Chapter 10: Gene Expression and Regulation

Important

- how is DNA genetic code read by the cell to make protein?
- what makes up a gene?
- how is a gene activated (eg. turned on and off)?
- how are genes interrupted
- what is the difference between *transcription* and *translation*

Central Dogma of Biology!!!

$$DNA\ (transcription\ in\ nucleus) \Rightarrow RNA\ (translation\ in\ cytoplasm) \Rightarrow Protein$$

Transcription

- converts double stranded DNA code into single stranded RNA code
- uses enzyme machine (RNA polymerase) to perform transcription
- RNA polymerase only reads one of the two DNA strands
- RNA polymerase matches RNA nucleotide with DNA nucleotides to produce single RNA strand with same code

RNA Polymerase (transcription process)

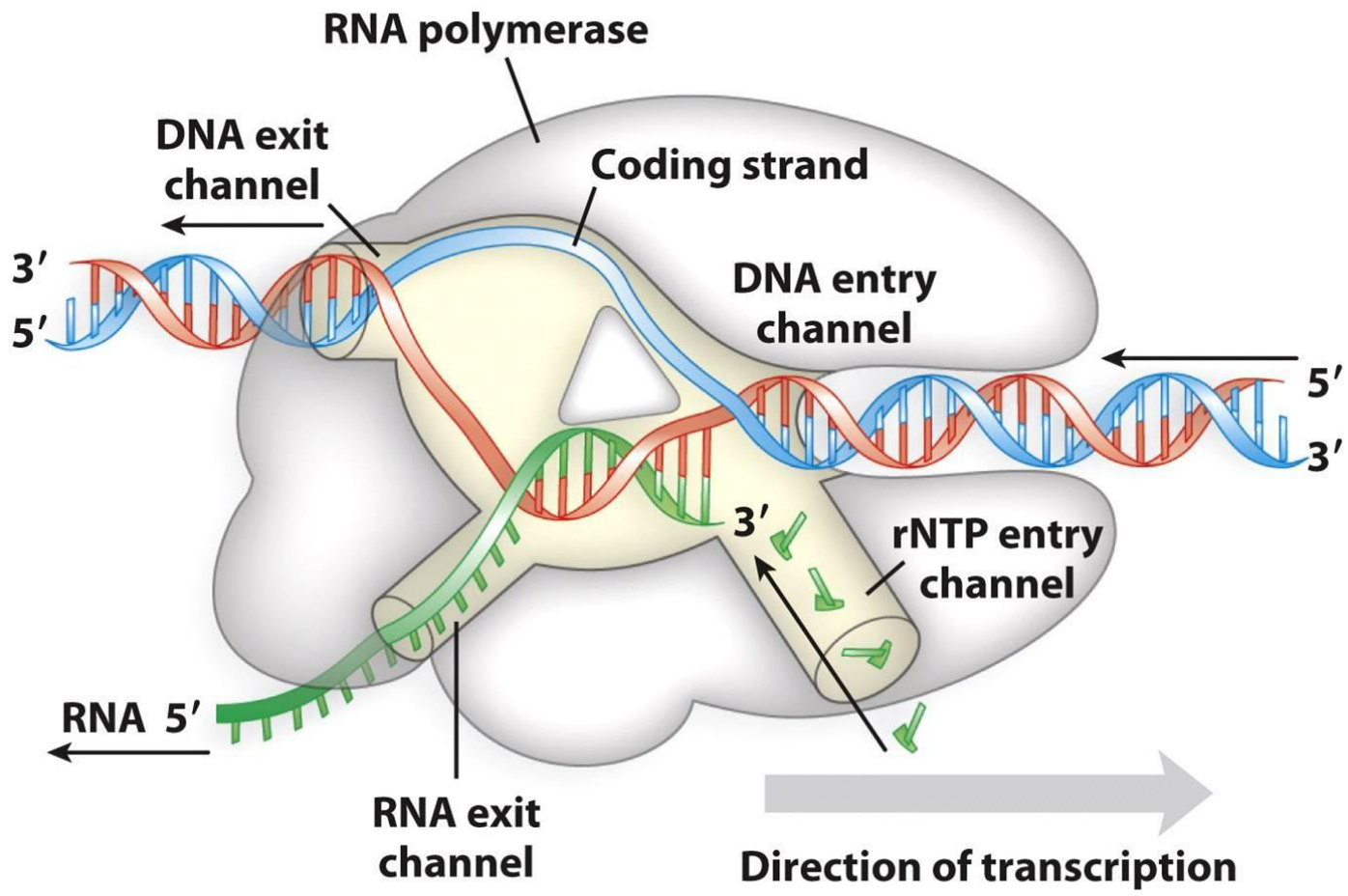


Figure 15-14
Molecular Biology: Principles and Practice

What Makes Up a Gene?

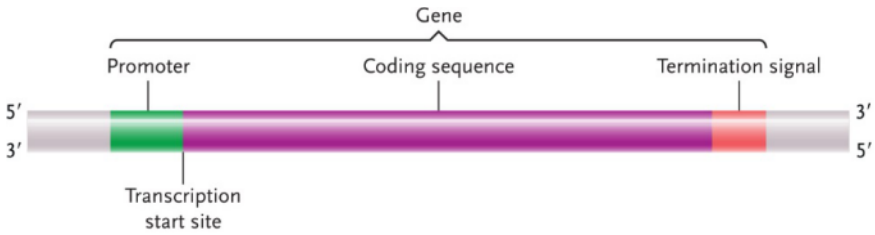


FIGURE 10.3 A typical bacterial gene contains information to make a protein: the promoter, the coding sequence, and the termination signal.

Gene: sequence of DNA on a specific region of the chromosome that makes RNA product
Promoter: region of DNA that acts as on/off switch for transcription

- All genes have promoters (sequences of DNA) that control when and at what level the gene is expressed

Terminator: region of DNA that acts to end transcription

- not all genes are on/off at the same time
- number of genes on at a specific time control cell type/function (eg genes in brain cells are different than skin cells
- changes in DNA sequence can affect gene function (alleles)

Is all of the transcribed gene coding region translated into protein?
Prokaryotes=Yes, Eularyptes=No
In eukaryotes, genes are called interrupted since not all of the transcribed RNA is translated into protein.

Coding regions=**Exons**, "building blocks of life", spliced together to form mature mRNA which is translated into protein
Non-coding regions=**Introns** (removed before translation)

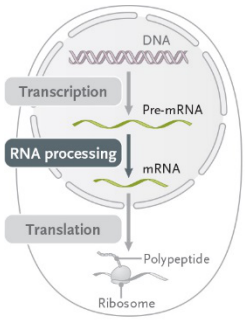
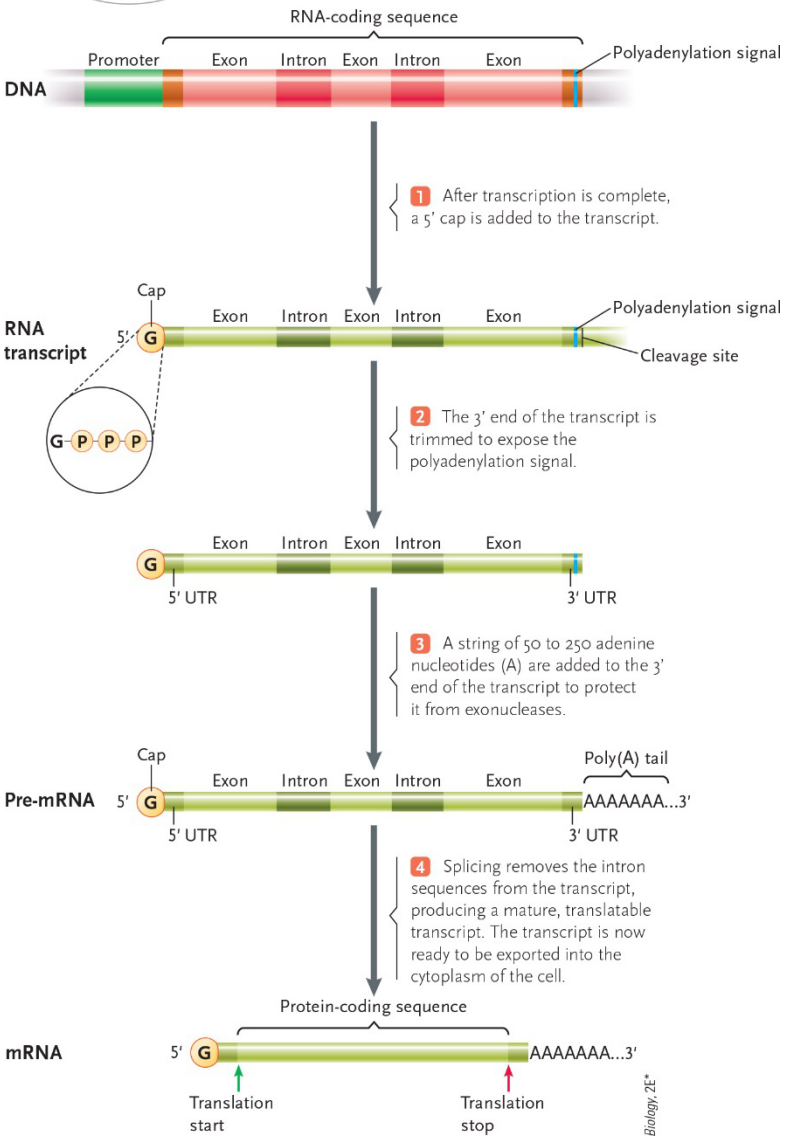


FIGURE 10.6 Following transcription, the mRNA molecule must go through a maturation process prior to export to the cytoplasm for translation.



Translation

- mature mRNA (exported from nucleus) is translated by **ribosomes** in cytoplasm
- cells have transfer RNAs (tRNA) which recognizes specific **three letter codes (codons)** on the mRNA which correspond to specific amino acids
- **tRNA** act as intermediary between mRNA and amino acids- brings in amino acids into growing polypeptide chain

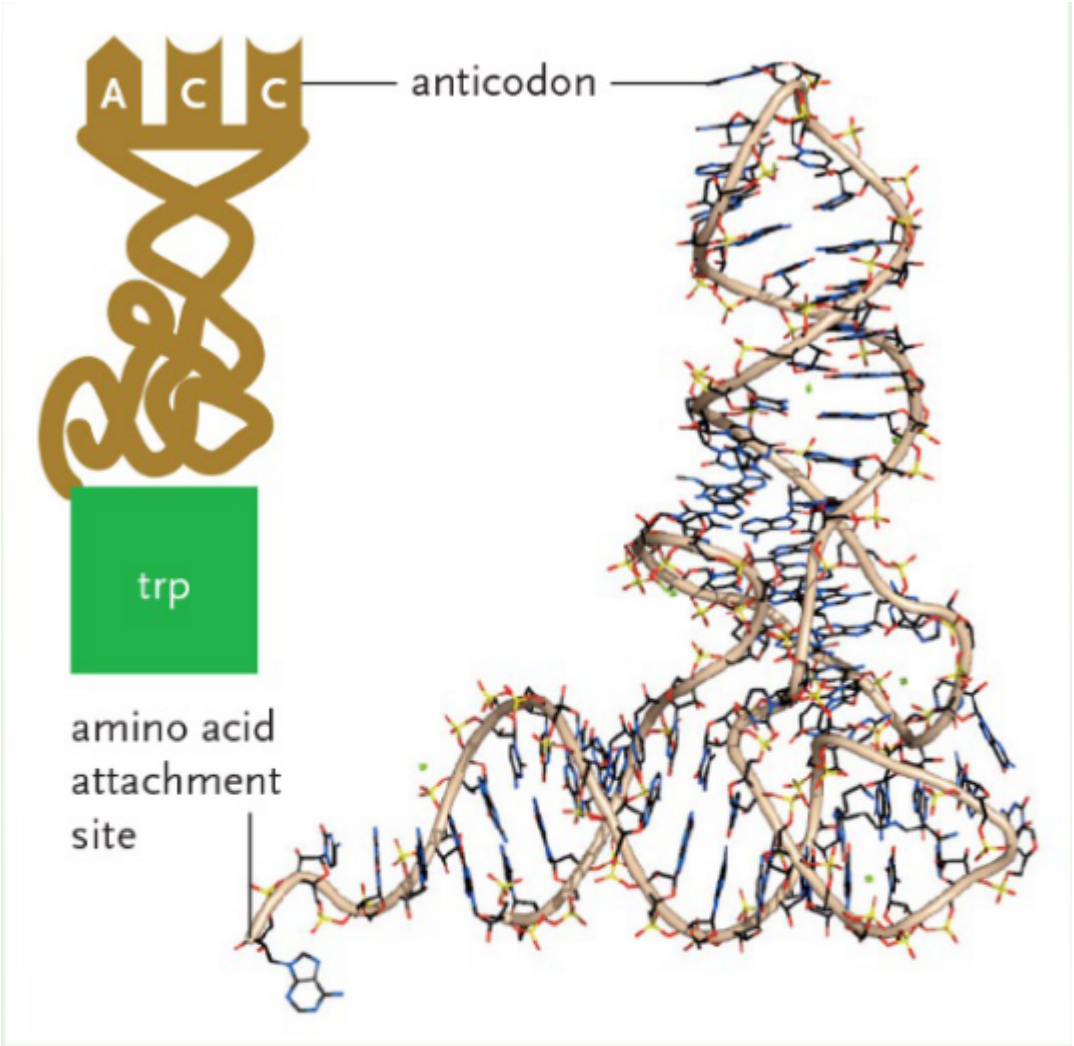


FIGURE 1 tRNAs help the ribosome translate the genetic code. The anticodon reads the mRNA codon, and the tRNA delivers the correct amino acid to the growing protein during translation.

Codon

- codon code is *redundant*: multiple codons code for same amino acid

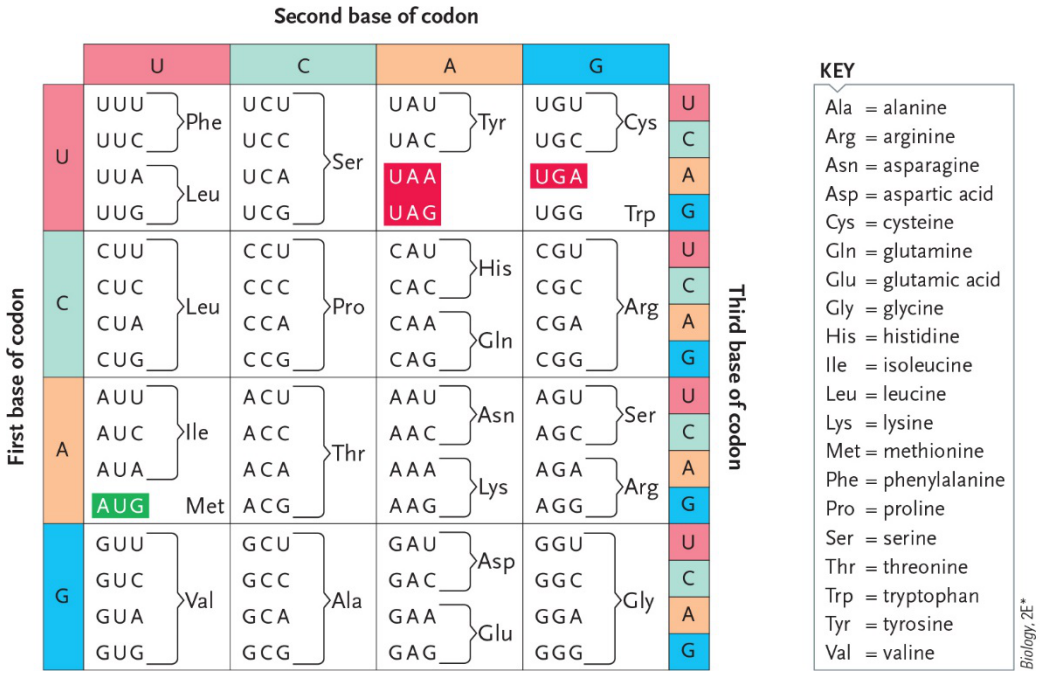


FIGURE 10.9 The genetic code. The 64 possible codons allow some redundancy when encoding 20 amino acids and the stop signal (in red).

- turning genes on/off can occur at many level: *Gene regulation*

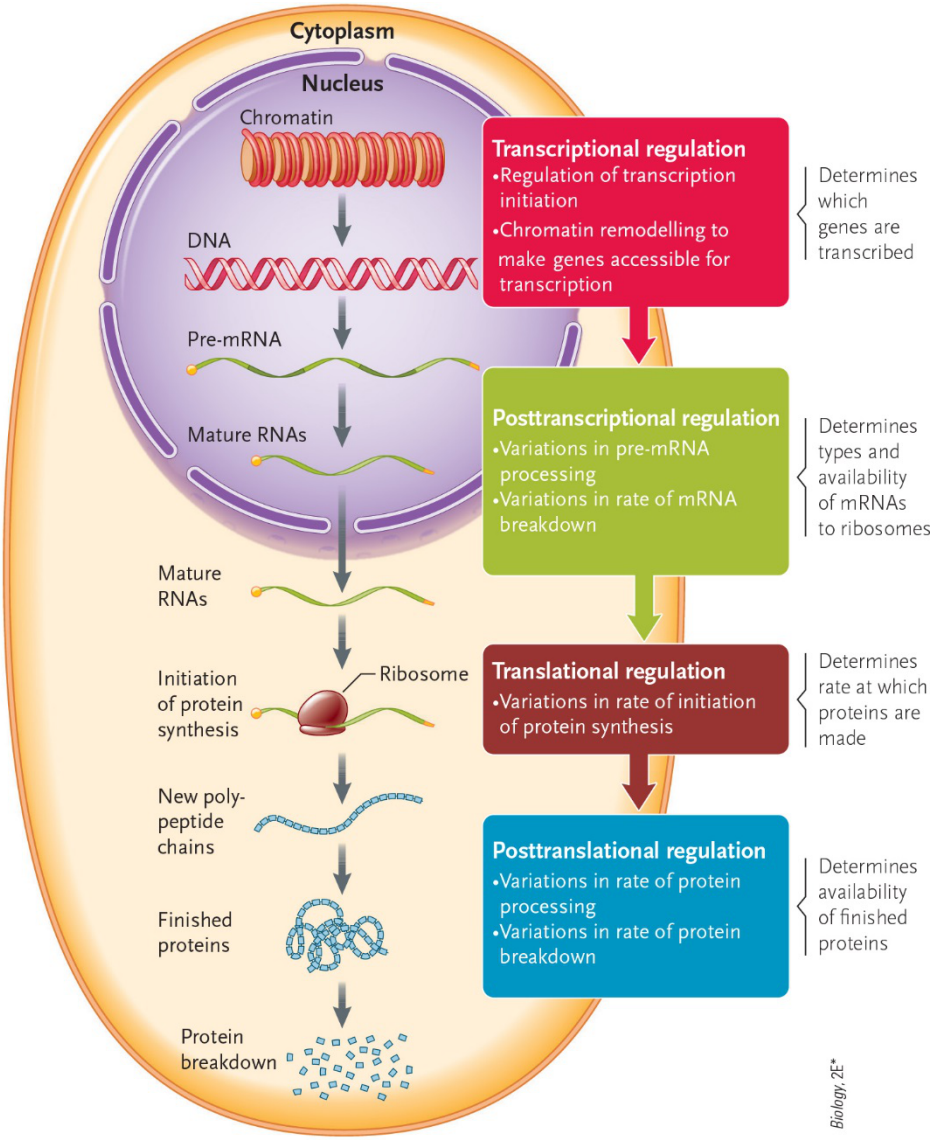


FIGURE 10.11 Points where gene expression can be regulated in eukaryotic cells.