Aوزارة التعليم العالي والبحث العلمي

جــــامعــة تـكـريــت

كلية العلوم

قسم علوم الحياة

ماجستير / فرع الحيوان

STRUCTURE AND FUNCTION OF GENOME
IN PROKARYOTIC AND EUKARYOTIC

من اعداد الطلاب

سمية محمد صالح يوسف

بإشراف

د. وجدي صبيح

Abstract

Genomes is the fundamental unit in carry of genetic information during the generations، and the different between types of organism's making the genome also different, So we highlight the most important differences from where structure and function of genome and it's contents in the eukaryotic and prokaryotic cells, Size and organization of chromosomes in the genome of human and some prokaryotic cells.

Genome:- A complete set of genetic instructions for any organism, and all genomes are encoded in nucleic acids, either RAN or DNA. Nucleic acids are polymers consisting of repeating mints called nucleotides ; each nucleotide consist of Sugar phosphate, and nitrogenous base .

The nitrogenous base in DNA are of four types (abbreviated base A,C,G and T),and the sequence of these bases encodes genetic information in DNA, but a few viruses carry it in RNA, The four nitro genous bases of RNA or (abbreviated A,C,G and V)

DNA is closely associated with special cduss of proteins, the histones (A group of proteins responsible for the first level of DNA packing in chromatin)to form lightly packed chromosomes. This complex of DNA and histone proteins is termed chromatin, which is the stuff of eukaryotic chromosomes.

In prokaryotic hat is subcellular orgrism that lacks anucleus,itss DNA is not completed to histone proteins,and it is genome is usually a single chromosomes.

In addition,agenome also contains many regions of noncoding DNA that do not encode proteins of noncoding DNA products .Non coding DNA is commonly found in areas prior to the start of coding sequences if genes as well as in intergenic regions (I.e,DNA sequences located between genes).

The study of genome is called "genomic "

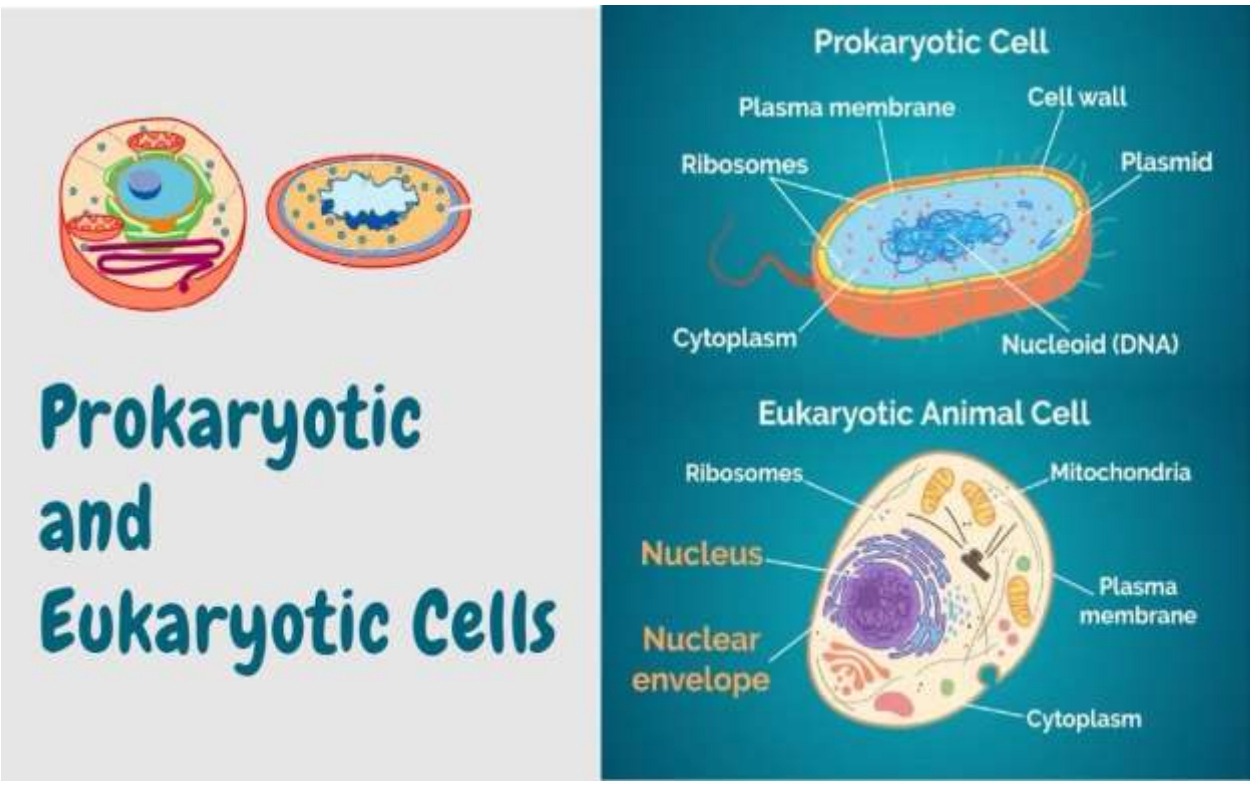
Function of genome:-
Analysis of genes at the function level is one of the main uses if genomics,an area known generally as functional genomics.Determinjng the function of individuals genes can be done in several ways.often a gene identified by forword genetics has been mapped to one specific chromosomal region,and the full genomic sequence reveals a gene in this position with an already annotated function.
The well-acceptsd major functions of the genome are to store and propagate the genetic material and to control the expression of genetic in formation encoded in DNA.
The genome is also major physical entity of each cell:
It is large mass, dynamic properties, and unique structural features effect major cellular processes by nongenetic means. Asaohysical entity, the genome exerts mechanical forces into its cellular environment via as transmission from the nucleus to the cytoplasm as well as within the nucleus between chromatin domains .
Results from a broad range of experiment show that mechanical forces generated by the genome are critical contributors to a wide range of cellular processes and to cellular homeostasis. The chromatin fiber also serves as physical binding scaffold both for proteins and for membranes m, and it is increasingly evident that key cellular events, including faithful cell division, involve controlled interactions of large molecular protein complexes and membranes with the genetic material. The genome is also a major structural component of the cell.

Genome in prokaryotic cell

Viral Genome

Viral genomes exhibit significantion diversity in structure some viruses have genomes that consist of DNA as either genetic material .This DNA may be single stranded ,as exemplified by human parvovimses ,or clouble strancled ,as seen in the herpesviruses and porviruses .Additionally, although all cellular life uses DNA as its genetic material ,some viral genomes are made of either single or double stranded RNA most bacterial genomes ,encoding only a few genes ,because they rely on their hosts to carry out many of the functions required for their replication.

most of the DNA in genome codes for pratein cor (tRNA and rRNA ,with a small amount of coding DNA ,primarily regulators.



genome in eukaryotic cell

Human genome

Humans come in many shapes and size ,but we 're all very similar at the DNA level .in fact ,the genome of a my two people are more than 99% the same. Most of the DNA (about 98.5%) does not code to proteins or mRNA.

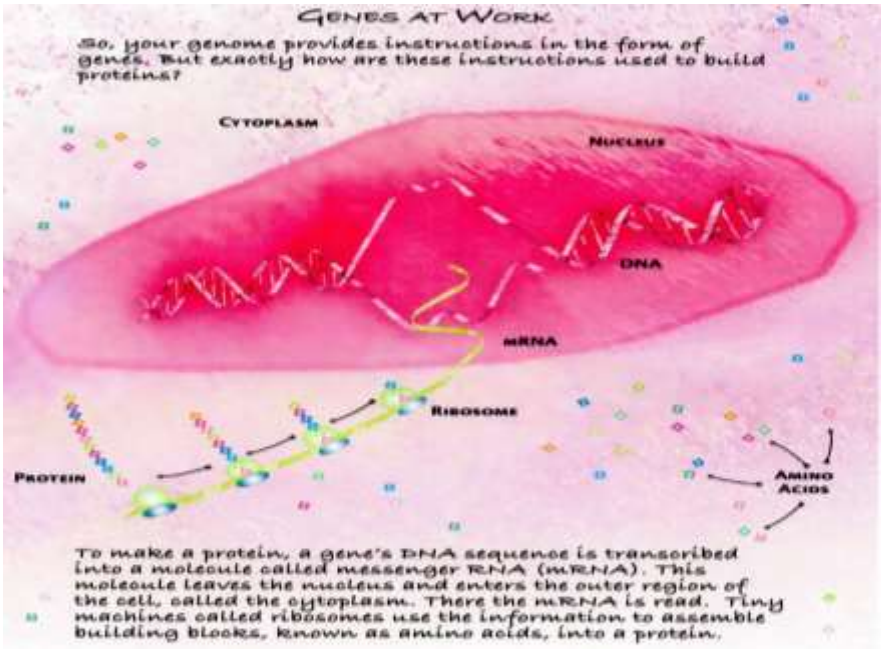
some noncoding regions are regulatory sequences , and other are introns.

* Non coding DNA the function of which is not well understood .Some noncoding DNA appears to participate in the formation of small noncoding RNA molecules that influence gene expression :some appears to play areole in maintaining chromosomal structure and in DNA packaging.

it is made up of 23 Chromosome pairs with a total of about 3billion DNA base pairs.

There are 24 distinct human chromosomes: 22 auto Somali chromosomes , plus the sex -determining x and y chromosomes .chromosomes 1-22 are numbered roughly in order of decreasing size . somatic cells usually have are copy of chromosomes 1-22 from each parent , plus on X chromosome from the mother and either any or x from the father , for atotel of 46

There are an estimated 20.000-25.000 human protein - coding genes.



Genome size

Genome size is usually measured by base paris (or bases in single -stranded DNA or RNA) .The value is another measure of genome size . Research on significant positive correlation between the c-value of procaryotes and the amount of genes that compose the genome .This inelicutes that gene number is the main factor influencing the size of the prokaryotic genome .

In Eukaryotic organisms ,there is a paradox observed namely that the number of genes that mak up the genome does not correlate with genome size in much larger than would be expected given the total number of protein coding genes.

genome size can be increase by culplication ,insertion ,or polyploidizaton. Recombination can lead to both DNA loss or gain .Genomes can also shrink becaues of cleletions Afamous example for such gene decay is the genome of mycobacterium lepera, the causation agent of leprosy. M leprae has lost many once -function at genes over time clue to the for metion of pseudogenes .This is evident in looking at its closest anocentor mycobacterium tuberculosis it lives and replicutes inside of hast and clue to this arrangement it cloes not have allowed it to live and prosp outside the host. Thus over time these genes have lost their function through mechanisms such as mutation causing them to become pseudogenes. lt is beneficial to an organism to rid it self of

non-essential genes because it makes replicating its DNA much faster and requir less energy . An example of increasing genome size over time is seen in filamentous plant pathogens . These plant pathogen genomes have been growing lavger over they years clue to repeat-driven expansion, The repeat-rich regions contain genes coding for host interaction proteins .with the addition of more and more repeats to these regoins the plants increase the possibility of cleve loping new vimlence factors throush mutation and other forms of genetic recombination. ln this way it is beneficail for these plant pathogens to have larger genomes .

Pseudogenes-:

often aresult of spontaneous mutation ,pseudogenes are dysfunctional genes derived from previously functional gene relatives .There are many mechanisms by which a fanctional gene can become a psudogenes in cluding the delation or insertion of one are multiple nucleotides . This can result in ashift or reading frame , causing the gene to no longer code for the expected protein ,introduced a premature stop codon or a mutation in the promoter region often cited example of pseudo genes within the human genome include the once functional (offactory) gene families over time many olfactory genes in the human genome become pseudogenes and were no longer able to produce functional proteins ,explaining the poor sense of smell humans possess in comparison to their mammalian relatives.

Organization of Genetic Material

The vast majority of an organisms genome is organized into cells chromosomes, which are discrete DNA stricter within cells that controls cellular a activity. Recall that while eukaryotic chromosomes are housed in the membrane-bound nucleus, most prokaryotes contain a single circular chromosomes that is found in an area of the cytoplasm called the "nucleoid" A chromosome may contain several thousand genes.

Organization of Eukaryotic chromosomes

The composition of genes in the human genome,as well as the determinants of their expression, is specified in the DNA of the 46 human chromosomes. Each chromosomes in the nucleus is along, linear double .

Stranded DNA molecule. The DNA molecule of chromosomes exists as a complex of DNA with family of basic chromosomal protein called histones and heterogeneous group of acidic Together. this complex of DNA and protein is called chromatin. There are 5major types of histones that play a critical role in the proper packaging of the chromatin fiber are H1,H2A,H2B,H3,H4.each complex of DNA and with core histones is called a(nucleosome) which is the basic structural unite of chromatin. The rest of the genome consists of several clad of (repetitive DNA)and includes DNA whose nucleotide sequence is repeated, either perfectly or with some variation, hundred millions of time in the genome.

The length of achromosome greatly exceeds the length of the cell , so achromosome needs to be packaged in to avery small space to fit with in the cell for example the comined lenghth of all of the 3billion base pairs of DNA of the human genome would measure approximatly 2 meters if completely stretched out , and some eukaryotic genomes are many times larger than the human genome . DNA super coliling refers to the process by wich DNA is twisted to fit inside the cell .proteins known to be involved in supercaling include to poisomerases ,these enzymes help maintain the structure of supercoiling chromosomes ,preventing over winding of DNA during certion
. cellular processes like DNA replication

ln enkaryotes ,the packaging of DNA by histones may be influenced by environmental factors that affect the presence of methyle groups on certain cytosine nucleotides of DNA packaging is called epigenetics .The epigenetics is another mechanism for regulating gene expression without altering the sequence of nucleotides .Epigenetic changes can be maintained through multiple rounds of cell division and therefore, can be heritable .

organization of prokaryotic

chromosome

chromosome in bacteria and archaea are usually circular, and prokaryotic cell typically contains only asingle chromosomes within the nucleoid .Because the chromosome hoploid As in eukaryotic cells , DNA upevcoiling is necessary for the genome to fit within the prokaryotic cell The DNA in the bacteria chromosome is arranged in several supevcolid domains .As with eukaryotes , to pomerases are involved in super coiling DNA ,DNA gyvase is atype of topomerase ,found in bacteria and some archea ,that helps prevent the overwintering of DNA(some antibiotics kill backeria targeting DNA gyvase).ln addition , histone - like proteins bind DNA and did in DNA packaging .other proteins bind to the origion of replication, the location in the chromosome replication initiates .Because the different regions of chromosomal DNA are more accessible to enzymes and thas many be used more readily as templates for gene expression .ln terestingly ,several bacteria ,including Helicobacter pylori and shigella flexneri, have been shown to induce epigenetic changes in their hosts up on in fection , leading to chromatin remodeting that may cause long-term effects on host immunity .Although most DNA is contained within a cell's chromosome ,many cells have additional molecules of DNA out side the chromosome, called extra chromosomal DNA that are also part of its genome.ln some cases ,genomes of certain DNA viruses can also be maintained inde pendently in host cells cluring latent viral infection ln these cases ,these are another from extra chromosomal DNA .for example ,the human papilloma virus.

(HPV) may be maintained in infected cells in this way.Beside chromosomes,some prokaryotes also have smaller loops of DNA called (plasmids)that may contain one or a few genes not essential for normal growth Bacteria can exchange these plasmids with other bacteria in process known of as horizontal gene trans fer (HgT).The exchange of genetic material on plasmids sometimes provides microbes with new genes beneficial for growth and survival under special conditions.In some cases, genes obtained from plasmids may have dunical implications, encoding virulence factors that give amicrobe the ability to cause disease or make amicrobe resistant to certain antibiotics. pkasmids are also used heavly in genetic engineering and biotechnology as away to more genes from one cell to another.

Type	**Properties**
F	Fertility (susceptibility to transmission by conjugation)
Scp1	Produce substance Anti-Antibiotic
FP2	Resistance pollution of elements of the weight
Col b	Resistance UV.
Col v	Resistance the viral invasion .
Lambda	Resistance the enter to properly cover for virus
R1	Prevent mutations for the bacterial cell
Rp1	Resistance natural substance than made from penicillin

Genome evolution

is the process by which agenome changes in structure (sequence) or size ever time .The study of genome evolutiin involutions multipe fields of genomic parasites, gene and ancient genomics .Genome evolution in bacteria is well under stood because of the thousands of completly sequenced bacterial genomes available .

Genetic changes may lead to both increase or Decrease of genomic complerity clue to adaptive genome streamlining and purifying selection

in general ,free -living bacteria have evolved larger genome with more genes so they can adapt more easily to changing environmental conditions .By contrast , most parasitic bacteria have reduced genomes as their hosts supply many if not most nutrients ,so that their genome dose not need to encode for enzymes that praduce the nutrients themselves. Eukaryotic genomes evolve over time through many mechanisms including much greater genetic diversity to the offspring than the prokaryotic process of replication in which the offspring are theoretically genetic colons of the parental cell

characteristic	**E.coli genome**	**Human Genome**
Genome size (base pairs)	4.6 Mb	**3.2Gb**
Genome structure	circular	**linear**
Number of chromosomes	1	**46**
Presence of plasmids	Yes	**No**
Presence of the nucleus	No	**Yes**
DNA segarated in the nucleus	No	**Yes**
Number of genes	4288	**20000**
Presence of introns	No	**Yes**
Average gene size	700bP	**27000bP**

*E.coli largely contains only exons in genes However, it does contain a small amount of self – splicing introns

FEATURE	PROKARYOTE	EUKARYOTE
Organisms	Bacteria	Protoctists, fungi, plants and animals
Cell size	0.5-10 micrometers in diameter	10-100 micrometers in diameter
Form	Mainly unicellular	Multicellular (the exception being Protoctista which has many unicellular organisms)
Cell Division	Binary Fission (they got no spindles)	Mitosis, meiosis, or both (we have spindles!)
Evolutionary Origin	3.5 thousand million years ago (woah, long time)	1.2 thousand million years ago (because they evolved from prokaryotes)
Genetic Material	DNA is circular and naked (no histones) and lies freely in the cytoplasm	DNA is linear and contained in a nucleus. It is associated with proteins (histones)
Protein Synthesis	Contain 70s ribosomes	Contain 80s ribosomes
Organelles	No membrane bound organelles	Many membrane bound organelles which may be double membraned (eg. mitochondria, nucleus) or single membraned (eg. golgi apparatus, lysosomes)
Cell Walls	Rigid containing polysaccharides with animo acids. Contains murein with is strengthening compound)	Cell walls of green plants and fungi are rigid and contain polysaccharides. Plant walls have cellulose for strengthening Fungal walls have chitin (no cell wals present in animal cells)
Flagella	Simple. They lack in microtubules and are not enclosed by a cell surface membrane. They are 20 nm in diameter	These are complex. They have a 9+2 arrangement of microtubules and are surrounded by a cell surface membrane. They are 200 nm in diameter
Respiration	Mesosomes in bacteria (except cytoplasmic membranes in blue-green bacteria)	Mitochondria present for aerobic respiration
Photosynthesis	Takes place on membranes which show no staking (blue-green bacteria)	Chloroplasts present for photosynthesis. (membranes in them stacked into grana or lamellae)
Nitrogen Fixation	Some have the ability	None can fix nitrogen

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