GENE AND TYPES OF GENE

Submitted BY

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GENE AND TYPES OF GENE

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- TYPES OF GENE

    EUKARYOTIC GENE

    PROKARYOTIC GENE

    VIRAL GENE

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INTRODUCTION

- A gene is molecular unit of heredity of living organism.Living beings depend on genes, as they specify all proteins and functional RNA chains.
- Genes hold the information to build and maintain an organism's cells and pass genetic traits to offspring.

DEFINITION

- A unit of heredity that is transferred from a parent to offspring and is held to determine some characteristic of the"proteins coded directly by genes"
- A gene is "a locatable region of genomic sequence, corresponding to a unit of inheritance, which is associated with regulatory region, transcribed regions and or other functional sequence regions.

HISTORY

- The existences of gene was first suggested by **GREGOR MENDEL(1822-1884).** Studied inheritance in pea plants and hypothesized a factor that conveys traits from parent to offspring's.
- Danish botanist **Wilhelm Johannes** coined the word gene in **1909** to describe this fundamental physical and functional unit of heredity.
- The genetic word was first used by **William Bateson 1905**.

- **Darwin** used the term gem mule to describe a microscopic unit of inheritance, and what would later become known as chromosome had been observed separating out during cell division.

- **Morgan and his studen**t began the first chromosomal map of the fruit fly drosophila
- **In 1953 James D Watson and Francis crick** demonstrated the molecular structure of DNA.
- **In 1972 Walter fires and his team** at the laboratory of molecular biology of the University of Ghent were the first to determine the sequence of gene.

Structure of gene

- We are well known that genes are present in the form of granular structure on chromonemeta of chromosome.
- The model of gene structure proposed by **benzer** is called **"benzer model**". According to this a gene may have three units.

1. Recon
2. Muton
3. Cistron

1 . RECON

- This is the unit of recombination. This smallest unit of recombination during crossing over.

2 . MUTON

- This is the unit of mutation. It is the smallest unit having the capacity of mutation. It may also consist of a single base pair. However, in practice mutations occurring at several other neighbouring nucleotides may map at the same size.

3. CISTRON

- This is the functional unit of expression. Cistron of a gene is responsible for synthesis of a polypeptides chain. Number of nucleotide is a cistron may vary from 100-30,000. If a gene is made up of more than one cistron, it is able to synthesize more than one polypeptides'.

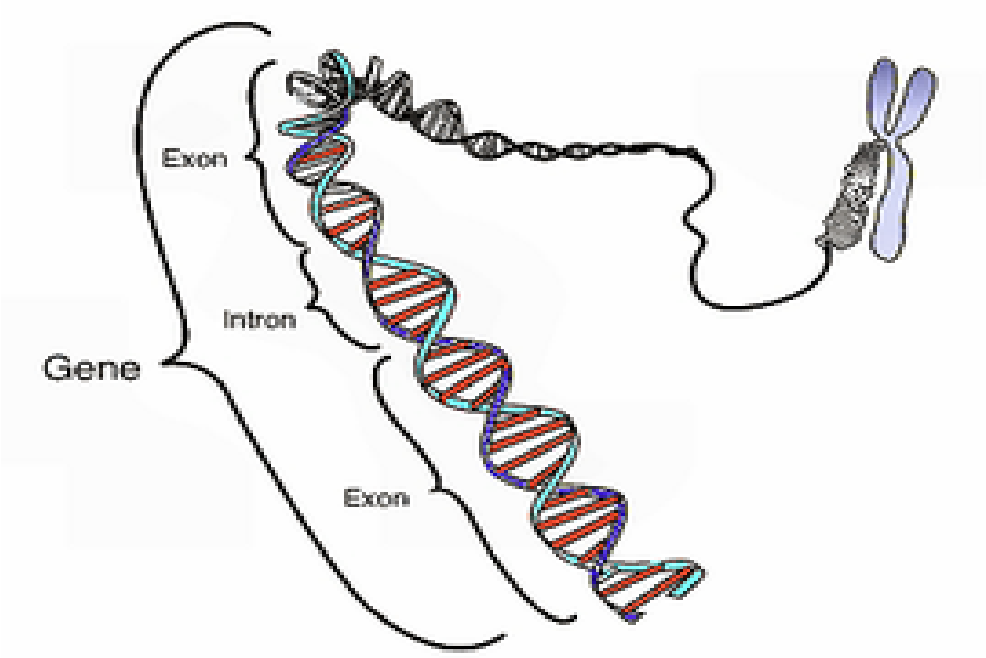

Fig 1 -- structure of Gene

OTHER TRMINOLOGIES USED IN RELATION TO STRUCTURAL CONCEPT OF GENE

COMPLON

- This is the complementary unit of cistron. A pair of genes having mutation at different cistron or complons show complementation. This result in the formation of normal protein in spite of mutation in gene.

OPERON

- An operon is defined as a set of genes which in a coordinated manner control or regulated the expression of structural genes. The operon concept of gene regulation was proposed by **Jacob and Monod** according to this concept, the Operator and regulator genes switch on off the expression of structural genes.

REPLICON

- It is a unit of DNA replication. A chromosome may have many replicons.

TYPES OF GENE:

There of three types of gene

1 prokaryotic gene
2 eukaryotic gene
3 viral gene

1. PROKARYOTIC GENE

In prokaryotic cells such as bacteria are usually found grouped tighter in operons. There are many types of prokaryotic gens.

1.REGULATOR GENE

- The regulator gene of lac operon is responsible for the production of a protein called"represser.
- The repressor may be active or inactive.
- The active repressor is also known as Apo repressor.
- This has an affinity for operator site of the operon and can bind with the operator gene disrupting the movement of RNA polymerase during transcription. In this way, due to presence of active repressor, production of mRNA does not take place.
- Thus proteins or enzymes are also not formed.

2. PROMOTER GENE

- It is located in between regulator and operator genes.
- It provides the site for attachment or RNA- polymerase during transcription of mRNA.
- Thus it decides the activity of this enzyme.

3. OPERATOR GENE

- It is found between promoter and structural genes.
- It operates the movement of RNA-polymerase along the DNA template.
- Attachment of this enzyme at promoter does not necessarily mean the functional movement of this enzyme on the template.
- The interaction between operator gene and repressor protein is the decisive factor for controlling the action of RNA-polymerase.

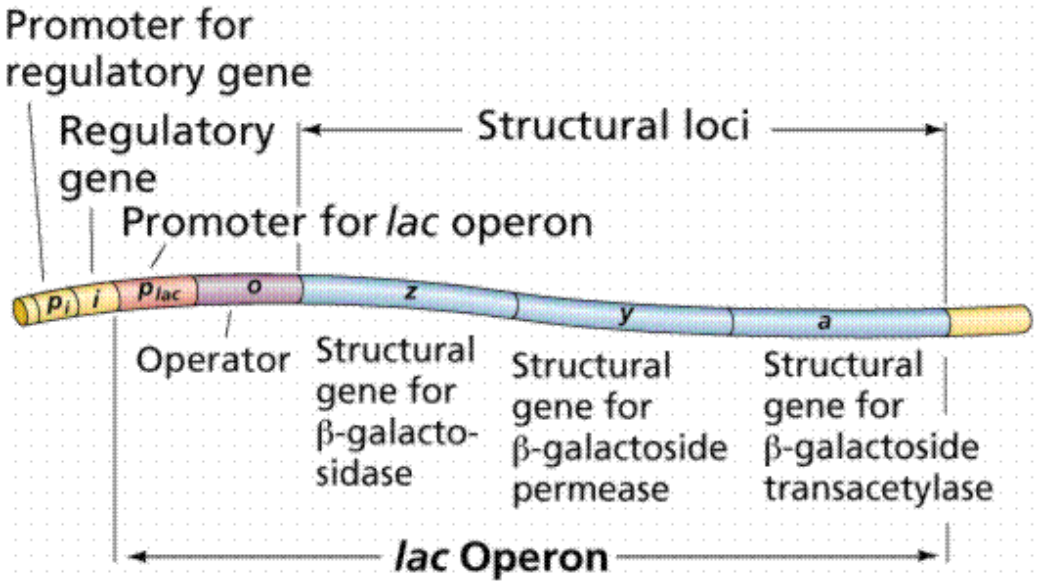

Fig 2- structure of prokaryotic gene

2. EUKARYOTIC GENE

- As a result of the analysis of a large number of eukaryotic genes, essential features of gene organization have become evident. Most striking, when compared to the organization and structure of prokaryotic genes, is the extreme complexity of the genes in eukaryotic cells, particularly higher eukaryotes.
- This often involves a large array of discontinuous segments that must be assembled into the final mRNA product as well as a

complex array of regulator sequences that govern the transcription of the gene.

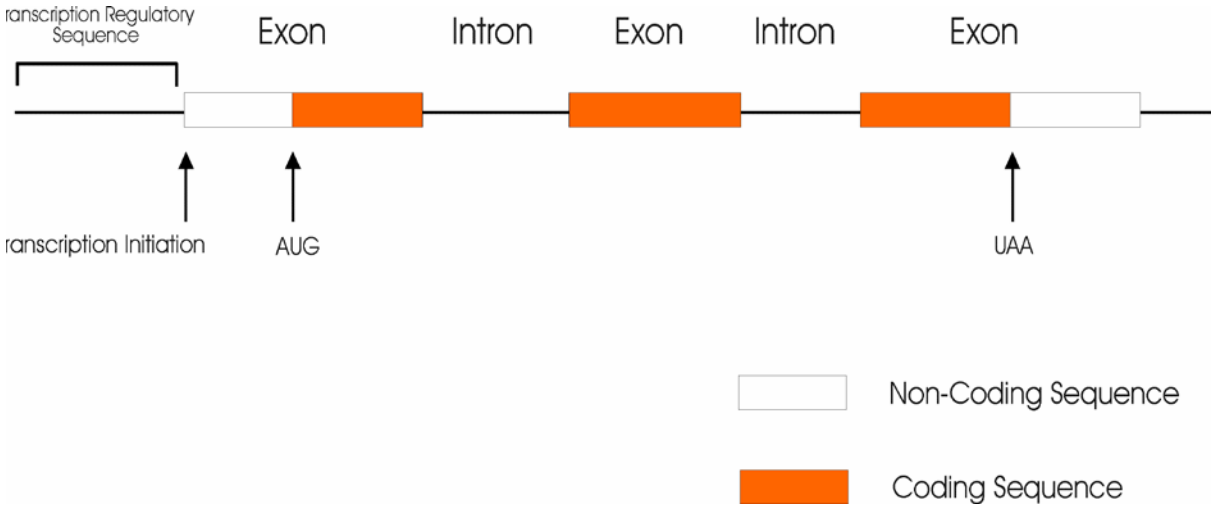

Fig 3 - structure of eukaryotic gene

Exons –

- Sequences in the gene that are found in the functional mRNA. Includes coding sequence but may also include non-coding sequence.
- The beginning of the first exon defines the site of initiation of transcription since there is no processing of the 5' end of the primary transcript.
- The end of the final exon defines the site of cleavage of the primary transcript at what is known as the polyadenylation site, creating the mature mRNA 3' terminus.
- Transcription does not terminate at this position but continues some distance downstream.

Introns –

- Intervening sequences in the gene that are removed in the formation of the functional mRNA.
- Usually includes non-coding sequence but there are instances of alternative processing where sequences can be both introns and exons.
- This arrangement can vary from relative simple (two exons separated by one intervening intron sequence) to extremely complex whereby a very large number of exons form the final mRNA.
- For instance, the dystrophin gene, that which is mutated in Duschenne muscular dystrophy, comprises at least 70 exons and more than one million base pairs of DNA.
- With respect to considerations of mutation frequency, one might suspect that the very large domains of certain genes contribute to an increased frequency of mutation, by creating a larger target size for mutation. Although much of the size is due to intervening sequence, the mutation of which would have no consequence, it is also possible that an actively transcribed domain would be more susceptible to mutagenic events.

3. VIRAL GENE— RETROVIRUS

INTRODUCTION

- A retrovirus is am RNA VIRUS that is duplicated in a host cell using the reverse transcriptase enzyme to produce DNA from its genome.
- The DNA is incorporated into the host genome by an integrase enzyme.
- Retrovirus is enveloped viruses that belong to the viral family Retroviridae.

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STRUCTURE

- Virions of retroviruses consist of enveloped particle about 100 nm in diameter.
- The virions also contain two identical single stranded RNA molecules 7-10 kb in length.

ENVELOP

- The envelop composed of lipids obtained from the host plasma membrane during budding process as well as glycoprotein encoded by the env gene

RNA

- RNA consists of a dimer RNA.
- The RNA genome also has terminal noncoding regions, which are important in replication, and internal regions that encode virion protein for gene expression.

PROTEIN

- Protein consisting of Gags proteins, protease pol protein and envelop proteins.
- Gag proteins are major components of the viral capsid, which are about 2000-4000 copies pre virion.
- Protease is expressed differently in different virus.

MULTIPLICATION

- When retroviruses have integrated their own genome into the germ line, their genome is passed on following generation.
- These endogenous retroviruses, contrasted with exogenous ones, now make up 5-8% of human genome.
- While transcription was classically thought to occur only from DNA to RNA, reverse transcriptase transcribes RNA to DNA.
- These inserts are transcribed by enzymes of the host new RNA molecules that enter the cystosol..
- Some of these RNA molecules are translated into viral protein.
- Ex. The gag gene is translated into molecules of the capsid protein the pol gene is translated into molecules of reverse transcriptase and the eve gene is translated into molecules of the envelope protein.
- It is important to own reverse transcriptase in its capsid; otherwise it is unable to utilize the enzyme of the infected cell to carry out the task, due to the unusual nature of producing DNA from RNA.

TRANSMISSION.

- Cell to cell
- Fluids
- Airborne like jaagsiekte sheep retrovirus.

GENS

Retrovirus genomes commonly contain these three open reading open reading frames that encode for protein that can be found in the mature virus.

GROUP SPECIFIC ANTIGEN (geg) codes for core and structural protein that can be found in the mature virus.

POLYMERASE (pol) codes for reverse transcriptase, protease and integrates

ENVELOPE (env) codes for the retroviral coat protein.

PROVIRUS

- This can be incorporated into host genome as a provirus that can be passed on to progeny cell.
- The retrovirus DNA is inserted at random into the host genome.
- Because of this, it can be inserted into oncogens.
- In this way some retrovirus can convert normal cell into cancer cell.
- Some provirus remains latent in the cell for a long period of time before it is activated by the change in cell enviournment.

RETROVIRUS LIFE CYCLE

- The retrovirus life cycle begins viral glycoprotein embedded in the lipid After envelop recognize receptor displayed on the host cell plasma Membrane and mediated viral attachment.
- Subsequently membrane fusion between the viral and host cell membrane follows and allow to viral entry.
- After gaining entry into the host cell the virus is uncoated by process that requires the mature gag protein
- Once the genetic material of the virus has been uncoated reverse transcriptase is implemented by the viral enzyme reverse transcriptase, which converts the RNA genome into double stranded DNA intermediate.
- The provirus is established, the DNA become a permanent addition to the infected cells genome. Here it is used as a template for viral RNA production and will be passed on to daughter cell during mitosis.

- Retroviruses contain open reading frames designated by the geg, pro, pol, and env genes which allow for the translation of of precursor protein that are then processed during and after virus assembly.
- As the gag pro pol and env proteins are synthesized they come together to assembly progeny virion at plasma membrane.
- As the complex increase in size its apply pressure to the membrane causing the virus to bud outward until finally the virion is pinched off and released into extracellular matrix.
- During and after the release of the virion from the cell, the gag precursor is cleavage by the viral protease enzyme.
- The mechanism behind the activation of pr is currently unclear. The enzyme is inactive prior to budding so that the precursors are not cleavage until after virion assembly.
- Geg precursor cleavage releases the viral protein. Cleavage of the gag pro pol precursor occurs simultaneously with the gag precursor and releases PR, RT, and IN protein products. Thus after budding from the cell, PR cleavage both gag and gag pro pol inactive precursor into active proteins that render the viral particle mature and infectious and viral life cycle can continue.

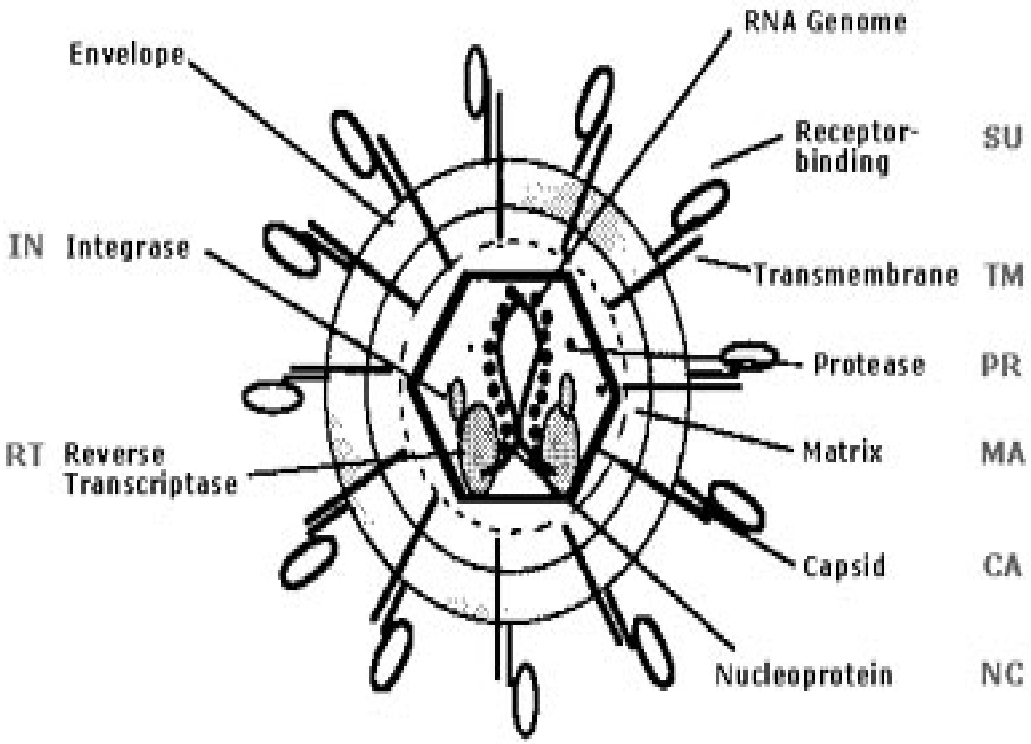

Fig 4 - structure of retrovirus

SUMMARY-

- Gene are functional unit of hereditary materials which are located on chromosomes
- Gene is functionally the unit of hereditary.
- Gens are the unit of transmission of characters from generation to generation.
- Gene is the unit of mutation.

CONCLUSION-

- A few genes that are controlled by one promoter.
- Gene are the three types namely—
  Prokaryotic gene, Eukaryotic gene, viral gene.
- The prokaryotic gene is made up of operator, promoter and regulator gene.
- Eukaryotic gene is made up of intron and exon.

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