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Uncover the Hidden Message in DNA

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Abstract

The development of the DNA theory of inheritance culminated in the publication of the molecular structure of DNA 68 years ago. DNA remained little studied because it was assumed to be an inert substance incapable of carrying genetic material because of its simple structure. It would not be until the mid 20th century that attitudes towards DNA began to change. In the DNA molecule's graceful curves was the key to a whole new science. Understanding the structure and function of DNA has helped revolutionize the investigation of disease pathways, assess an individual's genetic susceptibility to specific diseases, and formulate new drugs. It is also critical to the identification of pathogens. The system of DNA actually guarantees the stability of biological genetic information to a large extent, so if there is a revolutionary and positive gene mutation described in the theory of evolution, and it must be able to inherited stably. DNA is a dynamic and adaptable molecule (1). And scientists will increasingly realize that life and life processes are strongly connected to the physics of open quantum systems. Without the laws of quantum mechanics, we cannot understand life and life processes.

Keywords :- DNA storage; RNA; genetic code; genes; double helix; quantum computing; quantum mechanics; tunnelling; pathogens; codons; duons; sequencing; revolutionize; latency; tuberculosis; hereditary; mutations; transcription factor; encryption; Exabyte; terabyte; zettabyte; gigabyte; protons; genome testing; Schrodinger equation; steganography; cryptography; holographic; yin and yang; tautomers; phantom.

Introduction

The determination of DNA's structure in 1953 by Francis Crick and Jim Watson is hailed by many to be the most important discovery ever in human history. It is almost 22 years since human DNA was mapped, is one of the great scientific breakthroughs of all time. The entire human genome is made up of approximately three billion pairs, which in turn form some 20,000 genes. The information carried by DNA directs the construction of each organism, its maintenance, proper functioning and reproduction. The information is carried in coded form as a sequence of specific chemicals called nitrogenous bases. Just as a computer code is a unique sequence of 0s and 1s, so is life's genetic code a unique sequence of bases. It has enabled enormous advances in the understanding of human biology and disease.

More than 22years ago, scientists published the draft sequence of the human

genome known as the deciphered " Book of Life. " However, the sequence was incomplete at this time. The sequencing of genomes has suggested a new hypothesis : " that animal evolution usually works not by inventing new protein-coding genes, but by altering the timing, intensity, and location of the expression of preexisting genes" (2). Geneticists have continued to improve since then, but about 8% of the sequences are still missing or wrong. Now, thanks to new technology, scientists have fully cracked the last piece of the puzzle and mapped out the missing piece.

DNA is famous. It is a biological macro molecule with defined sequence. Our genetic material is encoded in DNA. The discovery of DNA double helix, relativity and quantum mechanics are hailed as the most important scientific discoveries of the 20th century.

Life makes DNA, our amazing molecule that efficiently stores all kinds of genetic information related to a person's genes and living systems, and is very compact and durable. DNA is the most building block of life on Earth. All the genetic information that organisms need to function, grow and reproduce, is stored in their DNA.

Since the genetic code was deciphered in the 1960s, scientists have assumed that it was used exclusively to write information about proteins. Some scientists were stunned to discover that genomes use the genetic code to write two separate language. One describes how proteins are made, and the other instructs the cell on how genes are controlled. One language is written on top of the other, which is why the second language remained hidden for so long.

For over 50 years we have assumed that DNA changes affecting the genetic code solely impact how proteins are made. Now we know that this basic assumption about reading the human genome missed half of the place. The genetic code was a 64-letter alphabet called codons. Some scientists discovered that some codons, which they called duons, can have two meaning, one related to protein sequence, and one related to gene control. These two meanings seem to have evolved in concert with each other. The gene control instructions appear to help stabilize certain beneficial features of proteins and they are made. The discovery of duons has major implications for how scientists and physicians interptet a patient's genome and will open new doors to the diagnosis and treatment of disease.

The fact that the genetic code can simultaneously write two kinds of information means that many DNA changed that appear to alter protein sequences may actually cause disease by disrupting gene control programs or even both mechanisms simultaneously. The emphasis is now on interpreting the individual variations in DNA and how they more specifically influence the risk of disease, particularly cancer. Hence, the secret code inside you called DNA. It is life's hereditary material, i.e. it holds and passes on the genetic information from parents to offspring. The information is carried in coded form as sequence of specific chemicals. All living things use the same genetic code, but some viruses, including corona viruses, use RNA instead of DNA to store their code.

Many researchers have assumed for decades that DNA is the primary creator of the human body, even including mental and emotional traits. But now it seems that there is an energy behind the DNA that operates the switch that turns genes on and off, and it clearly affects everyone, even a person's future appearance.

Can DNA be used as a hard drive to store data messages? The answer is yes, and this is a very magical technology. The latest research may completely revolutionize the computer storage method.

DNA is definitely the oldest life information storage tool on the planet, and it can also be used as a storage medium for all data information, and its storage density and service life far exceed the existing disc-based storage solutions. Therefore, DNA storage (3), being regarded by mankind as the future of data storage, becomes the best alternative to save the human data storage crisis.

How exactly does DNA storage work? What stage has it reached now?

What are the obstacles to commercial use? This requires us to answer them one by one.

Before understanding now DNA storage works, let us briefly understand the

principles of two existing solutions, magnetic storage and optical storage.

The principle of magnetic storage is to coat a magnetic medium on a metal material to form an electromagnetic effect under the condition of electrification, which can store and express the binary information of 0101. The advantage of magnetic storage hard disc is fast storage and reading speed, the disadvantage is that the data density is low compared to the volume weight. After 60 years of development, about 3TB of data can be stored on a 3.5 -inch hard drive.

The principle of optical storage is to store and record digitally encoded videos and audios in the grooves on the surface of the disc, and then read out the data in the grooves through a laser for transfer or playback. Currently, optical storage is also experiencing storage limits. Because if you want to store more data, the groove must be smaller and more compact, and the precision of the laser is required to be higher.

What are the advantages of DNA storage over magnetic and optical storage?

First, it saves space. However, upated with the double-helix three-dimensional structure of DNA, storage capacity of these single-layer tiled storage methods is many orders of magnitude different. The physical volume of DNA itself is small and three-dimensional, and the data density per unit space is very high. To give a simple example, 1 gram of DNA is less than the size of a dewdrop on a fingertip, but it can store 700 TB of data, which is equivalent to 14,000 50GB. There are still problems such as storage/reading speed and cost in the DNA encoding process, and DNA storage (4) is still on the way from commercialization.

In the laboratory, DNA storage (5) does not seem to be complicated, but in commercialization, there are still some problems.

First, both storage and retrieval are slow. Access to DNA storage devices is slow and time-consuming. In contrast to the electromagnetic signals stored on disc, DNA synthesis relies on a series of chemical reactions. Writing 200 MB of data to disc takes less than 1 second, and DNA synthesis takes almost 3 weeks.

Second, the DNA medium cannot be overwritten or rewritten. In DNA, once information is stored, it generally cannot be modified. To read this document, you need to fully sequence all the information and then transcode it (6,7).

Third, the accuracy of data storage needs to be improved.

Fourth, random reading and writing difficulties. The current DNA synthesis technology canmot generate long DNA molecules at one time, but can only synthesis numerous short fragments. This makes it difficult to quickly retrieve specific data in a mixture of many small DNA fragments.

Finally, and most importantly, DNA storage costs are prohibitive.

Furthermore, it is very energy efficient. The DNA material only needs to be kept in a suitable low temperature, dry, and sunlight --- free environment, it can be stored for a long time and can be used for remote transmission at any time, and no additional manual maintenance is required. Even if DNA needs to be frozen, the resources and energy consumed are almost negligible.

Today's high-density storage devices degrade over time. The tool that can be stored for the largest time is magnetic tape, which has a lifespan of 50 years. Other storage devices have shorter lifespan. In comparison, DNA has a shelf life of hundreds of years. Even if DNA needs to be frozen, the resources and energy consumed are almost negligible. It can be preserved for thousands of even tens of thousands of years. Hence, the DNA molecule allows data to be stored millions of times more tightly than current digital storage technologies. DNA is more reliable than computer discs and DVDs data storage tools.

The principle is very simple. First convert information, such as photos, text and sound files, into binary language or numbers, and then use coding to convert the series of "0"and "1" into a DNA code consisting of A, C, T, and G. Hence, every time the binary language is written into the DNA sequence, the DNA hard drive can be stored in a low temperature environment. When the data needs to be read, it is only

necessary to sequence the target DNA, restore the information to binary codes, and then complete the decoding, which can be restore to our common data. To put it simply, by technical processing, these DNA codes integrate the original information and record it in the artificial DNA chain, and the data becomes an entity. So, the pictures and videos are successfully stored in DNA fragments, and the data is read without loss.

We understand the language of DNA in conceptual terms. For instance, consider the language of DNA as you would the Spanish language. I know that Spanish is a language made up of sentences and that the letters used are the same as in Swedish or English. The sentences also have an object and a subject. But notwithstanding this information, I cannot read Spanish because I do not understand the words.

No one discovered DNA. Instead, many scientists uncovered more and more about DNA from 1869 --1953, until it culminated in the discovery of the famous double helix.

We are all here because of mutations. Mutations are needed for biological innovation, and on the other hand they cause diseases. Genetic mutations are changes in the DNA of an organism that can result from errors made during cell division, viral infections or exposure to radiation and carcinogens. They are essential to evolution as they can lead to adaptations that allow certain organisms to outcompete others in their environment but can also lead to disease. How does nature resolve this conflict ? The answer would lie in a genetic code that allows evolution to innovate while minimising the disruption this can create. And this code is hidden within a part of our genomes known as repetitive genetic in elements, which we know plays a key role in evolution. These elements are sequences in our own DNA that can make many copies of herselves. In order to build the proteins that our bodies need, our cells take instructions from our DNA by transcribing it into a similar molecule called RNA. But in rare cases, instead of buillding a protein, some RNA molecules convert back into DNA and insert themselves at new locations in our genome. In this way, the repetitive elements can continually create new copies of themselves. As a result, the human genome contains thousands of repetitive elements that are not present in any other species because they have copied themselves since humans evolved. But repetitive elements are just useless copies. They are discovered in1948. They can act as swiitches that switch genes on and off in maize.

This was initially thought to be an obscure phenomemon with no relevance for humans. Yet now it had become clear that repetitive elements are an important toolkit for evolution. By turning genes on and off, the repetitive elements can influence what characteristics a species evolves. They have been useful for biological innovations, such as evolution of pregnancy in mammals.

Scientists have found a code in the RNA that controls Alu elements hiding inside human genes. This code combines competing positive and negative molecular forces, like a yin and yang in our cells. It is known that competing molecular forced control many aspects of our genes.

We have known for decades that evolution needs to tinker with genetic elements so they can accumulate mutations while minimising disruption to the fitness of a species.The two forces are tightly coupled in evolution, so that as soon as any mutations make the yin stronger, the yang catches up and stops them. This allows the Alu elements to remain in a harmless state in our DNA over long evolutionary periods, during which they accumulate a lot of change via mutations. As a result, they become less harmful and gradually start escaping the repressive force. Eventually, some of them take on an important function and become indispensable fields of human genes. To put it another way, the balanced forces buy the time needed for mutations to make beneficial changes, rather than disruptive ones, to a species. Any this is why evolution proceeds in such small steps --- it only works if the two forces remain balanced by complementary mutations, which takes time.

Eventally, important new molecular functions can emerge from randomness. These findings tell us that humans are not a fixed pinnacle of evolution. Our genomes are like those of any other species : a fluid landscape of DNA sequences that keep changing. This explains how our genome can host its ever-changing repetitive

elements despite their potential to disrupt the exciting order in our cells.

DNA sequences have attracted much interest as pieces of quaternary digit information that can be used to store information (10), solve problems (11,12,13), and encrypt messages. DNA cryptography and steganography is a new field born from Adleman's research in DNA computing and from Viviana Pisca's project on DNA steganography. Researchers have developed a technique for conducting espionage on a molecular level, try hiding a message in human DNA. Using the technique, a sender would create a unique strand of DNA that only an intended recipient could isolate and read from millions of similar strands. It is a modern twist on an ancient art, steganography, the practice of community while concealing the communication. And DNA cryptography, i e., the encryption of messages using DNA, has been used to cipher secret messages (14,15,16,17).

The huge advantages that DNA structure offers for efficient parallel molecular computation and its enormous storage capabilities, made from the research field a very promising one for various application despite today limitations : expansive or time consuming.

Using DNA biotechnogy to solve the problem of data storage and build infrastructure for the era of artificial intelligence. First of all, we understand that 1EB is equivalent to about 13 billion Chinese people, and the amount of information in a 500-page book is added up. How big is the total amount of data in the world in recent years? Researchers estimated that in 2011 it was 1800EB. In terms of tenfold growth, the total amount of global data today is only 20,000EB. Unless the future data increases exponentially, 1 kilogram of DNA will be enough for our future data storage and use to ensure Artificial Intelligence. And 1 cubic millimeter of DNA can store 1 EB (Exabyte, 10 billion terabytes) . With the development of big data technology without worries, we are not afraid of being hindered by the bottleneck of storage technology. The journal " New Scientists " reported in February 2015 that 1 gram of DNA can theoretically carry 455 EB (Exabyte) of data.

At present, the total amount of data in the world every year is more than the sum of human history. The global amount of data in the human digital universe is expected to reach 44 trillion GB in 2020, which will exceed our storage capacity by then. The total amount of global data information will grow from 30 Zettabyte (Zettabyte, one trillion gigabytes) in 2018 to 163 ZB in 2025.

The realization of DNA storage technogy will alleviate the capacity problem of traditional storage to a certain extent, and greatly reduce the consumption of electronic components and energy. Of course, in terms of access technogy and cost control, the carbon-based storage method represented by DNA storage stiil has a long way to go, but with the progress of commercialization, the speed of its scale popularization will also accelerate. From the perspevtive of the history of data storage, the change of storage medium is a constantly changing and accelerating process, and DNA storage should also become the technical direction of our world's attention and resratcher.

Our existing data storage systems will not last for the next century because the United Nations predicts will exceed 9.7 billion by 2050. It is foreseeable that magnetic storage and optical storage will still occupy the mainstream of data storage in the future.

According to quantum researchers, there are holographic light quantum in our DNA, which is the source of our life. A famous American scientist once did such an rxperiment : He had the subject stay in a well-lit room for ten minutes before leaving the room. After testing, there was a faint light and shadow in the room where the subject had been, which was basically the same as the subject's human figure, and the light and shadow lasted for more than a minute. The second time, he let the subjects stay in a room with light for an hour, and after leaving the room, he checked the room and found that the light and shadow were stronger and clearer than before, and lasted for half an hour. The third time, the subject stayed for three hours. With the help of the instrument, it was found that the light and shadow formed were clearly visible, which was exactly the same size as the subject's

own body, just like the photon copy image of the subject, and lasted for nearly 8 hours and then gradually disappeared. For the fourth time, he directly inspected the room where his friend often works --- where the chairs are placed --- and found that even if the friend stopped working there , the light and shadow still existed and lasted for nearly a month.

Dr Pope found that, if a living cell is illuminated with light, the cell absorbs the light and then releases another intense light after a while. He called this phenomenon " delayed luminescence. " After Kariyev discovered that DNA molecules store light, Pope's results came as no surprise. That is to say that DNA is basically the storage unit of light and the source of emitting biophotons. And the human body is surrounded by a light field and the DNA responds to the frequencies within this light field. Our DNA apparently stores light as a direct source of energy and vitality. If DNA receives too much light, it will send out more light. In cancer patients, they have lost the rhythm of the body's natural cycle, and then light is far less coherent than healthy people. Hence, the light stored in their bodies appears to be greatly diminished. However, patients with multiple sclerosis are different. Such patients absorb too much light, all owing the chaotic light frequency to interfere with the normal function of cells.

A biochemist, Glen Rein discovered that DNA would have a direct response to human consciousness. The scenario is such that when a cell is about to divide or has died, DNA unwinds on its own, and when DNA repairs itself, it coils into a spiral. Either coiling or unwinding of DNA can be measured directly by looking at how much 260 nm light is absorbed by the DNA.

Quantum mechanics is a branch of physics. It is an interdisciplinary field by nature, bringing together nuclear physicists, biochemists and molecular biologists. It plays a role in biological processes and causes mutations in DNA. Quantum effects plays a hitherto unexpected role in creating instabilities in DNA. Examples of biological processes are visible are the transport of electrons and protons in photosynthesis, respiration, vision, catalysis, olfaction, and in basically every other biological transport process. And the model of biological quantum logic in the DNA molecule implies that entangled electrons can be shared between separate strands of DNA and held coherently as those separate strands of DNA are shared between dividing cells. This is the so-called quantum DNA.

An innovative study has confirmed that quantum mechanics plays a role in biological and causes mutations in DNA. The protons in the DNA can tunnel along the hydrogen bonds in DNA and modify the bases which encode the genetic information. The modified bases are called tautomers and can survive the DNA cleavage and replication processes, causing transcription errors or mutations. This well-known yet almost magical quantum mechanism called tunnelling --- akin to a phantom passing through a solid wall --- that they manage to get across. Spontaneous changes in genetic code may be caused by subatomic particles tunnelling across the DNA helix (18).

Magnetic resonance imaging, for example, relies on quantum properties of atomic nuclei to look inside the human body to understand its function and diagnose disease, without invasive surgery or any harmful side effects of ionizing radiation.

Other examples of technogies powered by quantum mechanics include: lasers, solar cells, electron microscopes, and atomic clocks used for GPS.

Quantum computing has the potential to radically change the world around us by revolutionizing industries such as finance, pharmaceuticals, Artificial Intelligence, and automotive over the next several years. The value of quantum computers comes as a result of the probabilistic manner in which they function. DNA has a very straightforward chemistry, giving it major potential for use in nanotechnology (19) in things like nanoscale computers and drug delivery systems. The trouble is that in quantum mechanics the way that wave functions change with time is governed by an equation, the Schrodinger equation (20,21), that does not involve probabilities. It is just as deterministic as Newton's equations of motion and gravitation.

Do you know how does tuberculosis hibernate to hide from antibiotics?

Tuberculosis (TB) is an infection disease that is caused by the Mycobacterium tuberculosis bacterium (MTB) and is responsible for over a million deaths each year (22). As more than two billion people possibly have a latent tuberculosis (LTB) infection, early LTB diagnosis is crucial for the efficient control and elimination of tuberculosis (TB). Although the spread of TB has been greatly reduced due to antibiotics, strains that resist all available treatments are now emerging. MTB is successful as a pathogen because it can persist in humans for decades without causing disease; in fact, one-third of the world population has latent MTB infections, in which MTB lives dormant within the host's body and may or may not reactivate at a later time. It accounted for an estimated 1.7 million deaths in 2009 making tuberculosis a global health emergency. The widespread prevalence of latent infections makes it difficult to control TB epidemics. Biologists are therefore interested in finding out what makes the disease latent and how MTB activates itself within a host. Hence, the non-replicating or dormancy like state of this pathogen which is impervious to anti-tuberculosis drugs is widely recognized as the culprit for this scenario.

It remains unclear why MTB can stay latent for so long and how it survives during latency. The resistance of latent TB to antibiotics implies that MTB may have an ability to shut down expression of most genes and stay dormant, not unlike bears hibernating in the winter. Hibernation in bacteria is called sporulation because many bacteria form protective and metabolically dormant spores that can survive in tough conditions, allowing the bacteria to persist in the environment until conditions improve.

Hypoxia, or oxygen shortage, is often associated with latent forms of TB. Biologists have found that MTB becomes dormant in low-oxygen environments, presumably with the idea that the host's lungs will recover enough to potentially spread the disease in the future. Since MTB shows a remarkable ability to survive for years without oxygen, it is important to identify MTB genes responsible for the development of the latent state under hypoxic condtions. Biologists are interested in finding a master regulator (transcription factor) that senses the shortage of oxygen and starts a genetic program that affects the expression of many genes, allowing MTB to adapt to hypoxia. To understand transcription, it is the mechanism that determines when and where genes are expressed. So, a specific group of proteins known as transcription factors read the code. They can recognize and bind to specific sequences of the DNA.

In 2003, biologists found the dormancy survival regulator (DosR), a transcription factor, is crucial for the survival of MTB and regulates many genes whose expression dramatically changes under hypoxic conditions. The DosR regulon enables the pathogen to persist during lengthy hypoxia. Comparative genomic analysis demonstrated that the DosR regulon is widely distributed among the mycobacterial genomes, ranging from the pathogenic strains to the environmental strains.

The dormancy survival regulator (DosR) regulon (23), a set of 48 genes normally expressed in MTB under conditions that inhibit aerobic respiration (24,25), is controlled via the two-component regulatory system consisting of two sensor kinases-DosS (Rv3132c) and DosT(Rv2027c) (26,27,28), and a response regulator DosR (Rv3133c). The underlying regulatory mechanism of DosR regulon expression is very complex. Many factors are involved, particularly the oxygen tension. In-depth studies on the DosR response should provide insights into its role in TB latency in vivo and shape new measures to combat this exceeding recalcitrant pathogen.

Conclusion

Today's genomic revolution is powered by genome sequencing technology that reads your DNA and can be instrumental in identifying everything from inherited disorders, characterizing genetic mutations that drive cancer progression, or tracking disease outbreaks. And genome is helping solve some of the most challenging problems of mankind and inspiring new hope for people around the world.

Genome testing (29,30) gives hope to patients. Beyond solving medical

mysteries, genomic testing is transforming everything from the treatment of diseases to helping solve how we will produce enough food to feed a growing population in the face of life. By continuing to bring awareness to genomics, we can show the world how it is one of the most transformational forces of our time.

Our human genome resembles a book written in an unknown language. The letters are recognizable, but the words are incomprehensible. DNA is important, but not the whole story of life.

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