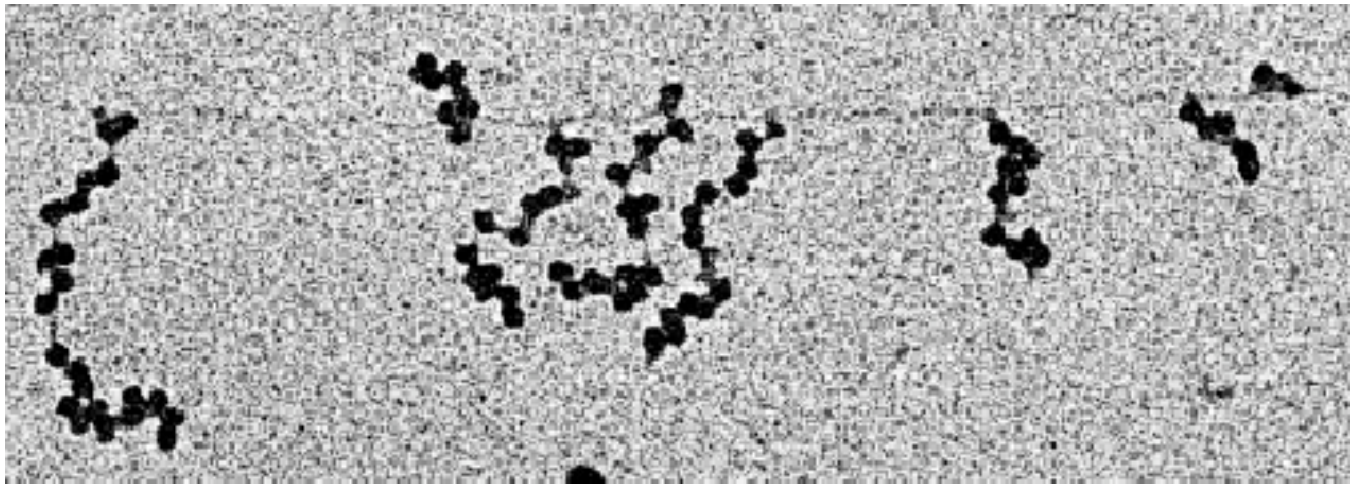
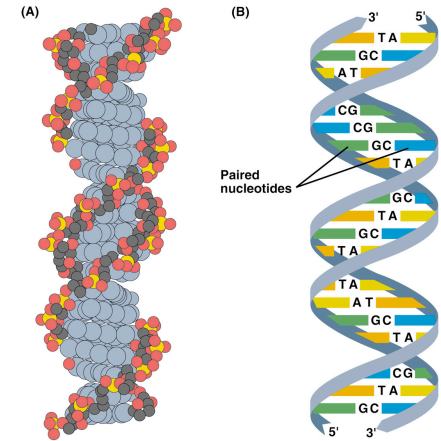


Gene Expression: Transcription



Reminder

- Genes must be replicated, transmitted, and expressed.
- The genetic information in a gene is encoded in the sequence of bases on one strand of DNA.



```
1           10           20           30           40           50           60           70           80           90           100
AcatttgcttctgacacaactgtgttcactagcaactcaaacagacaccATGGTGACCTGACTCCTGAGGAGAAGTCTGCCGTTACTGCCCTGTGGGGC
101
AAGGTGAACGTGGATGAAGTTGGTGGTGAGGCCCTGGGCAGgtttggtatcaaggttacaagacaggtttaaggagaccaatagaaactgggcatgtggag
201
acagagaagactccttgggttctgataggcactgactctctctgcctatttggctatccccacccttagGCTGCTGGTGGTCTACCCTTGGACCCAGA
```

Sequence Information

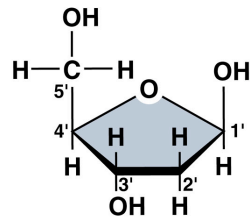
Genes are expressed by determining the sequence information in two of the classes of molecules that do the cell's work:

- **RNA (base sequence)**
 - ribosomal RNA (rRNA)
 - transfer RNA (tRNA)
 - small nuclear RNA snRNA
 - etc., etc.
- **Protein (amino acid sequence)**
 - ribosomal proteins
 - enzymes
 - cytoskeletal proteins
 - etc., etc.

RNA Structure

RNA is like DNA except:

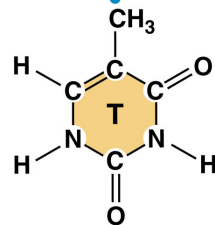
- Ribose instead of deoxyribose
- Uracil instead of Thymine
- Single-stranded but can form double-stranded regions with itself



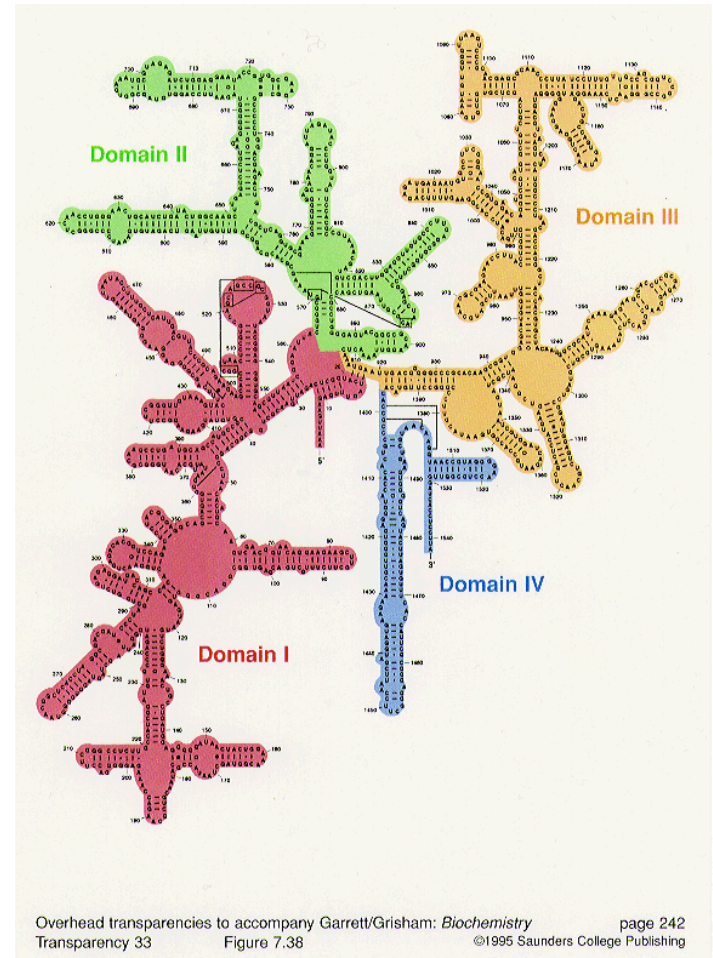
Deoxyribose

OH in ribose of RNA

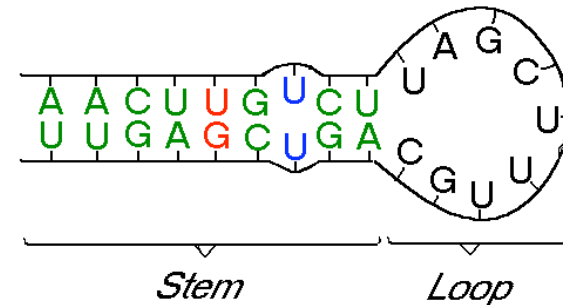
H in uracil



Thymine

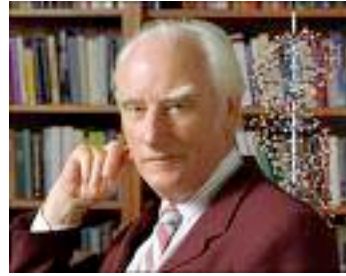


Overhead transparencies to accompany Garrett/Grisham: *Biochemistry* page 242
Transparency 33 Figure 7.38 ©1995 Saunders College Publishing



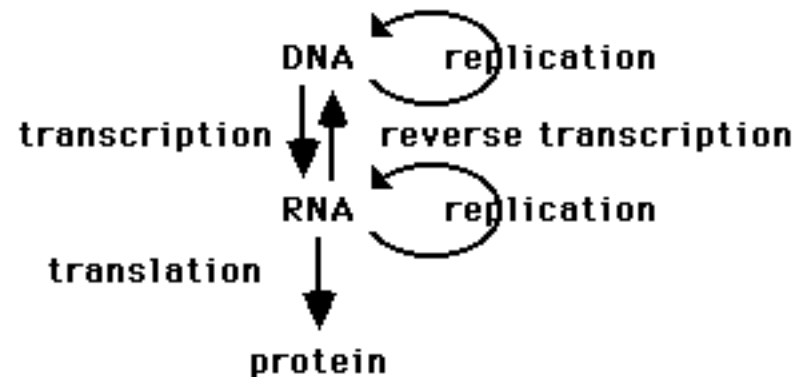
- Watson-Crick pairs
- UG pairs
- Mismatch

The Dogma of Sequence Information Flow



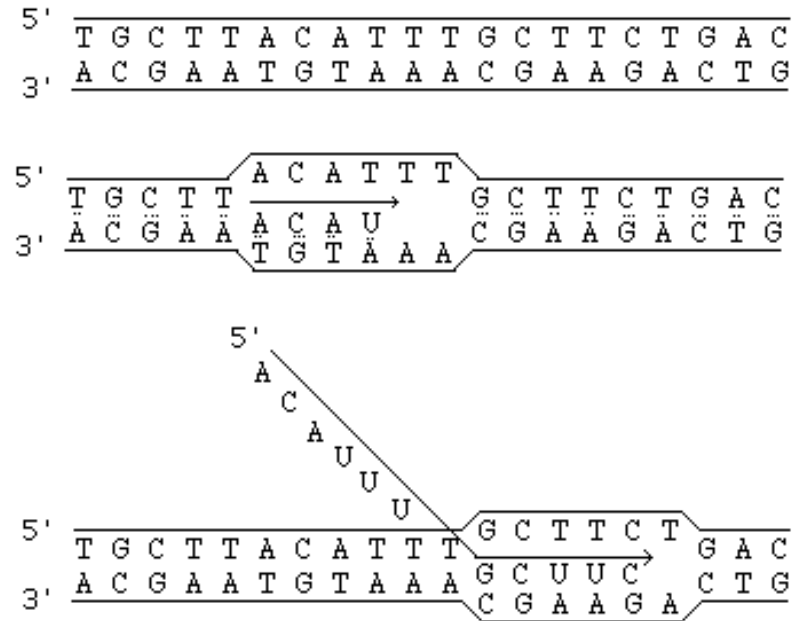
Sir Francis Crick

Sequence information is passed from nucleic acid to nucleic acid (DNA or RNA) and from nucleic acid (RNA only) to protein, but not from protein to nucleic acid.



Transcription

- The sense strand of DNA has the same sequence as the RNA transcript.
 - Only the complementary DNA strand, the antisense strand, is transcribed.
- (Some people use the opposite terminology!)
- Transcription requires a number of proteins:
- RNA polymerase (5 to 3' only).**
Proteins that determine what genes will be transcribed and when.

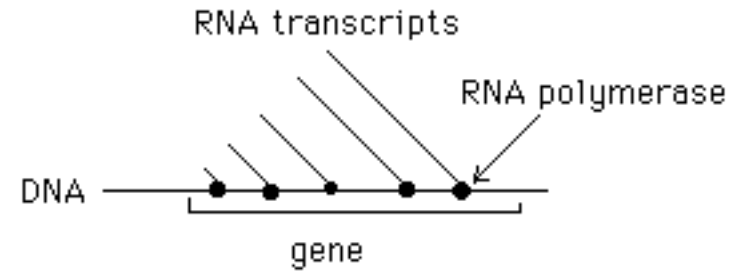
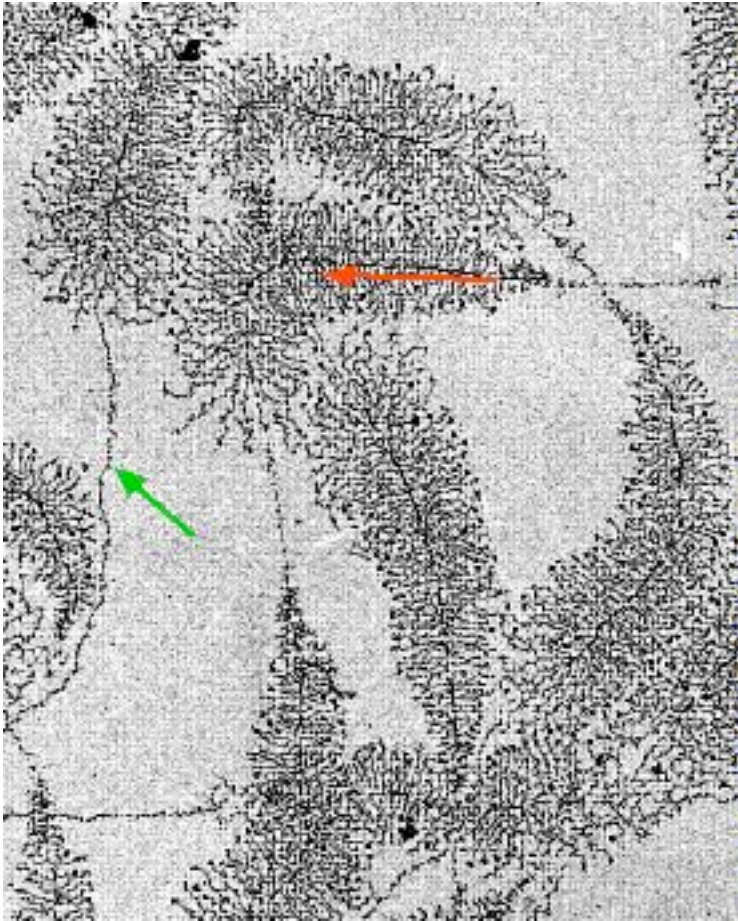


Starting transcription of the human β -globin gene

RNA transcript	5' A C A U U U G C U U C C . . . U U A 3'
DNA sense strand	5' A C A T T T G C T T C C . . . T T A 3'
DNA antisense strand	3' T G T A A A C G A A G G . . . A A T 5'

Transcribed region of β -globin gene and the transcript.
(The whole transcript is \approx 1650 bp long.)

Transcription Visualized 1



EM of ribosomal RNA (rRNA) genes of a newt.

Tandem repeats:

---|---|---|---|---|

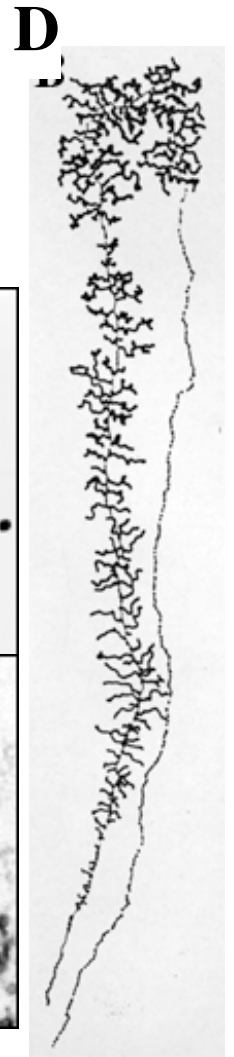
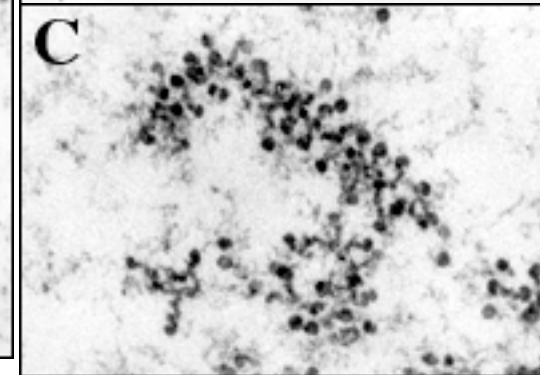
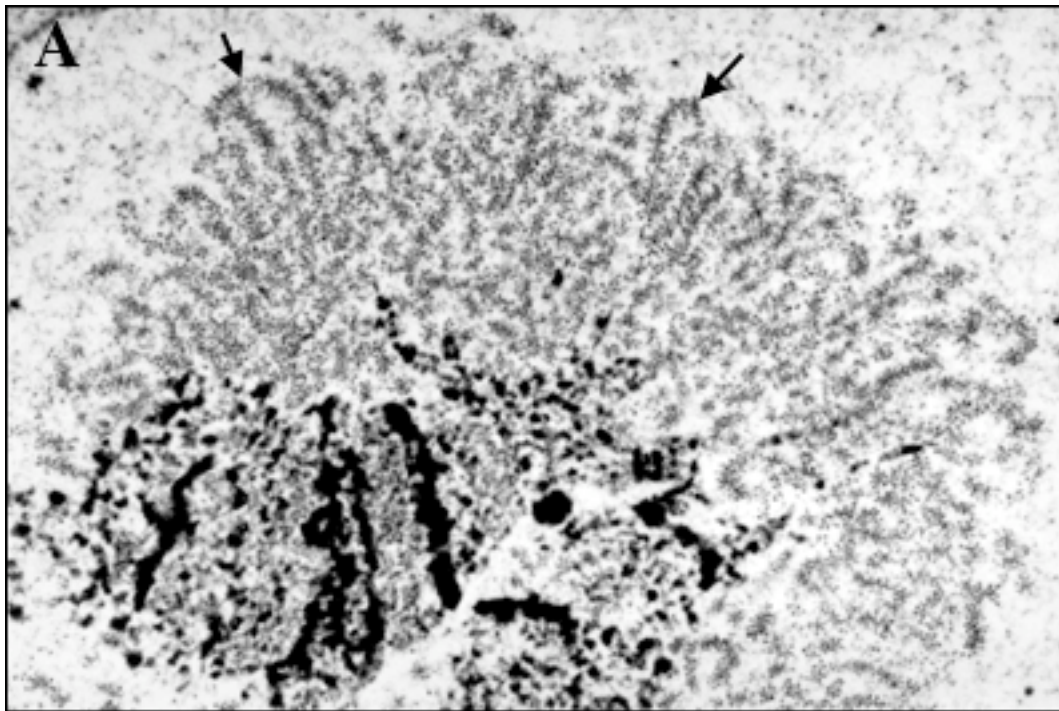
123U123U123U123U

Green arrow: chromosome

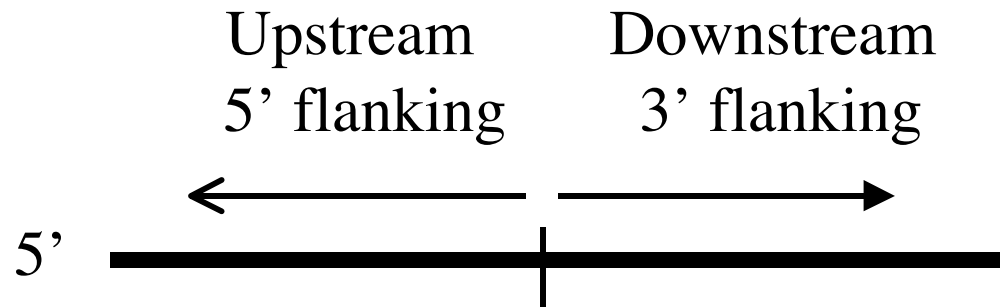
Red arrow: rRNA transcripts still attached to chromosome

Transcription Visualized 2

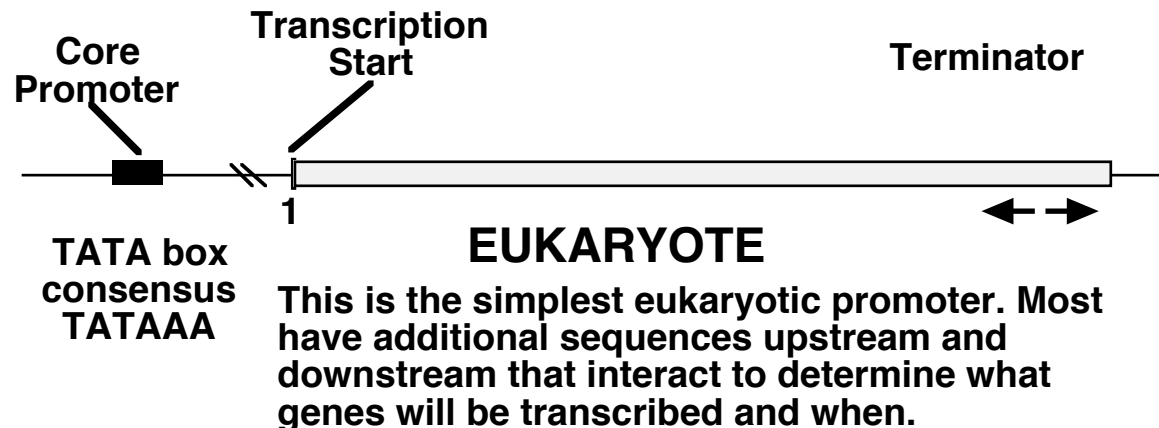
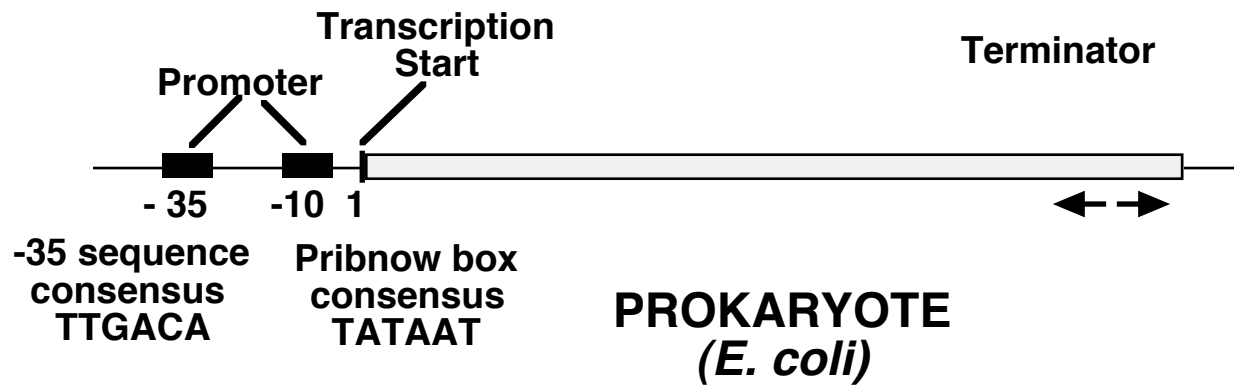
- A. EM of *Chironomus* polytene chromosome. Compact chromatin (dark areas) opens up to form loops that are being transcribed into messenger RNA (mRNA).
- B. Diagram of loop. As transcripts elongate they combine with proteins to form globular ribonucleoprotein.
- C. Higher magnification of EM.
- D. Loop with proteins removed



Terminology



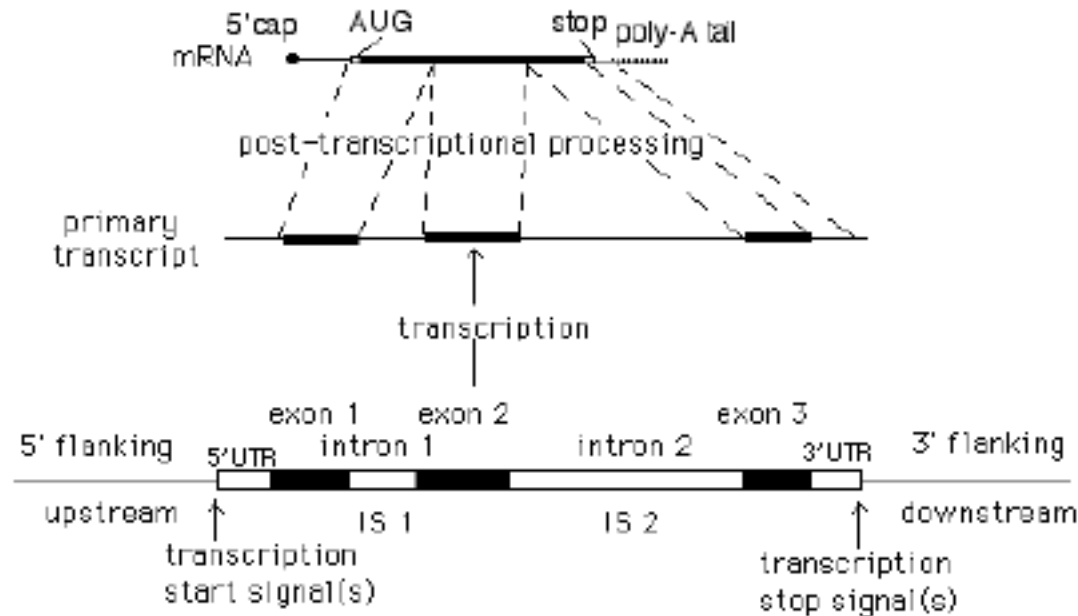
Transcription Start and Stop Signals



1. RNA polymerase and other proteins bind to promoter and move ca. 10 bp downstream before starting to transcribe.
 2. The transcriptional stop signal is often a pair of inverted repeats that encodes a hairpin loop (stem and loop) in the transcript.
- All this and more may take place in “transcription factories” to which genes move to be expressed.

Exons are regions of genes that code for polypeptides, while introns, leaders, and trailers do not.

Introns are found mainly in eukaryotes in nuclear and organelle genes.



In genes that contain introns, *post-transcriptional processing* consists of splicing the intron sequences out of the primary transcript and rejoining the ends. The result is an mRNA that retains 5' and 3' untranslated regions (5' UTR and 3' UTR), with continuous coding sequence in between. A 5' cap and 3' poly-A tail are added.

rRNAs and tRNAs are also cut out of longer transcripts.

