

# Unit 1: Biochemistry

Section 1-5: Protein Synthesis and Structure

Book Reading: Chapter 5 pages 78-85; Chapter 17 pages 309-327

## Protein Functions

### ❖ General Information

- *What percentage of a cell's dry mass do proteins account for?*
- Proteins are the most structurally sophisticated molecules known
- Each protein has a specific 3-dimensional shape, or "confirmation" that is vital to its function

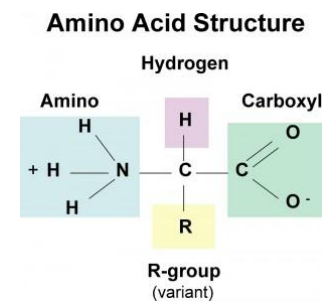
### ❖ Protein Functions Include *give a short description of each*

- Enzymatic-
- Structural-
- Storage-
- Transport-
- Hormonal-
- Receptor-
- Contractile and Motor-
- Defensive-

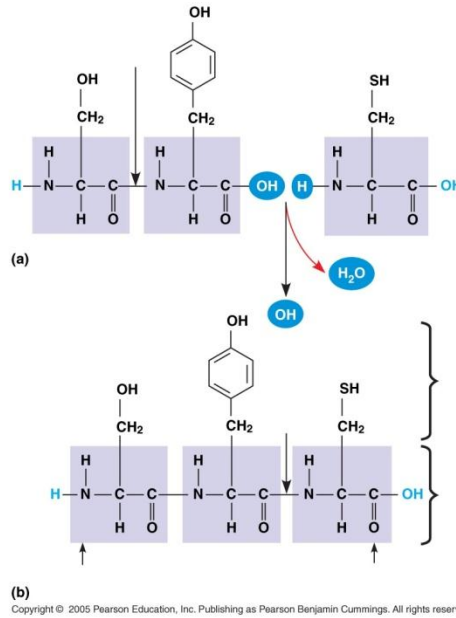
## Four Levels of Protein Structure

### ❖ Primary Structure

- *define*
- Amino Acids- monomers of polypeptides that include the following:
  - *List the components*
  - 
  - 
  -



- Amino acids are linked together with *what kind of reactions?*
- Peptide bonds- *define*
- The chain will have two ends:
  - N-terminus- *define*
  - C-terminus- *define*
- Primary structure is achieved through the processes of transcription and translation



#### ❖ Secondary Structure

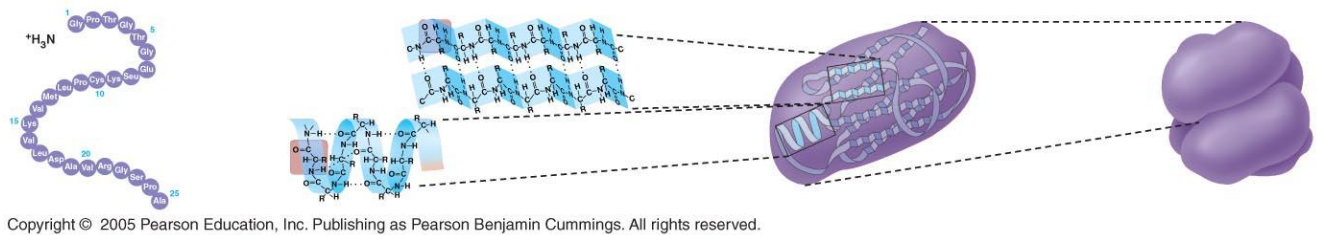
- *define*
- Alpha helix ( $\alpha$  helix)- *define*
- Beta pleated sheet ( $\beta$  pleated sheet)- *define*

#### ❖ Tertiary Structure

- *define*
- There are many forces that cause tertiary structure:
  - Hydrogen bonds between polar R-groups
  - Hydrophobic interactions- *define*
  - Disulfide bridges- *define*

❖ Quaternary Structure

- *define*
- Not all, but most proteins have quaternary structure



Protein Synthesis

❖ General Information

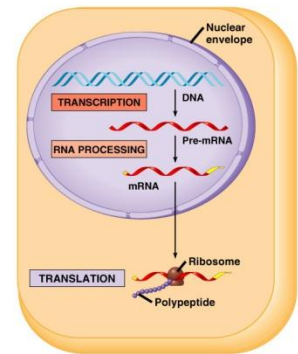
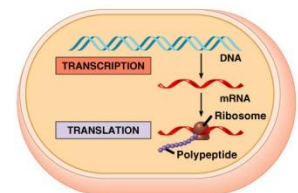
- Protein synthesis is also known as *what?*
- *What provides the instructions for the building of proteins?*
- It involves two processes:
  - Transcription- *define*
  - Translation- *define*

❖ Evolutionary Advantage of Transcription and Translation

- *list*
- 

❖ Differences between Prokaryotes and Eukaryotes

- Prokaryotes
  - One compartment (no nucleus)
  - Transcription and translation can happen simultaneously
- Eukaryotes
  - Transcription occurs in the nucleus
  - The primary transcript is then modified before leaving the nucleus
  - Translation occurs in the cytoplasm at the ribosome



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❖ The Genetic Code

- Triplet Code- *describe*
  
- Template Strand- only one strand of the DNA is transcribed into mRNA
  - *Is mRNA identical or complimentary to the DNA template?*
  - the DNA is read *in what direction?*
  - the mRNA is synthesized and read from *in what direction?*
  
- Codons- *define*
  - Each codon codes for one *what?*
  
- The genetic code contains redundancy, but not ambiguity
  - Redundancy- *explain*
  - No Ambiguity- *explain*
  
- Special Codons
  - AUG- *what is it?*
  - UAA, UAG, UGA- *what are they?*

		Second mRNA base						
		U	C	A	G			
U	UUU	Phe	Ser	UAU	UGU	Tyr	UGU	U C A G
	UUC							
	UUA	UCA		UAA	UGA	Stop	Stop	
	UUG	UCG		UAG	UGG	Stop	Trp	
C	CUU	Leu	Pro	CAU	CGU	His	CGU	U C A G
	CUC							
	CUA	CCA		CAA	CGA	Gln	Arg	
	CUG	CCG		CAG	CGG	Arg		
A	AUU	Ile	Thr	AAU	AGU	Asn	AGU	U C A G
	AUC							
	AUA	ACA		AAA	AGA	Lys	Arg	
	AUG	ACG		AAG	AGG	Met or start		
G	GUU	Val	Ala	GAU	GGU	Asp	GGU	U C A G
	GUC							
	GUA	GCA		GAA	GGA	Glu	Gly	
	GUG	GCG		GAG	GGG	Gly		

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# Transcription

## ❖ Initiation

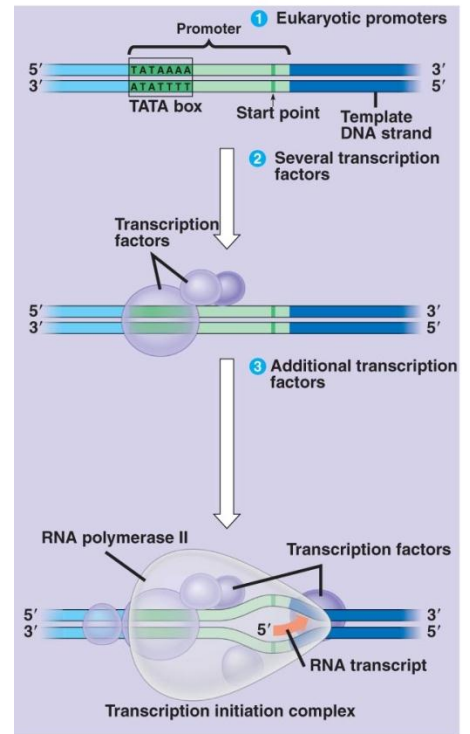
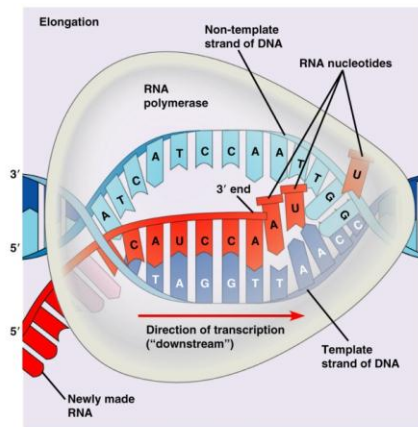
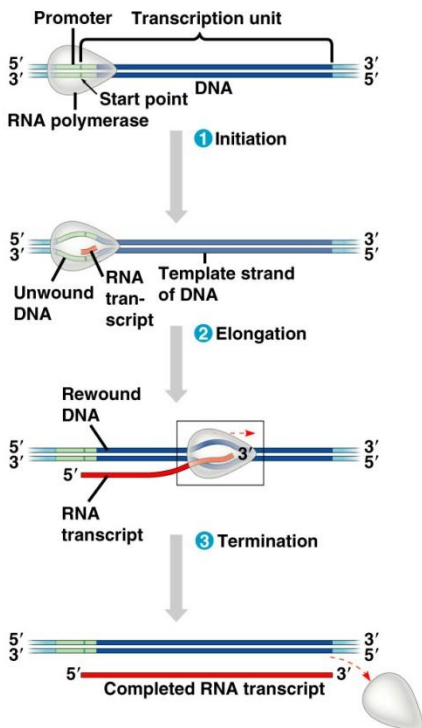
- RNA polymerase binds to the promoter
  - 
  - In eukaryotes,

## ❖ Elongation

- 
- Complementary base pairing occurs
  - A's are transcribed as *what?*
  - T's are transcribed as *what?*
  - C's are transcribed as *what?*
  - G's are transcribed as *what?*
- The new RNA molecule peels away from the DNA template and the DNA reforms

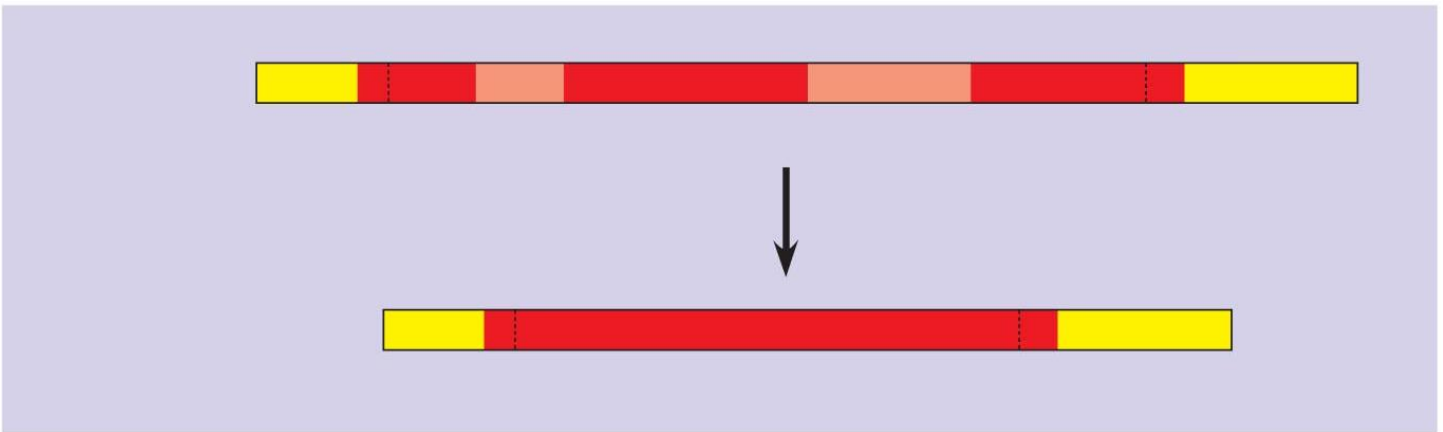
## ❖ Termination

- In prokaryotes, the RNA polymerase detaches after the termination signal is transcribed
- In eukaryotes- the RNA polymerase transcribes the *what is the name of the special sequence that must be reached before the mRNA is released?*



## RNA Processing

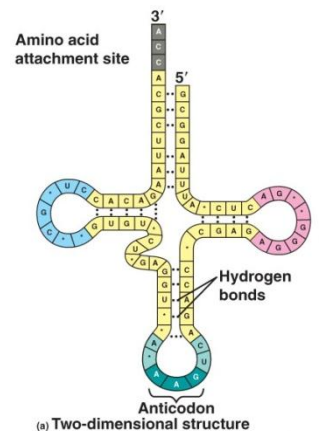
- ❖ HAPPENS ONLY IN *WHAT KIND OF CELLS?*
- ❖ Altering of the Ends of the mRNA
  - 5' cap- *describe*
  - Poly-A tail- *describe*
  - Functions:
    - *List*
    - 
    -
- ❖ RNA Splicing
  - *define*
  - snRNPs (snurps) *what is their function?*
  - Introns- *define*
  - Exons- *define*



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## Translation

- ❖ Important Components
  - Transfer RNA, tRNA
    - *Give function*
    - on one end it has an anticodon that is complementary to the mRNA codon
    - on the other end it is bound to an amino acid on its 3' end
    - excellent example of how structure fits function

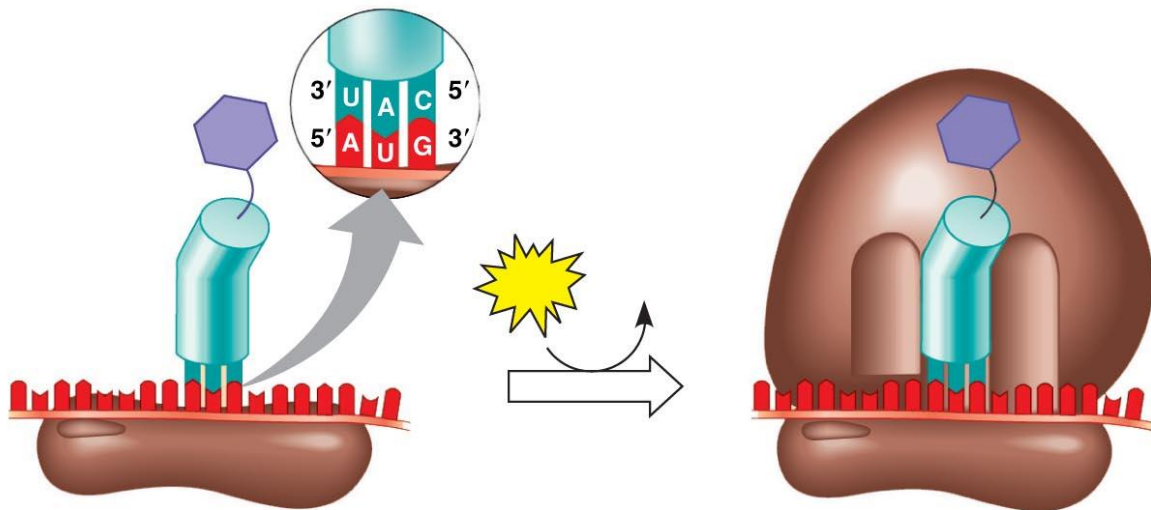


- Ribosomes
  - Made up of two subunits called the large and small subunit
  - Contains three sites for holding tRNA
    - P site- *what does it hold?*
    - A-site- *what does it hold?*
    - E-site- *what does it hold?*
  - Exit Tunnel- *what is it?*
  - Polyribosomes-strings of ribosomes capable of making multiple copies of a polypeptide very quickly



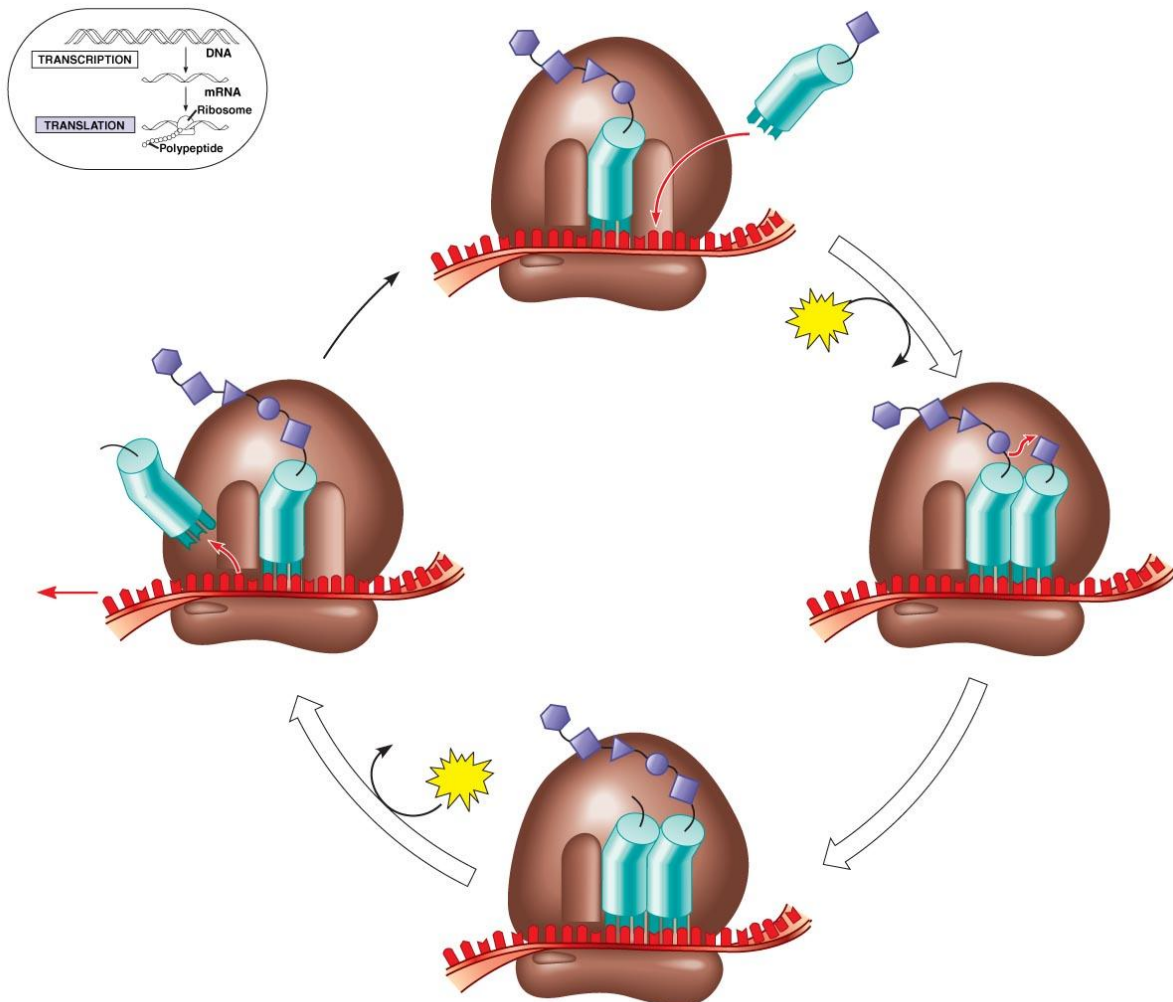
❖ Initiation

- Small ribosomal subunit binds the mRNA and the initiator tRNA
- 
- Translation Initiation Complex forms-



❖ Elongation

- The ribosome reads the mRNA from *what direction?*
- 
- 
- Translocation-

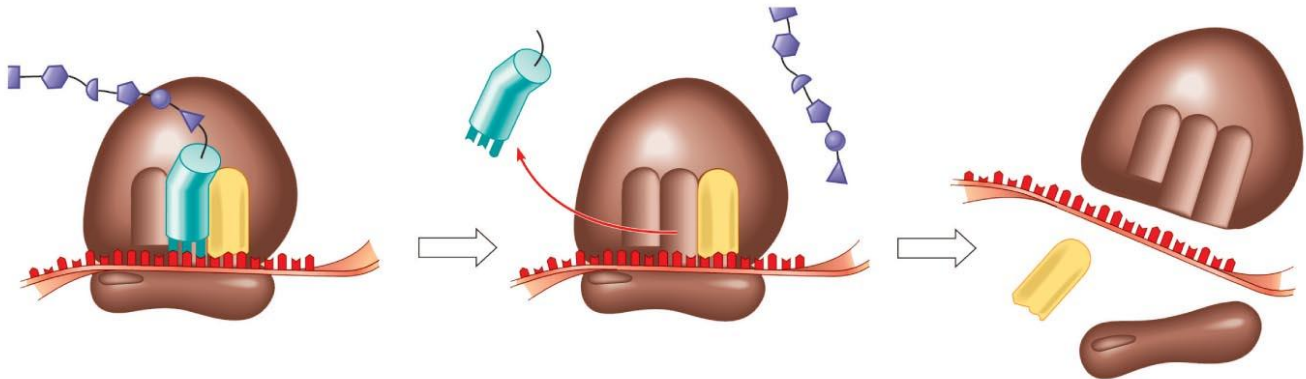


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❖ Termination

- Release Factor
  - *When is it added?*
  - *What does it do?*
- The polypeptide is released



Forming a Functional Protein

❖ Protein Folding

- Folding occurs as the protein is being synthesized
- Folding is dependent:
  - 
  -
- Chaperonins- *define*

❖ Post-Translational Modification

- Chemical modification *how?*
- Enzymes may *do what?*
- Single polypeptide may be cut into two or more smaller pieces

❖ Denaturation

- The change in a protein's native conformation that renders it biologically inactive
- Factors that cause denaturation:
  - Change in the environment
    - 
    -
  - Change in temperature
    - 
    -
  - Change in pH-