

Highlights Translation (continued)

1. Eukaryotic translation is mechanistically similar to prokaryotic translation. Differences include ribosome sizes (40S vs 30S and 60S vs 50S), rRNAs (28S, 18S, 5.8S, and 5S), mRNAs (cap at 5' end and polyA at 3' end, both involved in translation), and lack of formyl group on initiator tRNA's methionine.
2. Another difference is the circularization of the eukaryotic mRNA due to interactions between proteins on the mRNA cap (5' end) and the 3' polyA tail. Other translational differences in eukaryotes relate to the structure of eukaryotic cells. Targeting of proteins to organelles, the membrane, or outside of the cell, starts during protein synthesis. Proteins destined to leave the cytoplasm have a signal sequence, consisting of a stretch of hydrophobic amino acids near their amino terminus.
5. When the signal sequence emerges from the ribosome during translation, it is recognized by the signal recognition particle (SRP), which takes the entire ribosome/mRNA/polypeptide complex to the endoplasmic reticulum. There it interacts with the SRP receptor and in the process it links the ribosome with the emerging polypeptide sequence to the translocon.
6. The polypeptide passes through the translocon channel as it is being made and when the signal sequence completely exits the translocon, a signal peptidase clips it free of the rest of the polypeptide. The translation process continues until the stop codon is reached and then everything releases from the translocon.
7. The polypeptide remains in the endoplasmic reticulum where it is further processed to travel to the Golgi for additional processing and targeting. Other sequences in the polypeptide may help to direct modifications and/or the final destination of the mature protein.
8. Antibiotics frequently are designed to target various aspects of translation. They include streptomycin (interferes with binding of formylmethionyl tRNA to ribosome), tetracycline (inhibits binding of aminoacyl-tRNAs), chloramphenicol (inhibits peptidyl transferase activity), and puromycin (causes premature chain termination).

Highlights Gene Expression

1. Gene expression refers to the processes that result in the production of functional protein. Gene expression can be controlled at the levels of transcription, processing (splicing in eukaryotes), translation, mRNA stability, and protein stability. Tissue-specific gene expression is essential for multicellular, differentiated organisms.
2. Transcription factors, as noted previously, are proteins that bind to DNA and affect the transcription of genes located near where they bind. Common DNA-binding structures are found in the diverse set of transcription factors that are known. They include motifs (motifs - structural features) for helix-turn-helix structures, among others.
3. Proteins that bind to specific DNA sequences must "read" the sequence of bases inside the helix, usually by inserting a region into the major groove of the DNA and "checking" the hydrogen bonding molecules inside. Since different base pairs have unique hydrogen bonding orientations, the proteins that find and bind to specific base sequences.
4. Control of gene expression is also essential for prokaryotic organisms to be able to respond properly to

their environments. For example, *E. coli* prefers glucose for energy, but must be able to use other sugars, like lactose, when they are available.

5. An operon is a prokaryotic system for organizing genes all under the same transcriptional control. Genes on the same operon in prokaryotes are all synthesized on the same mRNA. mRNAs containing multiple gene coding sequences are referred to as polycistronic.

6. The lactose operon consists of three linked structural genes that encode enzymes of lactose utilization, plus adjacent regulatory sites. The three enzymes *z*, *y*, and *a* encode beta-galactosidase, beta-galactoside permease (a transport protein), and thiogalactoside transacetylase (an enzyme of still unknown metabolic function), respectively. (I'll say more about these in the next lecture).

7. A DNA-binding protein called the lac repressor plays a major role in determining whether or not transcription of the lac operon occurs. The lac repressor binds to the operator sequence (part of the promoter) of the lac operon and when it occupies that site, transcription is completely inhibited.