass is eaten continually by cattle, the grass is transformed into several other cattle by the cattle genome [14-21].
12. Transformation by somatic & germ line genomes in species of a living-thing.

Somatic: in dairy farm, mammary glands in collaboration with:

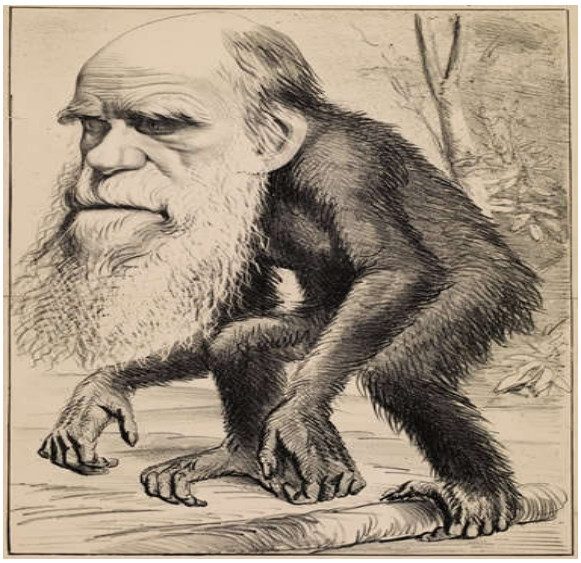
- the digestive enzymes in the digestive system, and
- the circulatory system do produce as many as 38 liters of milk per day by transforming grass & other nutritive substances into milk.

Germ line genome of the species: produces daughter generation of the same genome that contains the same coded system of information via self-replication. Sexual or asexual reproduction performs the transformation of nutritive substances into the daughter generations via self-replication of the genome. Self-replication was well done by Crick & Watson Model; however, they missed the concepts of:- transformation of nutritive substances in the compatible environment, the law of conservation of matter, and the dictative authority of genome on both mitotic and meiotic cell divisions by way of its preceding self-replication.

13. Embryonic stem cell or adult stem cell of a different animal species cannot be given to a person to repair and replace worn out or damaged tissues because the immunologically competent cells of the recipient find

that it is a kind of cell which has been replicated (produced) by a different genome with a different system of code and identify it as a foreign cell so that it will be destroyed by acquired immunity of the recipient. If a tissue or organ transplantation from a different animal species to man is executed a very strong graft rejection will occur exactly with the same mechanism as that against the stem cell by the immunologically competent cells of the recipient.

14. A mule is an interspecies hybrid that is sterile or infertile, being a dead end not to perpetuate as a species because of the problem with its genome, i.e., the problem of matching up of 32 DNA molecules from maternal origin (*Equus caballus*) with 31 DNA molecules from paternal origin (*Equus asinus*). During the first meiotic cell division pairing or synapsis, homologous DNAs (chromosomes) line up specifically point-to-point, i.e., homologous gene-to-homologous gene. The best practical evidences for the specific point-to-point synapsis of homologous DNAs (chromosomes) are formations of chromosomal (DNA) loops such as deletion loops and inversion loops. The homologous gene-to-homlogous gene synapsis or pairing cannot take place between the DNAs (chromosomes) of donkey origin & those of horse origin as they are from two different species with highly reduced homology and consequently cannot produce functional gametes. In other words, the DNA molecules organized in the form of chromosomes fail to match up during meiotic synapsis in order to produce functional gametes, proving the fact that a living-thing cannot exist or perpetuate without its functionally full set of genome. Because the genome is what determines what a creature is, each species of organisms may have a different number of DNA molecules, and truly in a different arrangement of nucleotides or genes in the genome which is different from that of any other species of living-things on earth. What differentiates species from one another forming the dividing line between them, is not that they do not look alike, it is that they are genomically isolated. If the cell was the unit of both structure and function in all living-things, ♂ mule & ♀ mule could have generated offspring because their ♂ & ♀ gonads and bodies are composed of cells; however, they are not able to reproduce next generation. This is the reason for why the Cell Theory is as false as Lamarckism. Charles Darwin's theory of evolution by Natural Selection and Origin of Species did not get the exact truth of biological science; it had been simply a battle (or struggle) of guessing for more than 40 years. He didn't target at the genome which is the transformer and the perpetuator of living-things. His theory of natural selection is an artificialized act on phenotypes of organisms whereas the actual cause of variations and evolution is only the change in the genome of the living-thing (organism). Darwinism is over artificialized by his diagram of the ape with the human-like face. His theory of evolution has been fused with the terms known as Natural Selection, Survival of the Fittest, and Preservation of the Fittest without knowing/ understanding the very cause of evolution or speciation. Darwinism is an erroneous theory and it has been confusing student children as well as scientists of biological sciences for many years. The confusing biological theories were the causes for our not being able to define what a living-thing was. Being confused is accepting and following the outcomes of a theory for which the establisher of the theory does not understand the cause of the outcomes. Natural Selection is an artificial term and is not the cause or the driving force of evolution. The only driving force of evolution is the change in the genome of a living-thing. Darwinism is also as false as Lamarckism. Although the scientific truth was not achieved in Darwinism, we have to forward a very great reward and elderly respect to Charles Darwin for his genuine determination & persistence to find out/understand the cause of evolution or speciation for about 40 years.



(a)

(b)

Figure 4: (a) Charles Darwin's diagram of ape with the human-like face forwarded to demonstrate the evolution of man; (b). Photograph of Charles Darwin, a British biologist

15. Parthenogenesis: Researchers for their investigative assessments about the effect of changing the number of DNA molecules in the genome of a species can use the organisms of specific species that reproduce offspring by involving the method of parthenogenesis, because they are practically observable models of nature. Example: In honeybees, eggs fertilized sexually with sperm from a drone father develop into females, while the production of further drones (males) depends on the

queen (occasionally workers) producing unfertilized eggs. This means that females (workers and queens) are always diploid, while males (drones) are always haploid; males being produced parthenogenetically from unfertilized eggs. In other words, the number of DNA molecules in the genome of individual female honeybee (worker or queen) is twice that found in the genome of individual male honeybee (drone). It can be seen that the difference in sex in humans is caused by change in genome brought about by difference in kind of DNA molecules that belong to the genome whereas in honeybees it is caused by change in genome brought about by difference in number of DNA molecules of the genome.

16. A single-celled Zygote of any multicellular plant or animal species develops (grows) into the reproductive adult stage that belongs to the species of its parents only. This is so because into what species a zygote (an offspring) develops is exclusively determined by the type of genome possessed by the parents. Example: A zygote of humans develops into the reproductive adult that belongs to the species of *Homo sapiens* only. A zygote of *Podocarpus gracillor* plants develops into the giant reproductive plant which belongs to the species of *Podocarpus gracillor* only. The uncoated genome of the deadliest Zaire Ebola virus self-replicates in its human host cell after penetration, giving rise to several copies of the full set of genome which will develop into virions (full sets of genome where each full set of genome is coated with protein called capsid) that belong to the type of deadliest Zaire Ebola virus only and not into any other type of virus. A zygoteof *Equus asinus* donkeys develops into a reproductive adult donkey that belongs to the species of *Equus asinus* only without making mistakes by belonging to any other species of animals!!
17. A person's ontogeny begins from a single-celled zygote and proceeds to the adult stage of maximum body weight, that consists of trillions of cells, by way of mitotic cell divisions. In these countably infinite number of mitotic cell divisions that occur in the body of a person, one cannot think of any one cell division of these to take place in the body of a person without the preceding self-replication of the genome as a signal, i.e., all DNA molecules that form the complete set of the genome do replicate simultaneously prior to each of the mitotic cell divisions. If cell division of meiotic as well as mitotic type is to occur in any type of cell in the body, the genome must self-replicate first and then only the sister chromatids are formed. The formation of two sister chromatids from a single chromosome that contains only one DNA molecule is a substantiated & spectacular evidence for the fact that the double helix DNA molecule is self-replicated into two daughter DNA molecules that are identical to their parent DNA molecule. The two successive meiotic cell divisions (meiotic division I & meiotic division II) to produce gamete/s are initiated by only one preceding self-replication of the genome found in that gamete producing cell. Each sister chromatid contains one double helix DNA molecule and also any one normal chromosome always contains only one double helix DNA molecule. Now, it can be seen that the cell division of any kind of cell found in any species of living-things is invariably ordered to occur or signaled to take place by the self-replication of its genome. No self-replication of genome in a cellular organism means no cell division. Thus, if there was no replication of genomes in all species of living-things, there would be no living-things on earth as there would be no cell division. The cause of being different of species from one another (i.e., speciation) among all living- things from viruses to humans is the genome by its being different in each species from that of any other species of living-things.
18. Polyploidy: Polyploid cells and organisms are those that contain more than two haploid sets of chromosomes. Most species of organisms are diploid (2n), containing two haploid sets of chromosomes-one inherited from each parent. Polyploidy may occur due to abnormal cell division, either during mitosis, or commonly during metaphase I in meiosis. Polyploidy occurs in highly differentiated human tissues in the liver, heart muscle, and bone marrow. It occurs in the somatic cells of some animals, such as goldfish, salmon, and salamanders, but is especially common among ferns and flowering plants, including both wild and cultivated species. Autopolyploids are polyploids with multiple haploid sets of chromosomes derived from a single species. Autopolyploids can arise from a spontaneous, naturally occurring genome doubling, like the potato. Others might form following fusion of 2n gametes (unreduced gametes). Allopolyploids are polyploids with chromosomes derived from different species. Precisely it is the result of multiplying the chromosome number in an F1 hybrid. Polyploidization is a mechanism of sympatric speciation because polyploids are usually unable to interbreed with their diploid parent species or ancestors. Polyploidy is very common in plant but much rarer in animals. Polyploidy is an important mechanism for generating new species, the process of speciation. Speciation occurs when the genomes of two populations of the same species become so different over time that they can no longer interbreed. Usually this takes a long time of slow change, or needs some geographic separation to occur, but with polyploidy, it can be instantaneous! If a plant undergoes polyploidy, it is immediately unable to breed with others of its own species. That is, in just one generation a brand new species of living-thing is created by changing the genome! Allopolyploidy, is particularly important, which involves the doubling of genome (i.e., chromosomes) in a hybrid plant. Mostly a hybrid is sterile because it does not have the required homologous pairs of chromosomes for successful/ functional gamete formation during meiosis. If through polyploidy, however, the plant duplicates the chromosomes set (genome) inherited from each parent species, meiosis can occur to produce functional gametes, because each chromosome will have its homologue to pair with so that the formerly sterile hybrid, thereby attains the status of a full species distinct from either of its parents. Plant breeders utilize this process of treating desirable hybrids with chemicals such as colchicines that are known to induce polyploidy. Creating new species like this proves that evolution is spectacularly a practical science, using the principles of genome model rather than being a scientific guess [22-24].

19. When the Somatic Cell Nucleus is Transferred into an enucleated egg, developing into embryonic stem cells and even into a full adult (e.g., Dolly,the sheep produced) by the technology of Somatic Cell Nuclear Transfer (SCNT) is possible and achievable by the directive coded information of the genome. Dolly, the sheep is genomically identical with the donor Somatic Cell Nucleus [25].

Living-things have different levels of body organization that should be correctly structured as follows

1. Biological virus- a genome (i.e., a nucleic acid) covered with a coat of protein called capsid and in some species or families of virus covered with an additional envelope of bilayer lipid. Viruses do transfer and inherit genomic characteristics exactly like other living-things. This proves that viruses are living-things at the molecular level, whereas single-celled organisms are living-things at the cellular level and those multicellular organisms, being living-things at tissue, organ, system, or organism of several systems level.
2. Cell- a cell with a group of organelles to perform a set of different functions in single-celled organisms or a common function in multicellular organisms.
3. Tissue- a group of cells that perform a common function.
4. Organ- a group of tissues that perform a common function.
5. System- a group of organs that perform a common function.
6. Organism- any complete living-thing (having its own genome unique to its species, i.e., an organism can be a virus, a single-celled organism, or a multicellular organism of any level of body organization that can be of tissue, organ, system, or organism of several systems level).

Schleiden, Schwan, and Virchow Theory (i.e., Cell Theory) has been identified to be responsible for confusing biological scientists of the world to the extent where they unanimously have stated that biological viruses are not living-things. At present, the scientists of biological science have stated that they are not able to define what a living-thing is. Then, without knowing what a living-thing is, how can they write that biological viruses are not living-things? Due to the confusion caused by Cell Theory, biologists were not able to define what a living-thing is and as a result, the level of organization of living-things has been wrongly structured until it is treated by this paper. Because of the misleading and superficial (shallow) concept of the Cell Theory, the fact that the genome is the transformer of nutritive substances into living-things of its own species is completely unknown and the importance of the law of conservation of matter for the interpretation of living-things is unrealized. In short, the "Cell Theory which states that the cell is the unit of both structure and function in all living-things" is as false as Lamarckism. Knowingly or unknowingly people make mistakes or forward erroneous generalizations (theories or conclusions) in science; however, sooner or later the science itself identifies the wrongness of their generalizations because science is dynamic by its very nature of continuously progressive development.

Figure 5.a: The names of the three scientists who produced the Cell Theory written on the sides of triangle

Careers: Schleiden = botanist; Schwann = zoologist; Virchow = medical doctor. Three of them were Germans.

Feleke Eriso

Figure 5.b: Cell Theory was established by Schleiden M, Schwann T, and Virchow R whereas Feleke E identified it false

We give our kids milk and not poison. We don't have to mislead student children of human races of the globe with erroneous/wrong scientific theory/principle or rule. These student children are the potential human resources who will generate better science & technology. Science is truth that searches for truth and does not compromise. This paper is not to blame the elders, but to report that the "Cell Theory" is false and has been confusing & misleading for a very long time. It is the must for a professional educator of university level to report such a global mistake. We have to respect elders since respecting elders is the moral obligation for all of us, but it is not to be at the expense of the priceless student children of the globe engaged in learning biological sciences to make this planet a better place to live for humans. In an exam hall, a student who did not understand the meaning of a question cannot give a correct answer to the question and similarly, biological scientists' capacity to utilize a living-thing without knowing its definition will be a limited one. Look! Without the presence of 46 DNA molecules that form a complete set of **Genome** in *Homo sapiens*, humans wouldn't exist on earth.

We must know the fact that we investigators/scientists are the learners of science. We have to be active learners!! Scientists say that "**Discovery** is seeing what everybody else has seen but **Thinking** is what nobody else has thought". Since the classical work of Pavlov (1927, 1929) on the conditioned reflex, it has been known that the sight, smell and thought of food causes salivation in man. It is true that if one had seen and tasted lemon fruits in the past, his/her thought of a lemon fruit will instantaneously trigger salivary secretion in his/her mouth. This is a similar mechanism to that of **active learning** that is defined as "doing things and thinking about the things being done to come up with understanding". This is so because we learn by way of five senses namely:

- Sight,
- Hearing,
- Touch,
- Smell, and
- Taste.

On the other hand, it is also right to say that the effect of catalytic enzymes is generally slow because substances known as enzyme inhibitors alter catalytic action of the enzymes and consequently slow down, or in some cases, stop catalysis. Inhibition occurs when the substrate and a substance resembling the substrate are both added to the enzyme. When an inhibitor which resembles the substrate is present, it will compete with the substrate for the active site in the enzyme. The misleading/confusing effect of "Cell Theory" on the pace of continous & progressive development of biological sciences was similar to the slowing down effect of enzyme inhibitors on the speed of catalytic action of enzymes in metabolism. The genome is the coded system of information that directs the making (building) of the entire body structures upto the characteristic highest level of body organization (eg., biological virus level, cell level, tissue level, organ level, or system level) of a complete living-thing, i.e., the last level of growing/ differentiating body organization of a specific species. The function of genome cannot be limited to a few inheritable traits such as height, eye color, skin color, petal color, shape of seed coat, hair color, and others caused by a few genes out of many other genes carried by the genome. These inheritable traits are parts of the organism's body. In the same way, all structural & functional molecules in a living-thing are made (produced or built) by the effect of catalytic enzymes coded for by genes carried by the genome of that species of living-thing (eg., the genome in 46 chromosomes of humans). Based on this viable truth a living-thing can be defined as follows. Any living-thing is the product of reaction of its genome & its nutritive substances in its compatible environment [26-29].

A gene or a few genes out of many genes carried by a genome of a living-thing can express the traits which are under their effect in the organism, but they cannot produce (make) the whole or complete body of the organism like the genome that exerts its effect with the expression of all genes it carries. The reaction between the genome of a living-thing and its nutritive substances in its compatible environment is termed metabolism. The energy required to drive the metabolic reactions between the genome & its nutritive substances is derived from the nutritive substances in the food-chains for heterotrophic organisms with the exception of green photosynthetic plants (autotrophic organisms) which use sunlight energy to synthesize their own food from CO_2 & H_2O including macro- and micronutrients in the presence of photosynthetic pigments (chlorophyll). In other words, the nutritive substances for autotrophic organisms consist of CO_2 & H_2O, sunlight energy, macro- and micronutrients in their compatible environment. Like in any species of heterotrophic organisms, in any individual of autotrophic organisms the metabolic reaction of its genome and its nutritive substances listed above in its compatible environment transforms the nutritive substances into the living-things that are accurately its own species by the transformative effect of the genome [30-33]. The transformative productivity of the photosynthetic (autotrophic) organism is determined by the kind of genome of the plant species in a compatible environment.

Application of established evidences to observe living-things in their natural environment and interpret to have a verified and substantiated conclusion:

$$\text{Genome} + \text{Compatible Environment} \xrightarrow[\text{"tolereable range of temperature"}]{\text{"transformative metabolism"}} \text{An Observable Form of a Living-thing}$$

Figure 5.c. The Genome Model of Living-things for Definition, Equation, and Transformation of Living-things. In this model, the quantity of reactants on the Left Hand Side is equal to the quantity of the transformed products on the Right Hand Side, being compatible & true with the "Law of Conservation of Matter" which states that matter is neither created nor destroyed. It must be kept in mind that the nutritive substances are found as the components of "Compatible Environment" on the reactants side (i.e., Left Hand Side).Of course, the nutritive substances for autotrophic organisms are:- CO_2 & H_2O, sunlight energy, macro- and micronutrients from soil in the presence of their photosynthetic pigments (chlorophyll). In this equational formula, "tolerable range of temperature" is stated below the arrow because many different species of living-things have different ranges of temperature only in which they can be alive and grow well.

The term **environment** means everything such as plants, animals, microorganisms, water, air, temperature, pH, minerals, food, nutritive substances, energy, and light. Environment includes both the internal such as the internal environment of an organism or that of a cell (i.e., cytoplasm) and the external surrounding environment. Indeed environment includes everything and no chance is left for anything to be out of the environment. The nutritive substances transformed into maize seeds by the genome of maize plant in Enzymes Catalyzed Metabolic and Equational Transformation are:- CO_2 &H_2O including macro- and micronutrients from the soil using sunlight energy in the presence of chlorophyll pigments as maize is an autotrophic green plant. The catalyzed metabolic reaction between the genome of 2 lions and the nutritive substances of the compatible environment caused the increase of lions in number on the product side. The nutritive substances or types of food of lions are flesh of preys such as zebra, buffalo, giraffe, and several other herbivorous wild animals. The flesh of all those different species of preys eaten by lions is transformed into living lions by the genome of eater (predator) lions as the genome of any eaten, absorbed or assimilated organism does not have any effect of transforming into its own species. This is what invariably happens in food-chains of eating and being eaten. The genome of a prey that consists of DNA/s (nucleic acid/s) is digested by the digestive enzymes of the predator into nucleotides which are further digested into absorbable monomers that consist of:- phosphate, pentose sugar, and nitrogenous bases (A, C, G, T/U).

Enzymes catalyzed metabolic and equational transformation in:

- Genome of 1 quintal of maize seeds + ? —"transformative metabolism"→ 630 quintals of maize seeds.

Genome of 1 quintal of maize seeds + Environment —"transformative metabolism"→ 630 quintals of maize seeds.

Genome of 1quintal of maize seeds + 629 quintals of m.seeds —"transformative metabolism"→ 630 quintals of maize seeds. (balanced)

- Genome of 2 chickens (♂ & ♀) + ? —"transformative metabolism"→ 32 chickens.

Genome of 2 chickens + Compatible Environment —"transformative metabolism"→ 32 chickens.

Genome of 2 chickens + 30 chickens —"transformative metabolism"→ 32 chickens. (balanced)

- Genome of 2 sheep (♂ & ♀) + ? —"transformative metabolism"→ 30 sheep.

Genome of 2 sheep + Compatible Environment —"transformative metabolism"→ 30 sheep.

Genome of 2 sheep + 28 sheep —"transformative metabolism"→ 30 sheep. (balanced)

- Genome of 2 lions (♂ &♀) + ? —"transformative metabolism"→ 14 lions.

Genome of 2 lions + Compatible Environment —"transformative metabolism"→ 14 lions.

Genome of 2 lions +12 lions —"transformative metabolism"→ 14 lions. (balanced)

Plasmodium falciparum, a protozoan parasite of man:

- Genome of 2 gametocytes (♂ + ♀) + ? —"transformative metabolism" "via intermediate host"→ 200,000 gametocytes in a human host.

Genome of 2 gametocytes + Compatible Environment —"transformative metabolism"→ 200,000 gametocytes.

Genome of 2 gametocytes +199,998 gametocytes —"transformative metabolism"→ 200,000 gametocytes. (balanced)

- Genome of 1 bacteriophage + ? —"transformative metabolism"→ 2000 bacteriophages (viruses that infect and replicate in bacteria).

Genome of 1 bacteriophage + Internal Environment of a bacterium —"transformative metabolism"→ 2000 bacteriophages (viruses).

Genome of 1 bacteriophage + 1999 bacteriophages —"transformative metabolism"→ 2000 bacteriophages. (balanced)

Then, these monomers are assimilated into the body of the consumer or predator. The catalyzed metabolic reaction of transformation between the genome of 2 gametocytes of *Plasmodium falciparum* in red blood cells of human host and the internal environment of the intermediate host (i.e., in female Anopheline mosquito, producing stages of male & female gametes and zygote into ookinete after fertilization, oocyst, sporozoite) and the injected or inoculated back by mosquito into a new healthy human host while the hungry infected mosquito was taking a meal of blood managed to produce 200,000 gametocytes of *P. falciparum in* red blood cells in the new person infected. This long statement depicts that the internal cytoplasmic contents of liver & red blood cells of human host and other internal contents of mosquito's body are transformed by the genome of *P. falciparum* into199,998 gametocytes of *P. falciparum*. This is a complete life cycle of *P. falciparum* involving two indispensable (essential) hosts.

In the catalyzed metabolic reaction of genome of 1 bacteriophage virus with the internal environment of a bacterium, the cytoplasmic contents of the bacterium that served as the nutritive substances are transformed by the genome of the bacteriophage virus into 2000 bacteriophage viruses each having a genome just like that of the parent bacteriophage being coated with a capsid and the bacterial host cell is lysed. When a bacteriophage virus gets into its host bacterium what enters the bacterium is only the naked **genome** of the bacteriophage virus whereas its capsid is left behind outside the cell wall of the bacterium. Then the genome of the bacteriophage virus directs the self-replication of itself and the synthesis of its own type of capsid protein with accurate sequence of amino acids for its kind of species, using the internal contents of the host bacterial cell as raw materials (nutritive substances). This process of using specific code of viral **genome** for replication gives rise to the progeny of bacteriophage viruses in several hundreds in a single generation. If the replication of viral genome and capsid was directed by the coded information of the bacterial host cell's **genome** and not under the directives of the bacteriophage virus's **genome**, the daughter bacteriophage viruses produced could become bacterial cells.This is not different from the event of lions that ate the flesh of different species of herbivorous wild animals and whose genome transformed the flesh of these wild animals into the living individual lions of its specific species in kind. The presence of genome and capacity of transforming nutritive substances into living-things by

genome is the unique (key) characteristic of all living-things. Hence, biological viruses are living-things like all other single-celled or multicellular organisms. When a food-chain or a food-web is observed it can be seen that the genome transforms living-things from one form into another.

The genomes of all known cells are comprised of double stranded DNA molecules; the known genomes of viruses are

DNA: double stranded-linear or circular, or Single stranded-linear or circular, or

RNA: double stranded-linear, or Single stranded-linear.

We cannot say that a single-celled organism is not a living-thing for it does not have an amniotic membrane like terrestrial vertebrates. The most important unique structure for a matter to be a living-thing is the presence of its **genome,** i.e., its complete set of DNA or RNA molecules.

Viral replications

Viral replication involves six steps:- attachment,
- penetration,
- uncoating,
- replication,
- assembly, and
- release.

- During attachment and penetration, the virus attaches itself to a host cell and injects the genome only into it, leaving the protein coat (capsid) behind, i.e., uncoating.
- During replication, and assembly, the viral DNA or RNA incorporates itself into the host cell's genetic material and induces it to replicate the viral genome.
- During release, the newly created daughter viruses are released from the host cell, either by causing the cell to break apart, waiting for the cell to die, or by budding off through the cell membrane.

The genome is replicated prior to mitosis or meiosis. Every mitotic cell division or every two rounded meiotic cell division is invariably preceded by replication of genome of the cell. In other words, all DNA molecules of the genome undergo replication in the interphase stage known as S-phase in cell cycle. It is only after genome replication has been completed that the two rounded meiotic cell division (meiotic division I and meiotic division II) both in animals & plants can take place. In any type of cell mitotic cell division can take place if and only if the replication of all DNA molecules of the genome is performed in the S-phase within the Interphase. Distinctive individuality of living-things is enhanced by crossing-over between nonsister chromatids, i.e., by the exchange of fragment of a maternal chromatid for a corresponding fragment of a homologous paternal chromatid at times of pairing of homologous DNA molecules/chromosomes in meiotic division prophase I. In addition to this, the random distribution (independent assortment) of the maternal and paternal homologous DNA molecules between the daughter cells at meiotic division I increases genomic variation among individuals. It is this genomic variation that causes distinctive individuality among the six billion people of the globe with the exception of identical twins. On the other hand, the mitotic division is equational and the genome in the daughter cells and the original parent cell are identical. As a result, there is no genetic recombination or crossing-over between nonsister chromatids in the process of mitotic cell division. Replication of the genome in a cell is a kind of order for the cell to divide where the kind of division can be the mitotic cell division for growth in multicellular organisms or to increase number of individuals in single-celled organisms or meiotic cell division to produce gametes for perpetuation of the species. It must be kept in mind that pairing of homologous chromosomes does not occur in mitosis but in meiosis only. Occasionally during meiosis, chromosomes fail to separate normally into the four haploid cells, resulting in the event known as nondisjunction. Down syndrome is one of the outcomes of nondisjunction. In such abnormal meiotic divisions some of the haploid cells that are produced lack a DNA/chromosome, while others have more than one copy. The resulting gametes form abnormal embryos most of which die. It also leads to a high rate of miscarriages (spontaneous abortions) in early pregnancy.

When food is eaten by a consumer in the food-chain, the food substance contains biological molecules including proteins, carbohydrates, genome that consists of DNA/s, lipids, and vitamins. The genome (nucleic acids) as explained earlier is digested into its final absorbable monomers of phosphates, pentose sugar and nitrogenous bases (A, C, G, T/U). When these monomers of genome are absorbed into the body cells of the consumer organism, they bond to one another in the process of anabolism to form nucleotides which are then bound together to form new strands with each of the old strands of the unwinding (unzipping) & replicating parent DNA of double helix (Fig. 12). The sequence of nucleotides in the new strand is determined by the coded information in the original parent DNA, because the old original parent DNA strand is serving/dictating as a template for the new strand in the process of replication. This is how the genome is able "to code for replication of itself from transformable nutritive substances of its compatible environment into several other daughter DNAs via self-replication".

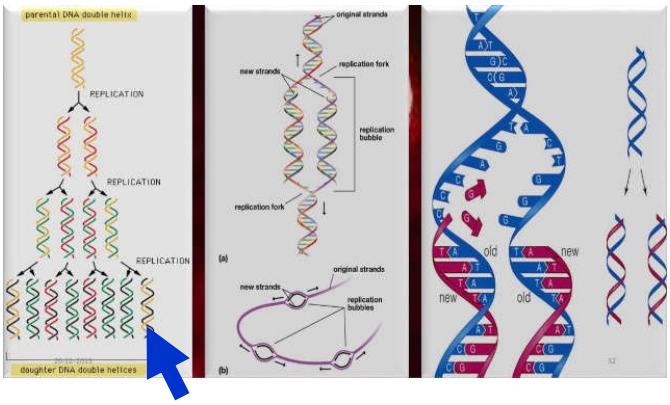


Figure 6. Replication of double helixed DNA molecule/s

A person's **ontogeny** begins from a single-celled **zygote** and proceeds to the adult stage of maximum body weight, that consists of trillions of cells, by way of mitotic cell divisions. In these countably infinite number of **mitotic cell divisions** that occur in the body of a person, one cannot think of any one cell division of these to take place in the body of a person without the preceding replication of the genome as a signal, i.e., all DNA molecules that form the complete set of the genome do replicate simultaneously prior to each of the cell divisions. If cell division of meiotic as well as mitotic type is to occur in any type of cell in the body, the genome must replicate first and then only the sister chromatids are formed. The formation

of two sister chromatids from a single chromosome that contains only one DNA molecule is a substantiated & spectacular evidence for the fact that the double helix DNA molecule is replicated into two daughter DNA molecules that are identical to their parent DNA molecule. The two successive meiotic cell divisions (meiotic division I & meiotic division II) to produce gamete/s are initiated by only one preceding replication of the genome found in that gamete producing cell. Each sister chromatid contains one double helix DNA molecule and also any one normal chromosome always contains only one double helix DNA molecule. Now, it can be seen that the cell division of any kind of cell found in any species of living-things is invariably ordered to occur or signaled to take place by the replication of its genome just like the signal shot for contender athletes to begin competitive running. The genome is replicated in this way for the production of tissues. No replication of genome in a cellular organism means no cell division. Thus, if there was no replication of genomes in all species of living-things, there would be no living-things on earth as there would be no cell division!!

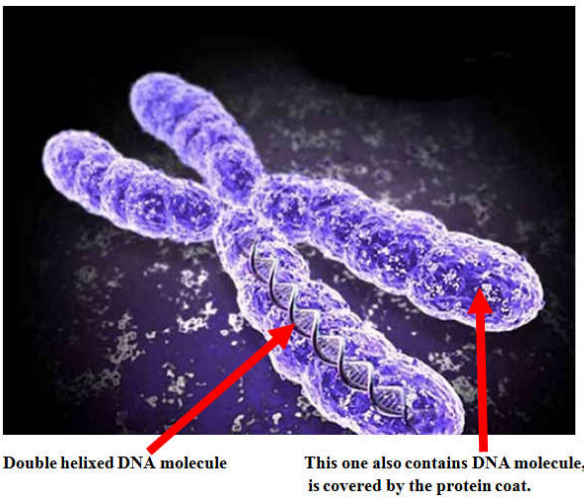


Figure 7. Two sister chromatids formed following the replication of genome as a signal

Each of the two sister chromatids contains a DNA molecule of double helix. What the investigators or the students of genome biology or even those of genetics target at is the double helixed DNA molecule; however, what is usually displayed by modern textbooks & teachers in classroom lessons for students of genome biology is the protein coat called chromosome that encloses the double helixed DNA molecule. The chromosome confuses or disguises to take the role of genome's DNA molecules. Students are studying the duplication of the DNA's protein coat termed **chromosome** but not the **real presence & replication of DNA** molecule inside it and the DNA molecule cannot be seen either. The concept of DNA replication is also not explained deliberately & indirectly in the process of chromosomes duplication & cell divisions in spite of the fact that cell division is under 100% control of genome replication. Look, how a gadem confusing factor the **chromosome** is for student children of genome biology!!

In DNA replication, the double helix is unwound and each strand acts as a template for the next strand. Bases are matched to synthesize the new partner strands. In molecular biology, **DNA replication** is the biological process of producing two identical replicas of DNA from one original DNA molecule. This process occurs in all living organisms and is the basis for biological inheritance. DNA is made up of a double helix of two strands, and each strand of the original DNA molecule serves as a template for the production of the complementary strand, a process referred to as semiconservative replication. Proofreading and error-checking mechanisms ensure near perfect fidelity for DNA replication.

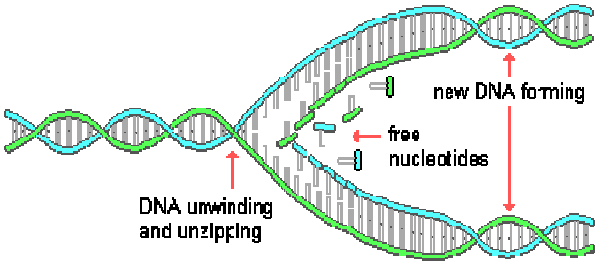


Figure 8. Replication of DNA

A genome of a species of living-things may consist of one molecule of DNA (or RNA, in some viruses) or many molecules of DNA with the fixed number of DNA molecules for each species of organisms. In short, a

genome ➖ consists of ➡ **DNA/RNA molecule/s** ➖ each of which consists of ➡ **genes**.

The only cause of mitosis or meiosis is the replication of DNA molecule/s that form the characteristic full set of genome for the species of the organism so that two identical copies of the original parent genome are produced. This is how the genome divides (replicates) itself in viruses & other organisms to give daughter DNA molecules. The nutritive substances in the case of heterotrophic organisms, are digested by enzymes into smaller/simple unit molecules of absorbale size like amino acids, monosaccharides, fatty acids, glycerol, phosphate, pentose sugar, and nitrogenous bases. Digestion takes place inside the cells (intracellular digestion) in the case of green plants, for green plants do synthesize their own food inside the cells, but it is outside the cells (extracellular digestion) in animals & other heterotrophic organisms. Next, these products of digestion are absorbed by the body of the consumer where they are used as the source of usable energy (ATP) by way of catabolism (glycolysis, Kreb's Cycle, and Oxidative Phosphorylation) and building blocks in anabolism of structures such as tissues, organs, systems and of functional molecules like hormones, enzymes, cytokines, as well as the nutrient milk, including the formation of gametes for the perpetuation of species in sexually reproducing organisms. Each step of metabolic reaction is catalysed by enzyme proteins coded for by the genome of the consumer (eater) organism only. The catalytic effect of enzymes allows the metabolic reactions to occur effectively at lower temperatures in which the living-things can be alive and such lower temperatures are referred to as a tolerable range of temperature or a living temperature for each species of living-things. In the absence of these enzyme proteins the metabolism (in order to proceed in the product direction) would require a higher temperature which could kill or burn the consumer to death. The DNA or RNA genomes self-replicate using nutritive substances as raw materials (building blocks) and utilize the catalytic effect of enzyme proteins coded for by their own coded information. Hence, they transfer the hereditary traits to their daughter generations. At present, the scientists of biological sciences have unanimously stated that

viruses are not living-things for they cannot multiply (replicate) without entering host cells. This is an absolutely false and unscientific reasoning to say that biological viruses are not living-things! There are several intracellular parasites such as *Plasmodium falciparum* and *P.vivax* that cannot multiply outside their host cells and break apart (lyse) their host cells just like the biological viruses when their daughter generations are released. *P. falciparum* and *P. vivax* are living-things. Therefore, the biological viruses are living-things because of the same conceptual reason. A multicellular endoparasite of man called *Clonorchis sinensis* needs two intermediate hosts (snail, and fish) and man as a definitive host in its life cycle. Without these three different species of hosts *C. sinensis* cannot reproduce (multiply or replicate). Because of this dependency of *C. sinensis* on three different host species of organisms to replicate (to perpetuate) itself we do not say that *C. sinensis* is not a living-thing. There are several other multicellular endoparasites with similar dependencies on their host organisms to replicate themselves that are exactly similar to the dependency of biological viruses on their host cells to replicate themselves. With this in mind, we cannot say that biological viruses are not living-things. The genome of a biological virus replicates or produces the exact copy of itself and the exact copy of protein coat called capsid including the envelope of bilayer lipid if present in the parent species, being the same in all aspects as the parent biological virus. The body of every individual living-thing from a biological virus to man is invariably built by its genome's transformative effect from its nutritive substances in its compatible environment for a countably infinite number of generations. In short, biological viruses are certainly living-things because they possess genome that is unique to living-things with self-replicating capacity by way of transforming nutritive substances (i.e., cytoplasmic contents of their host cells) in their compatible environment into biological viruses having specific species accuracy in kind. In other words, the genome of a living-thing is not only the transformer of nutritive substances from one form into another among living-things, it is also the perpetuator of each species in all living-things.

If one bacterial cell by way of mitotic division becomes 32 bacterial cells in number, then, how & where did 31 bacterial cells come from? According to the Cell Theory, the answer to this question is the **pre-existing parent bacterium** without any source of matter to be transformed into bacterial cells, which is added to the 31 successive daughter bacterial cells, making the total 32 bacterial cells. This answer of Cell Theory is false because the Law of Conservation of Matter states that matter is neither created nor destroyed. The real & actual correct/scientific answer to the question stated above is the following one.

Answer: It is the set of the nutritive substances of the bacterial cell that is transformed into the $\underline{\underline{31}}$ bacterial cells by the reaction between the genome of the original parent bacterium and its nutritive substances in its compatible environment. Indeed, it is the transformative effect of the bacterial genome that transformed the nutritive substances into bacterial cells and not by a miraculous increment only from the pre-existing cell without any source of matter to be transformed into bacterial cells. Cells increase not only in single-celled organisms to increase the number of individuals but they also increase in multicellular organisms such as in man to cause increase in size (i.e., growth) by way of somatic cell divisions or via germ cell divisions to give a zygote from which somatic cell divisions cause increase in number of individuals/people. The actual matter which is transformed into the next successive daughter cells by the effect of coded & dictative information of genome found in the parent cell or zygote is the set of nutritive substances either to cause increase in number of individuals or growth. The Cell Theory puts that "all cells arise only from pre-existing cells by division" and this kind of generalization is not different from seeing & telling what everybody else has seen. The concept of Cell Theory of cells arising only from pre-existing cells is without any substance of thinking and contradicts with the Law of Conservation of Matter. Contradicting with the Law of Conservation of Matter in our task is in fact, being ignorant of the fact that science cannot develop without science.

Conclusion

1. A living-thing is defined as the product of reaction of its genome and its nutritive substances in its compatible environment.
2. The genome is the transformer of living-things where it transforms the nutritive substances into living-things with specific species accuracy in kind.
3. The concept of transformation of nutritive substances into living-things by genome does not contradict with the Law of Conservation of Matter at all.
4. The Cell Theory which stated that "the cell is the unit of both structure and function of all living-things" was identified false. The report of Cell Theory that concluded "all cells arise only from pre-existing cells by division" without any source of matter to be transformed into successive daughter cells is contradicting with the Law of Conservation of Matter and this kind of contradiction is indeed the result of being ignorant of the fact that science cannot develop without science.
5. Artificialized Charles Darwin's theory of evolution by natural selection/Origin of Species is also as false as Lamarckism
6. Biological viruses are certainly living-things. They do transfer & inherit genomic/hereditary traits or characteristics exactly like all other living-things. This is a giant and exceptional revolutionary advance in the history of both pure & applied biological sciences.
7. Genome is the unit of both structure and function in all living-things. The only self-replicating structure or molecule in all kinds of living-things is the genome and it is the only molecule that contains the coded set of information for building all structures & the entire biomass of every individual in all living-things. It is this coded set of information contained by genome that is inherited from parents and transferred to successive generations as the set of traits or characteristics. The genome together with its coded set of information is inheritable from parents & transferable to successive generations. Except the genome, all living-things do not have any other molecule or structure that is capable of self-replicating and containing the coded set of information for building the structures & the entire biomass of any individual organism.
8. Genome is the perpetuator of each species in all living-things.

9. The change in a genome includes changes such as the change in number of DNA molecules, deleting a gene or some genes from a molecule of DNA, inserting a gene or some genes in a molecule of DNA, replacing a nitrogenous base by another nitrogenous base in a nucleotide of a DNA molecule and any other point mutation.
10. The cause of being different of species from one another (i.e., speciation) among all living-things, from biological viruses to humans, is the genome by its being different in each species from that of any other species of living-things.
11. The chemical composition of the nucleotides (i.e., the building blocks) of which the genome of any living-thing, from biological viruses to humans, is made up is exactly the same in all living-things except the nitrogenous base being Uracil (U) in RNA instead of being Thymine (T) as in DNA. The genomes of different species of all living-things are different from one another due to the difference in sequence and total number of their nucleotides. The structural difference between Thymine (T) & Uracil (U) is somewhat insignificant and as a result it cannot cause a big functional difference between them and this is why both T & U belong to the group of Pyrimidine and both of them pair with the same nitrogenous base called Adenine (A).
12. Crick & Watson both received the Nobel Prize and other numerous awards for their discovery (seeing) of DNA model, but their model was left as an unutilized raw datum because it was not deeply interpreted by way of thinking for the purpose of identifying the fact that the genome was the unique transformer from one form of living-thing into another species of living-thing in food-chains/webs and the perpetuator of species in all living-things. Also, the priceless role of selfreplication of the genome, using nutritive substances as raw materials/inputs, for the existence of living-things on earth was not realized by Crick & Watson with their DNA model. This unpenetrative Crick & Watson-discovery of DNA Model is a very good demonstrative example for the reason why it is said that discovery is seeing what everybody else has seen whereas thinking is what nobody else has thought.
13. The report of this manuscript is irreversibly ascertained to have a greater capacity to revolutionize beneficial implementation of pure and applied biological sciences than ever before for the betterness of human life on earth.
14. The term gene bank is an unscientific, unrealistic, inappropriate, or a completely wrong term, conveying a wrong message of science because keeping/storing some genes in banks out of a genome (i.e., some genes from a complete set of DNA molecules that form a genome of a species) cannot conserve the species of a living-thing against extinction if what is kept in the bank is not a complete or full genome. Actually, what is kept in bank to conserve a species of a living-thing is a full genome. Therefore, the erroneous/misleading term (i.e., gene bank) cannot be allowed to confuse the scientists of the world and must be replaced without delay by the scientific and realistic term referred to as genome bank.
15. If there was no replication of genomes in all species of living-things, there would be no living-things on earth as there would be no cell division or as there would be no viral replication. No replication of genome means no cell division.
16. A gene transfers only one trait of an organism to the next successive generations (eg. Albinism in humans), but a genome transfers all traits of the organism to the n ext successive generations and perpetuates the species of the organism against extinction by exerting its dictative control of replication to a countably indefinite number of generations.
17. Existence and continuing to exist of any one species of all living-things is determined and completely controlled by self-replication of its genome.
18. Creating a brand new species of living-thing in just one generation time by changing the genome through the process of polyploidy and creating a full adult animal (e.g., Dolly, the sheep) by the technology of Somatic Cell Nuclear Transfer (SCNT) are the spectacular & practical evidences for the fact that "a living-thing is the product of reaction of its genome and its nutritive substances in its compatible environment". The accurate & scientific new definition of the term evolution of living-things based on Genome Model is the change in the genome of an organism which results in a brand new species that usually cannot interbreed with its parent species and when the change in the genome is a drastic one, the emergence of a new species can happen in a single generation-time (eg, through polyploidy in plants). Thus, the old definition of evolution for living-things based on the generalizations such as Darwinism & others which stated that evolution is a gradual change over many generations is false. The old definition of evolution does not understand the cause of the change either.
19. Using of host cell's enzyme, ribosome, and other cellular resources/contents for viral replication so as to generate large populations of biological viruses in successive generations is the part of mechanism or part of eating the content of the host cell as a nutrient in the transformation of the host cell biomass into the biomass of viruses by the transformative action of the genome of the virus that entered the host cell. Now, this is a clear & concrete truth to say that matter is neither created nor destroyed!!
20. Any living-thing that existed in the past (eg., Dinosaur), that is existing at present (eg. Blue Whale), and that which will emerge in the future by way of speciation or evolution is invariably the product of reaction of its genome and its nutritive substances in its compatible environment. In other inclusive words, the largest living-thing in the world, i.e., *Sequoiadendron giganteum* (General Sherman) tree located in the Giant Forest of Sequoia National Park in Tulare County, in the U.S. state of California as well as the smallest living-thing, i.e., the single-stranded DNA virus with its scientific name being *Porcine circovirus* type 1 is the product of reaction of its genome and its nutritive substances in its compatible environment.

Recommendation

1. A course entitled: **Genome Biology** must be worked out by experts of curriculum and offered as a compulsory course in both schools and university levels to speed up the development of biological

science & its applications in fields of Medicine; Agriculture; Environmental protection & conservation of natural resources such as soil, water, and wildlife; Nutrition; Environmental and water sanitation; Biotechnology; Investigative research activities of biology; and in other related areas than ever before.

2. In educating children, it is wise & impartive/didactic to put **Genomics** as a prerequisite to **Genetics**.
3. It can be remembered that evolution has been considered by many scientists as a subject of scientific guess in biology until the present time. With the established genome model of living-things and the accurate definition of a living-thing at hand, the scientists of biology of the world will be in a position to treat the **evolution** of living- things as a field/subject of short and long term practical study. This is true because the actual driving force of evolution in living-things is the change in the genome of individual species.
4. It is ascertained that the emergence of genome model of living-things along with the definedness of a living-thing will make learning biology as a type of **recreation and enjoyment** for student children of the world because they will be learning what is known & defined including a practical model to be observed with the eyes of learners for every species of living-things in laboratories.
5. The established genome model of living-things and the verified definition of a living-thing are believed to increase **confidential options of accurate devising and executing** productive research projects in applied fields of biology far more than it has been observed herebefore.
6. Perpetuative effect of genome in **human overpopulation problem** can be controlled wisely by implementing family planning.
7. In the field of applied immunology: mechanisms such as recognition of self or foreign antigens, degrees of graft rejection or acceptance in organ or tissue transplantation, and application of vaccinations totally depend on the **kinds of genomes**. Substantiated achievement in stem cell research for its best and worthiest use of life-saving purposes depends on the detailed & curious study of **genome** of the stem cell and the **genome** of the recipient client.
8. **Genetics** is the study of a specific individual/single gene for its determinant effect in the transfer of an inheritable trait. **Genomics** on the other hand, is the study of a genome and all the genes found in that genome of a species of living-things. The genome is a complete (entire) set of genes that belong to an organism of a species. For instance, the human genome is made up of a complete set of very long DNA molecules, one molecule of these corresponding to each of 46 chromosomes and this genome contains about 20,000 to 25,000 genes. From these definitions, it can be understood that genomics is analogous to human anatomy and genetics is analogous to human physiology in preceding the pre-requisite course. It is obvious that human anatomy is a prerequisite course to the course of human physiology for students of medical science. Teaching genetics only without offering genomics as a pre-requisite course to genetics is undidactic, unwise, and a waste of educational asset as it is not a comfortable instructional or educational design for learners to be productive in understanding or assimilating the scientific subject matter.
9. Where do people or other living-things keep their **genome** (**DNA**/s or **RNA**/s in some viruses)? Student children must be taught that a copy of **genome** is kept in each virus or cell of a living organism. **Genomes** (**DNA**/s or **RNA**/s) are surrounded by protective barriers (i.e., cell wall & membrane or cell membrane, nuclear membrane, and chromosomal protein coat or capsid in viruses) that keep the **genome** safe. To teach students biological sciences (**genomics** & **genetics** in particular) effectively it is necessary to develop accurate & easy procedures for the student children to break down cell walls & membranes, nuclear membranes, and chromosomal protein coats or capsids in viruses so that they can separate the **genome** (**DNA**/s or **RNA**/s) out and see it or learn it by practical observation. Otherwise, it will be a kind of teaching by telling and leaving students confused!!!
10. Is it possible to transform a pair of ♂ & ♀ mules by way of polyploidy into a new species that can interbreed among themselves and cannot interbreed with any of their parent species?

The Answer is: *Yes* !! This is a demonstrative, or a practical example of **evolution**.

Active learning in science is **doing things** and **thinking about the things being done** to come up with **understanding**.

Discovery is seeing what everybody else has seen but **thinking** is what nobody else has thought!!

It is declared that this is the first report of scientific investigation of its kind in the entire world.

Ethics

No ethical error is seen or committed in the execution of this study.

Competing interests

I declare that I do not have any competing interests with anybody.

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things by serving as concrete evidences. This is the reason why it is said that science cannot develop without science.

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