

Gene structure

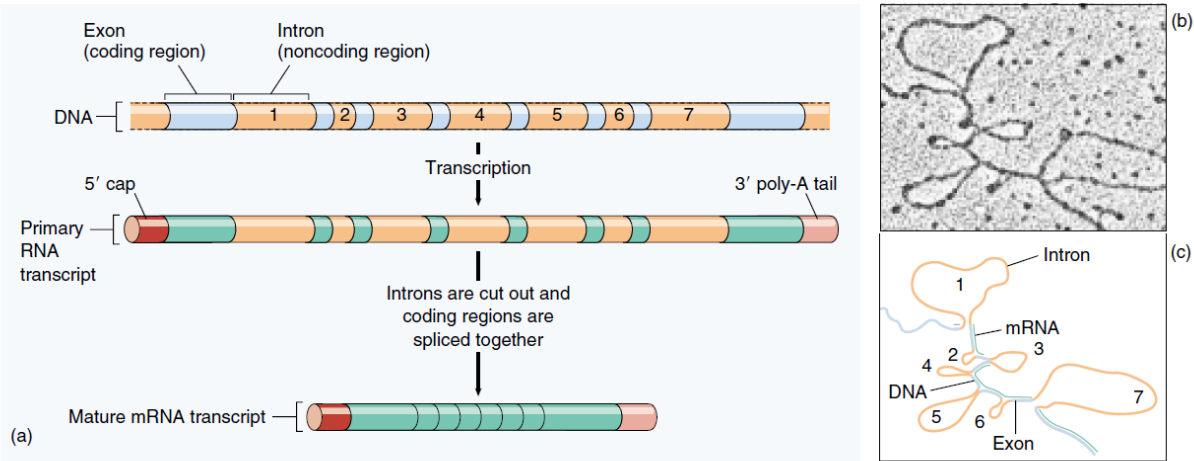
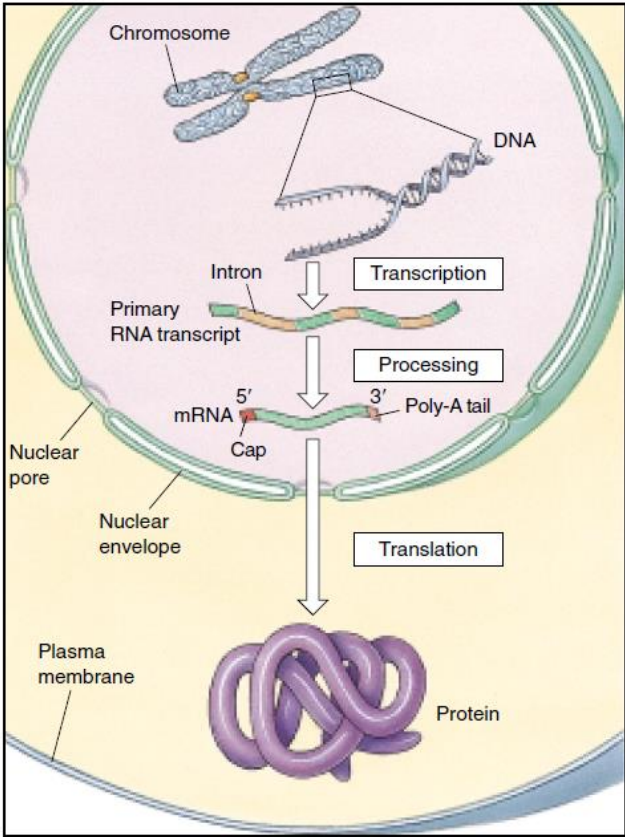


FIGURE 15.15

1. Introduction and History of gene

Definition: A gene is a specific sequence of DNA containing genetic information required to make a specific protein.

Types of Gene based on organism

- Prokaryotic gene (which is seen in prokaryotes, example: Bacteria, Cyanobacteria)
- Eukaryotic gene (Which is seen in higher organisms such as Plants, Animals)

2. Introduction and History of gene

- The classical principles of genetics were deduced by Gregor Mendel in 1865 on the basis of breeding experiments with peas.
- He assumed that each trait is determined by a pair of inherited 'factors' which are now called gene.
- In 1909 Wilhelm Johannsen coined the term 'GENE'.

3. Prokaryotic gene structure

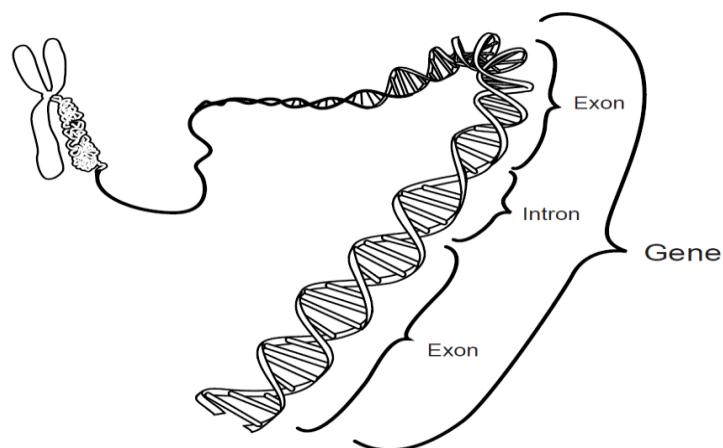
Prokaryotic Gene is composed of three regions:

1. Promoter region

2. RNA coding sequence

3. Terminator region

- Prokaryotic gene is continuous and uninterrupted where there is no introns present
- The region 5' of the promoter sequence is called upstream sequence and the region 3' of the terminator sequence is called downstream sequence.



Promoter region:

This is situated on upstream of the sequence that codes for RNA. This is the site that interact RNA polymerase before RNA synthesis (Transcription).

Promoter region provides the location and direction to initiate transcription

At -10 there is a sequence TATAAT or PRIBNOW BOX. At -35 another consensus sequence TTGACA

These two are the most important promoter elements recognized by transcription factors.

RNA coding sequence:

The DNA sequence that will become copied into an RNA molecule (RNA transcript).

Starts with an initiator codon and ends with termination codon No introns (uninterrupted).

Collinear to its mRNA.

Any nucleotide present on the left is denoted by (-) symbol and the region is called upstream element. E.g. -10, -20, -35 etc. Any sequence to the right of the start is downstream elements and numbered as +10, +35 etc.). Terminator region:

The region that signal the RNA polymerase to stop transcription from DNA template.

Transcription termination occur through Rho dependent or Rho independent mannregion

4. Eukaryotic gene structure

Eukaryotic gene are complex structures compared that prokaryotic gene. They are composed of following regions

- Exons
- Introns
- Promoter sequences
- Terminator sequences
- Upstream sequences
- Downstream sequences
- Enhancers and silencers (upstream or downstream)
- Signals (Upstream sequence signal for addition of cap. Downstream sequences signal for addition of poly A tail.)

Exons

- Coding sequence, transcribed and translated.

- Coding for amino acids in the polypeptide chain.
- Vary in number, sequence and length. A gene starts and ends with exons.(5' to 3').
- Some exon includes untranslated (UTR)region.

Introns

- Coding sequences are separated by noncoding sequences called introns. • They are removed when the primary transcript is processed to give the mature RNA
- All introns share the base sequence GT in the 5'end and AG in the 3'end.
- Introns were 1st discovered in 1977 independently by Phillip Sharp and Richard Roberts.

Significance of Introns

- Introns don't specify the synthesis of proteins but have other important cellular activities.
- Many introns encode RNA's that are major regulators of gene expression.
- Contain regulatory sequences that control transcription and mRNA processing.
- Introns allow exons to be joined in different combinations (alternative splicing), resulting in the synthesis of different proteins from the same gene.
- Important role in evolution by facilitating recombination between exons of different genes (exon shuffling).

Promoters

A promoter is a regulatory region of DNA located upstream controlling gene expression.

1. Core promoter – transcription start site (-34) Binding site for RNA polymerase and it is a general transcription factor binding sites.
2. Proximal promoter-contain. primary regulatory element. • These together are responsible for binding of RNA polymerase II which is responsible for transcription.

Upstream (5'end)

- 5'UTR serve several functions including mRNA transport and initiation of translation.
- Signal for addition of cap (7 methyl guanosine) to the 5'end of the mRNA.
- The cap facilitates the initiation of translation.
- Stabilization of mRNA. Downstream (3'end)
- 3'UTR serves to add mRNA

- stability and attachment site for poly-A-tail.
- The translation termination codon TAA.
- AATAA sequence signal for addition of poly A tail.

Terminator Recognized by RNA polymerase as a signal to stop transcription

Enhancer Enhances the transcription of a gene upto few thousand bp upstream.

Silencers Reduce or shut down the expression of a near by gene.

- Number of genes in each organism is more than the number of chromosomes; hence several genes are located on each chromosome.
- The genes are arranged in a single linear order like beads on a string.
- Each gene occupies specific position called locus.
- If the position of gene changes, character changes.
- Genes can be transmitted from parent to off springs.
- Genes may exist in several alternate formed called alleles.
- Genes are capable of combined together or can be replicated during a cell division.
- Genes may undergo for sudden changes in position and composition called mutation.
- Genes are capable of self duplication producing their own exact copies. Salient features of gene.