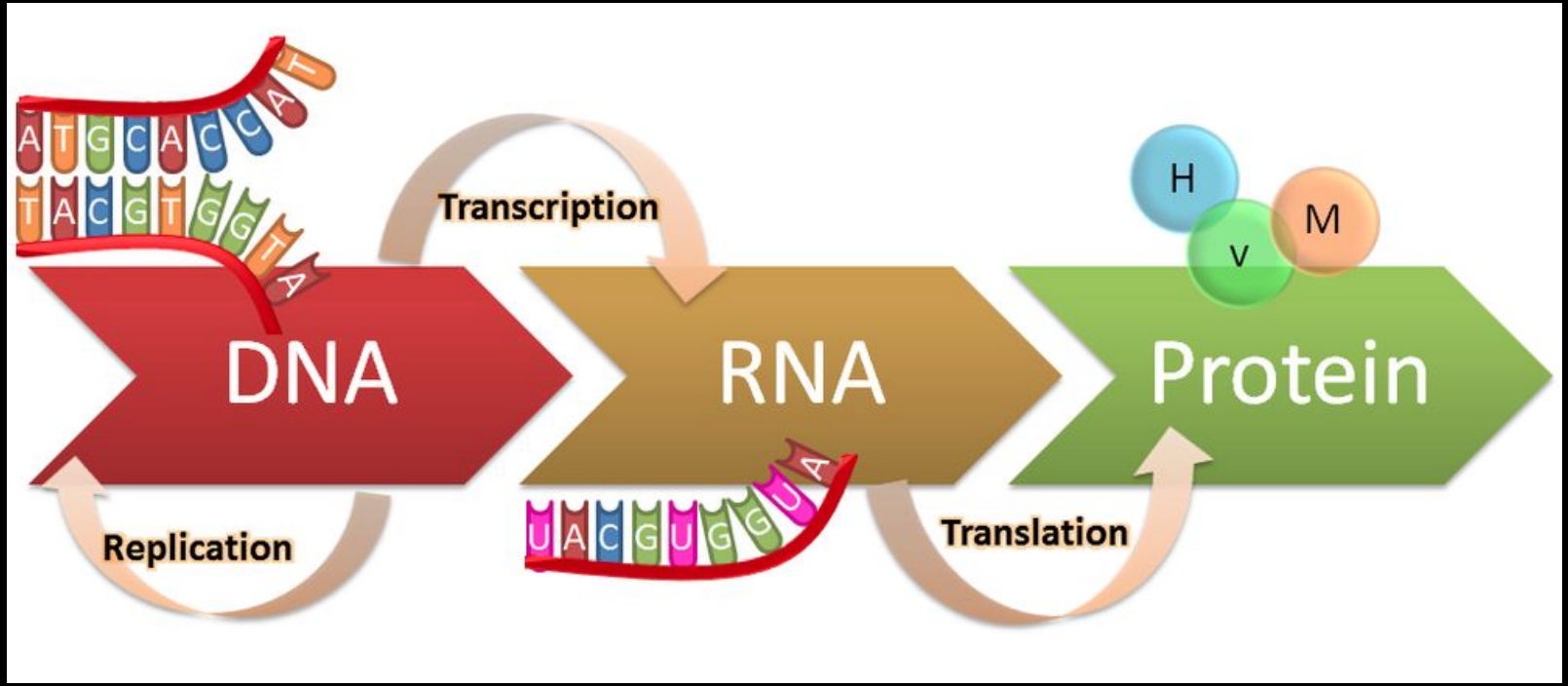
Bellringer

What is the central dogma of biology?

A. RNA→ DNA→ Protein
B. DNA → Protein → Gene
C. DNA → Gene → RNA
D. DNA → RNA → Protein

Review of DNA processes

Replication (7.1) → Transcription(7.2) → **Translation(7.3)**



Understandings:

- Initiation of translation involves assembly of the components that carry out the process
- Synthesis of the polypeptide involves a repeated cycle of events
- Disassembly of the components follows termination of translation
- Free ribosomes synthesise proteins for use primarily within the cell
- Bound ribosomes synthesise proteins primarily for secretion or for use in lysosomes
- Translation can occur immediately after transcription in prokaryotes due to the absence of a nuclear membrane
- The sequence and number of amino acids in a polypeptide is the primary structure
- The secondary structure is the formation of alpha helices and beta pleated sheets stabilised by hydrogen bonding
- The tertiary structure is the further folding of the polypeptide stabilised by interactions between R groups
- The quaternary structure exists in proteins with more than one polypeptide chain

Applications:

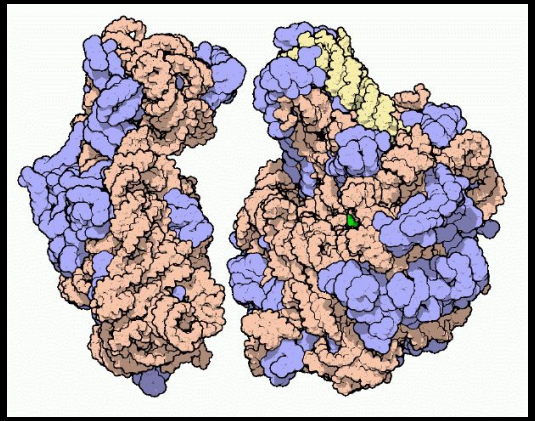
- tRNA-activating enzymes illustrate enzyme-substrate specificity and the role of phosphorylation

Skills:

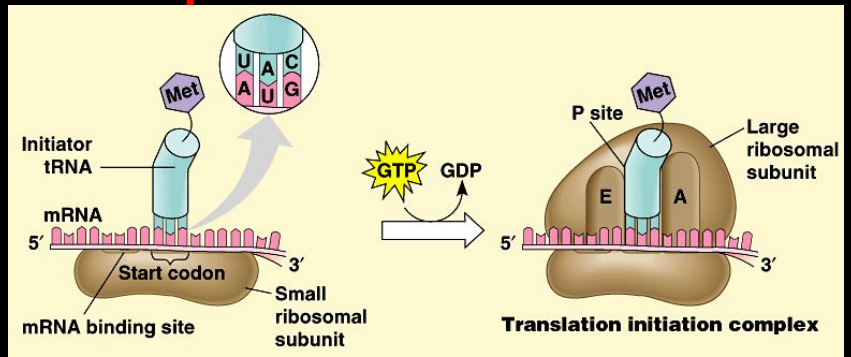
- Identification of polysomes in electron micrographs of prokaryotes and eukaryotes
- The use of molecular visualisation software to analyse the structure of eukaryotic ribosomes and a

SL 2.7 Review

Translation is the process of turning mRNA into the amino acid sequence of a protein.



The ribosome is the organelle responsible for reading RNA, three nucleotides at a time and synthesizing protein

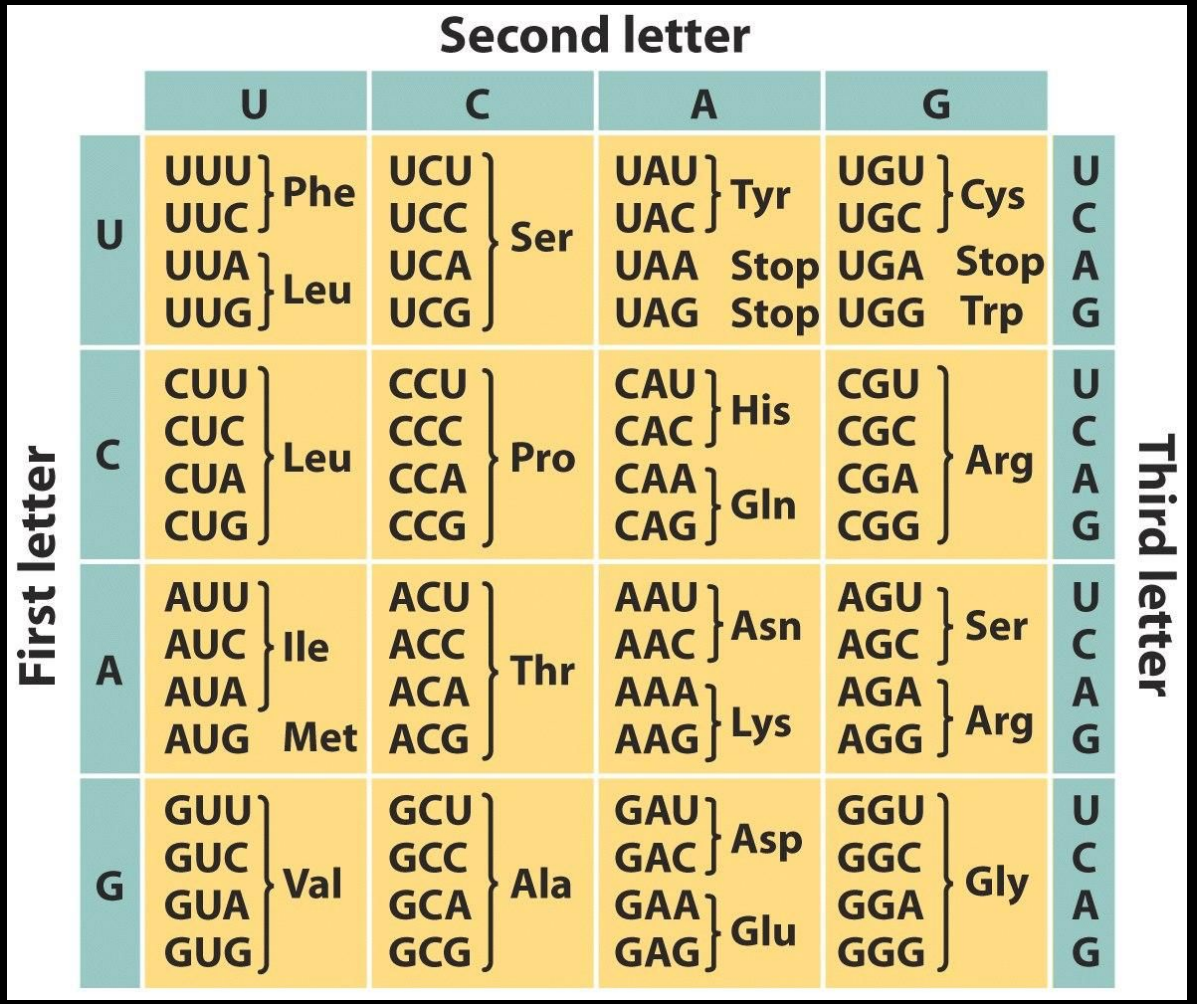


SL Review 2.7

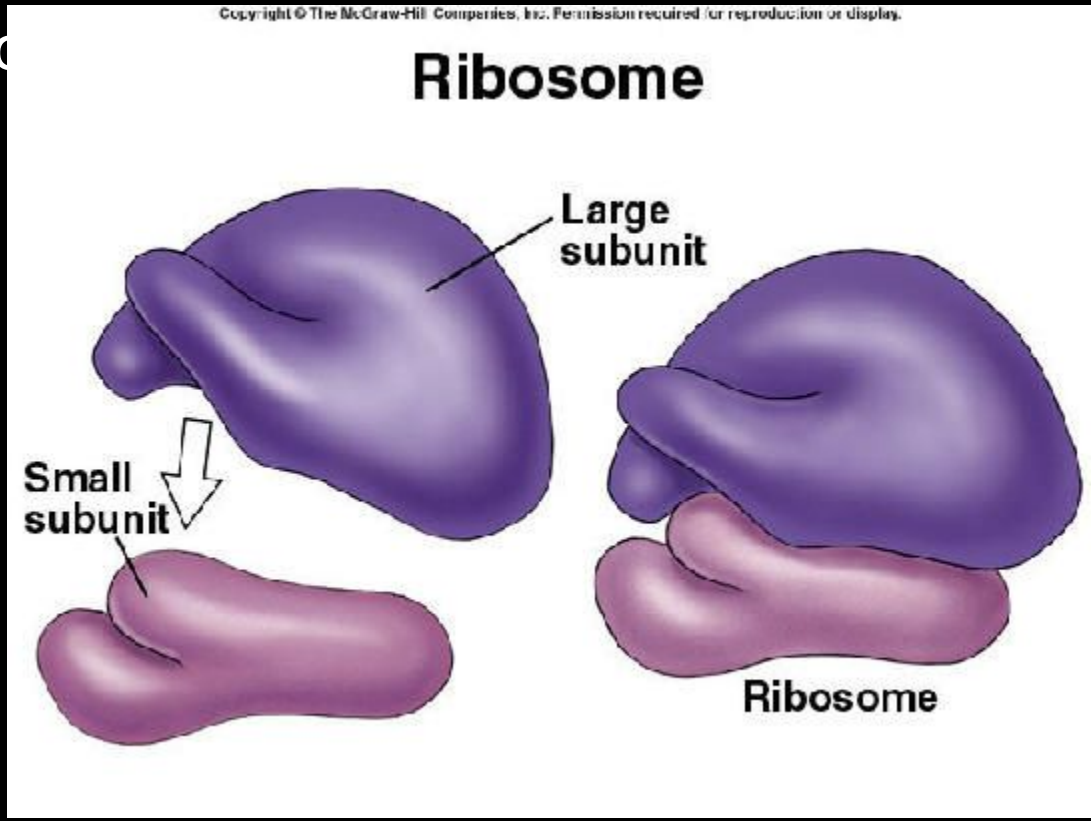
Codons = three nucleotides code for one amino acid of a polypeptide chain

Start codon = AUG (first aa is always methionine)

Stop codons = TAA, TAG, TGA



7.3S1 Analyze the structure o eukaryotic ribosomes and tRNA

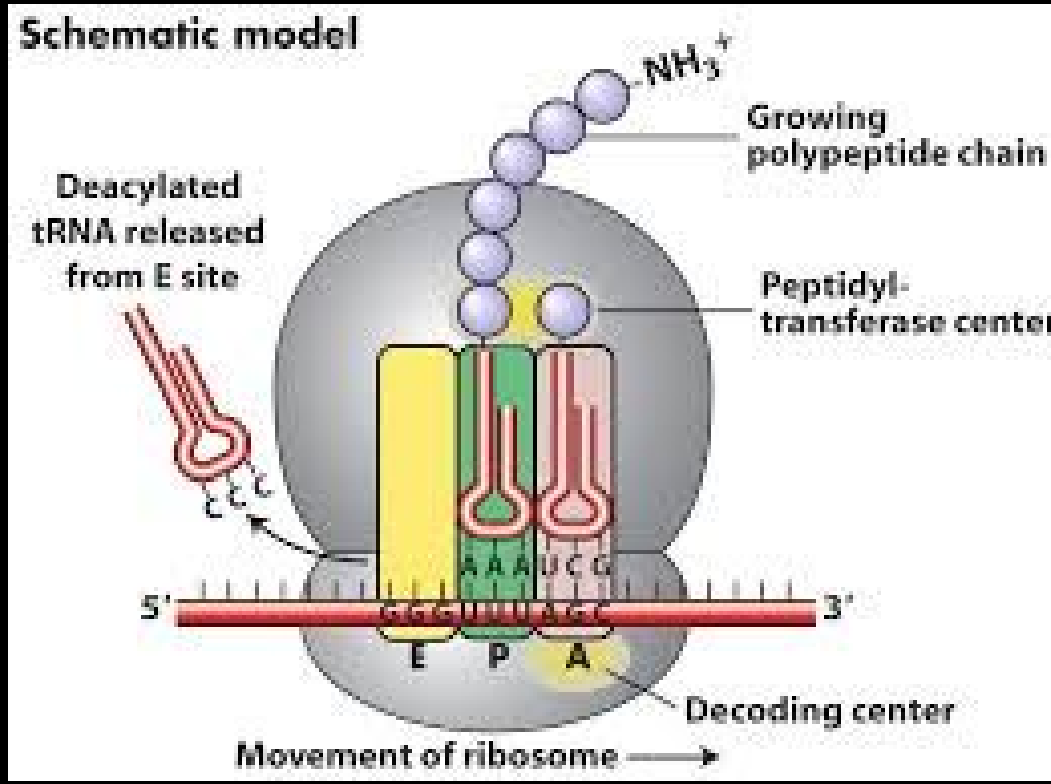


Ribosome contains

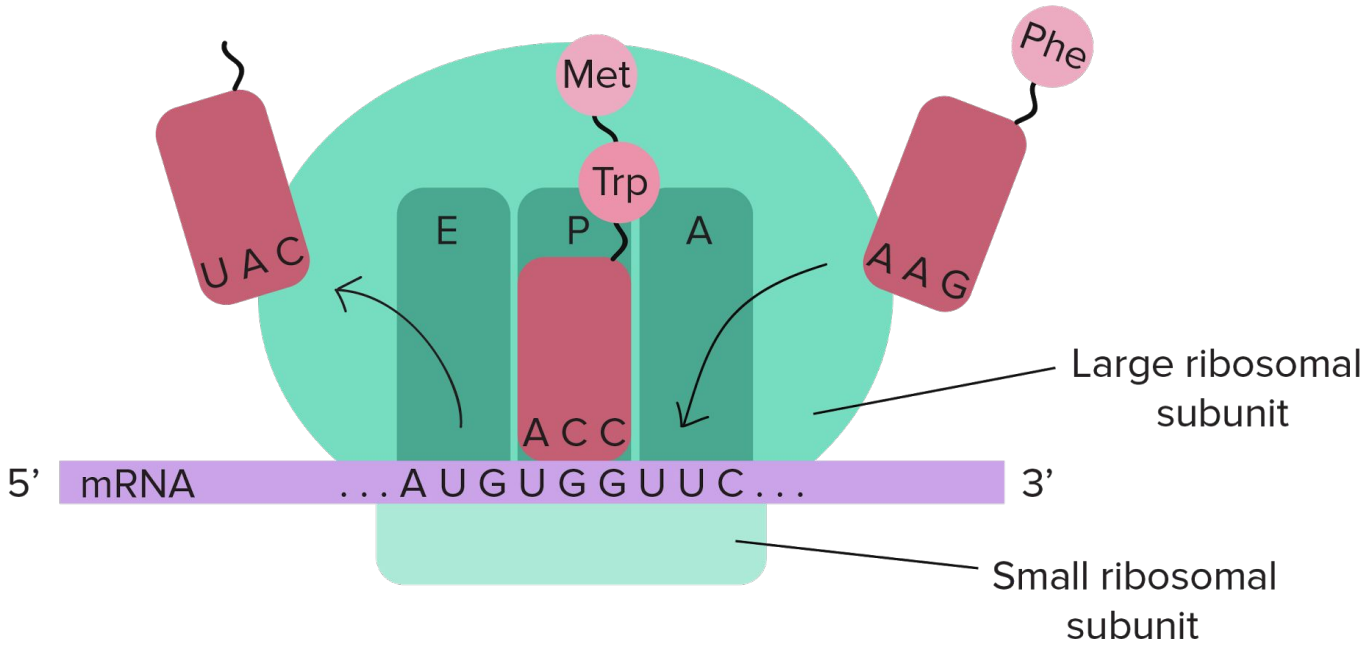
- Two subunits- large and small
- Each subunit contains RNA and protein
- Small unit binds to mRNA
- Large unit binds to tRNA in 3 binding sites, E for exit, P for peptidyl site and A for aminoacyl.

7.3S1 (continued) Ribosome sites have specific functions

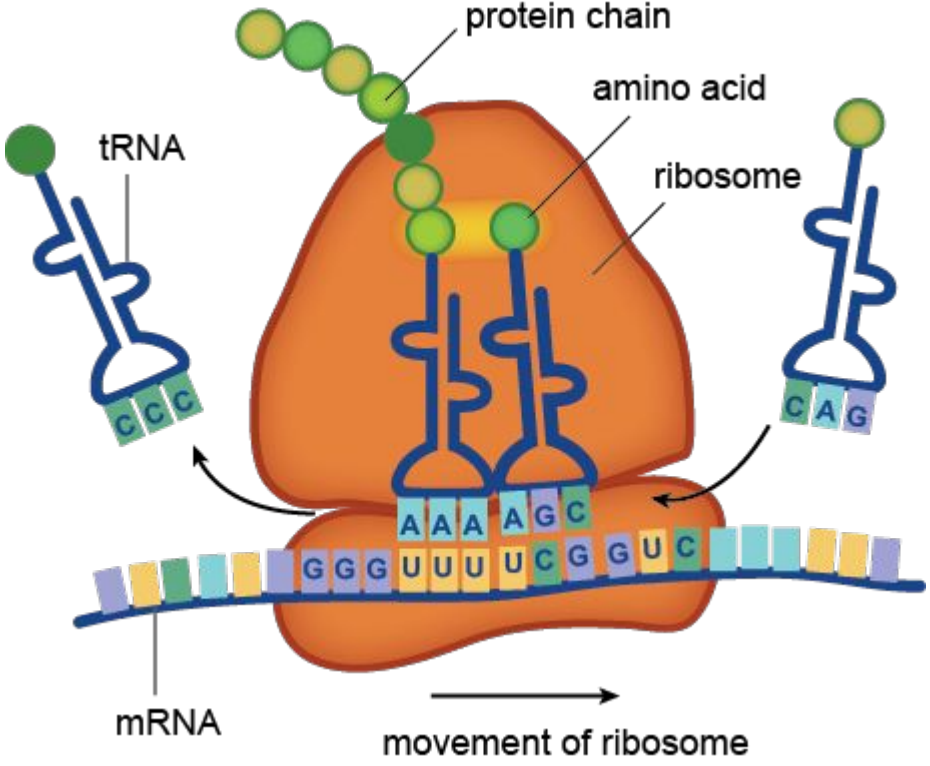
1. A site- tRNA carries amino acids and binds
2. P site- tRNA holds the peptide chain
3. E site- tRNA exits ribosome

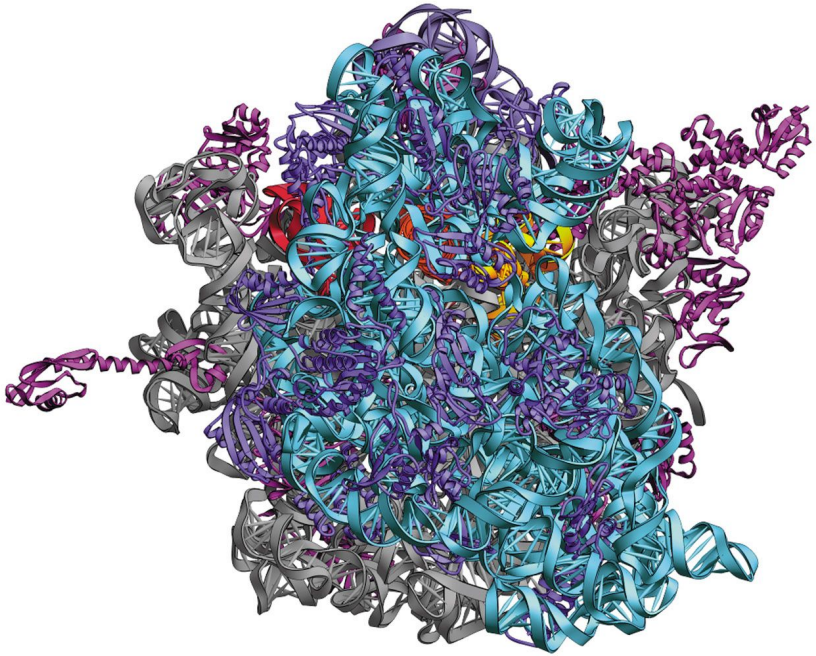


Draw and label a ribosome in your notes



https://www.youtube.com/watch?v=-K8Y0ATkkAI



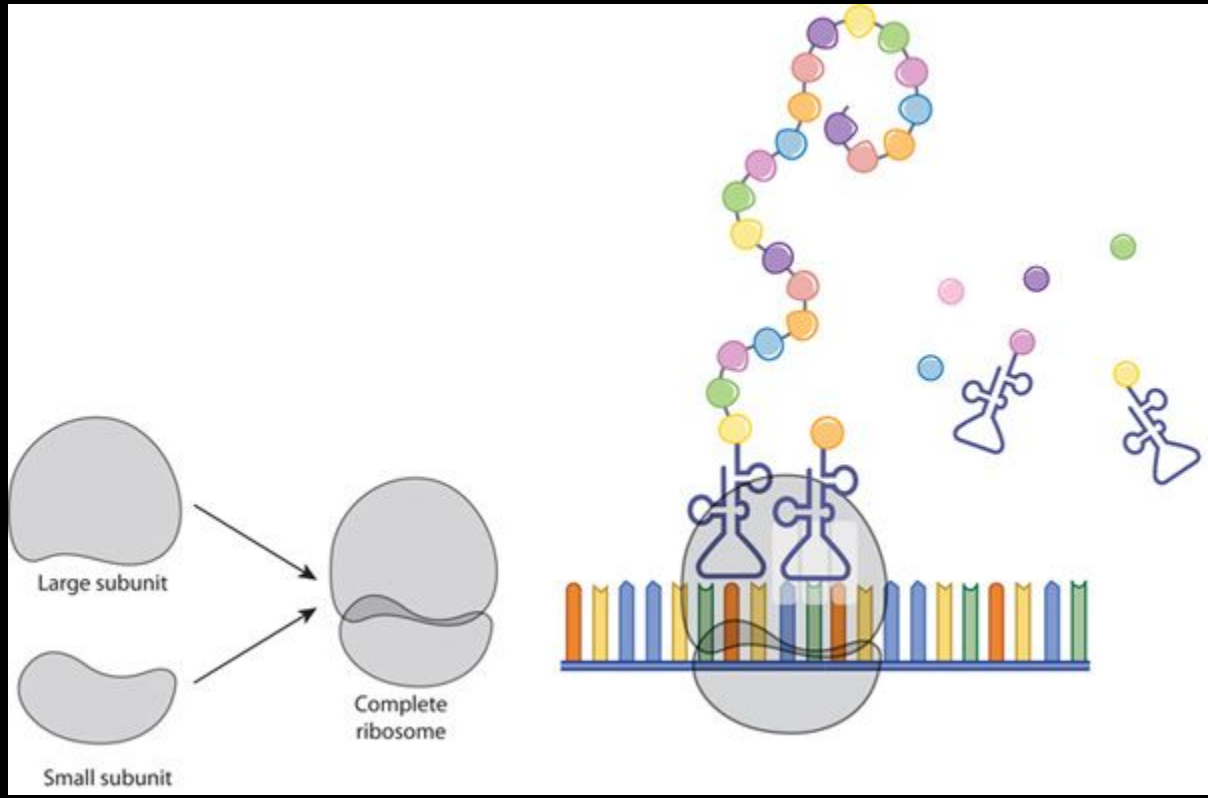


7.3U1 Initiation of translation involves assembly of the components that carry out the process

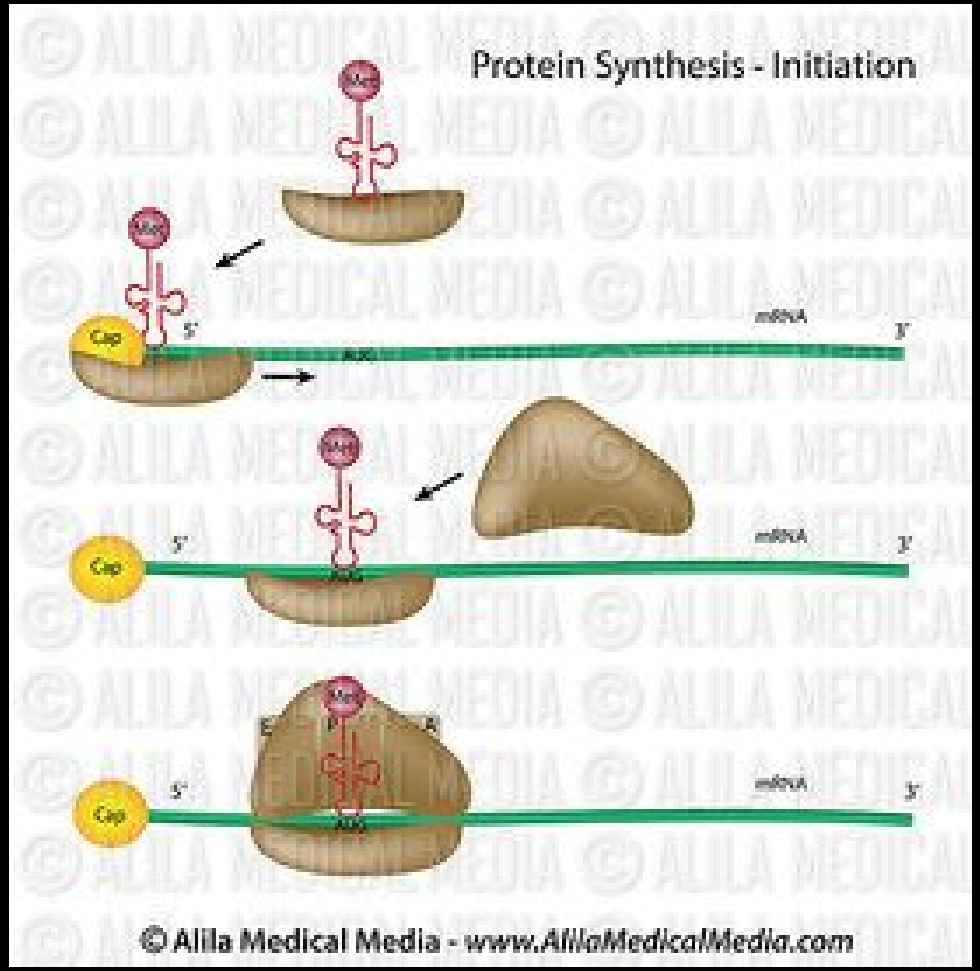
Step 1: Initiation (A site)

Step 2: Elongation (P site)

Step 3: Termination (E site)

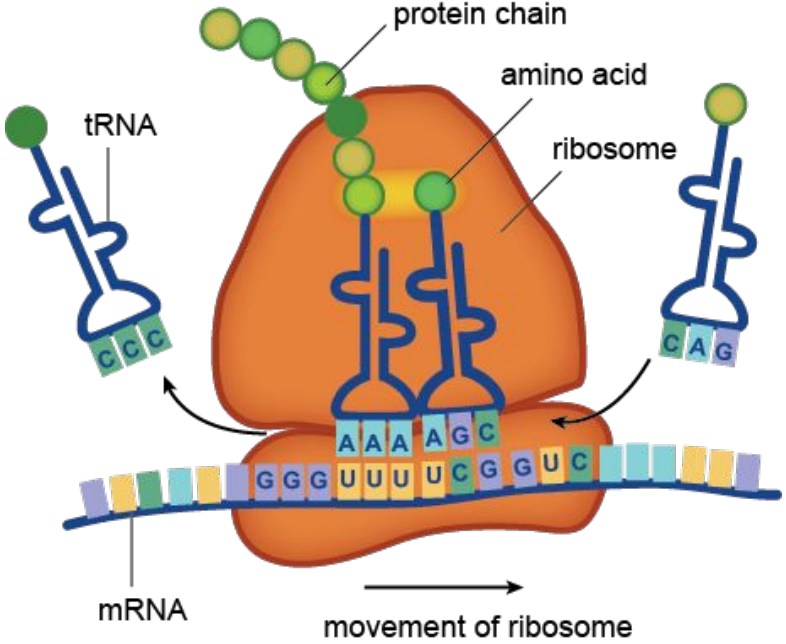


Step 1: Initiation



1. mRNA binds to the small subunit of the ribosome.
2. The small subunit moves along the mRNA 5' - 3' until it reaches a start codon (AUG)

-Occurs at A site



3. Complementary tRNA to the start codon (UAC) binds to the P site of the ribosome

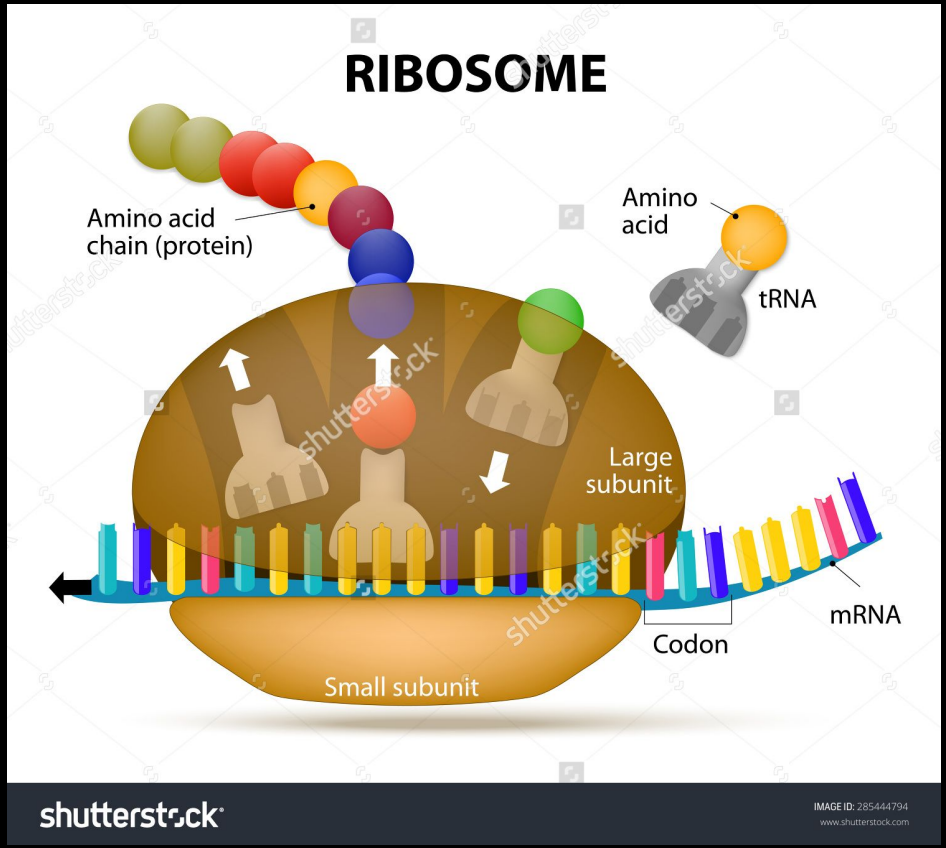
4. The large subunit of the ribosome binds to the tRNA and small subunit

7.3U2 Synthesis of the polypeptide involves a repeated cycle of events

Step 2. Elongation

1. A second tRNA (with amino acid attached) complementary to the second codon on the mRNA binds to the A site

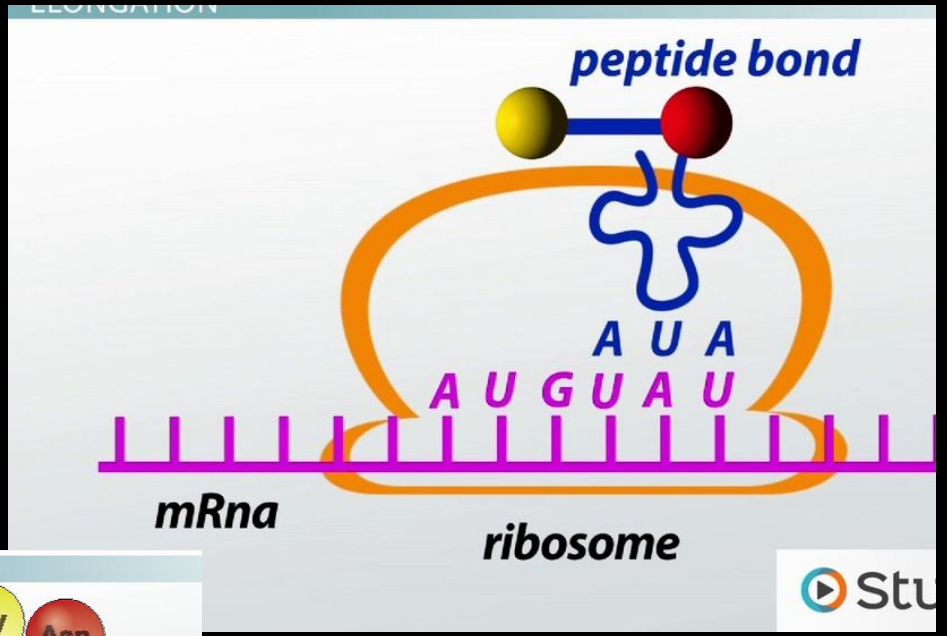
2. The amino acid carried by the tRNA in the P site is transferred to the amino acid in the A site

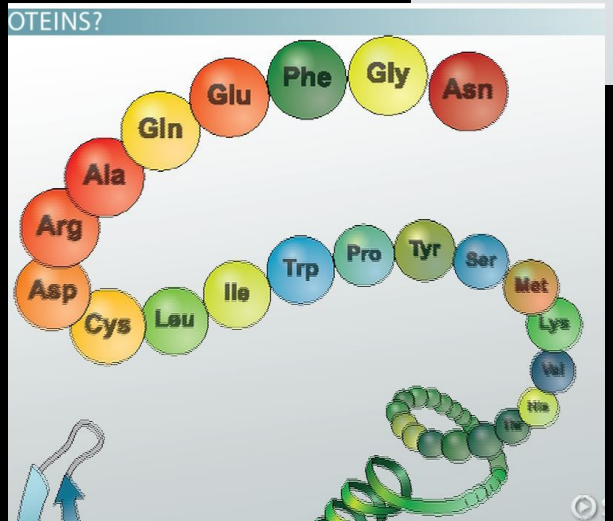


Elongation (continued)

3. Ribosome catalyzes a new peptide bond between the amino acids.

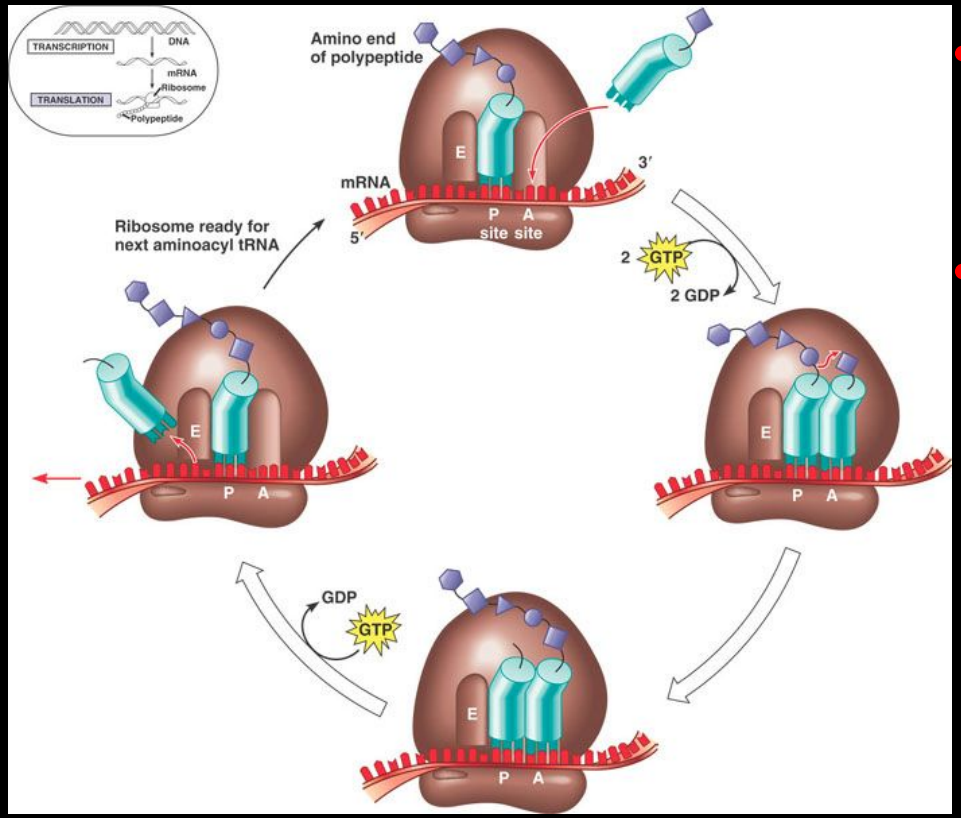
4. The growing polypeptide increases in length.





Elongation continued

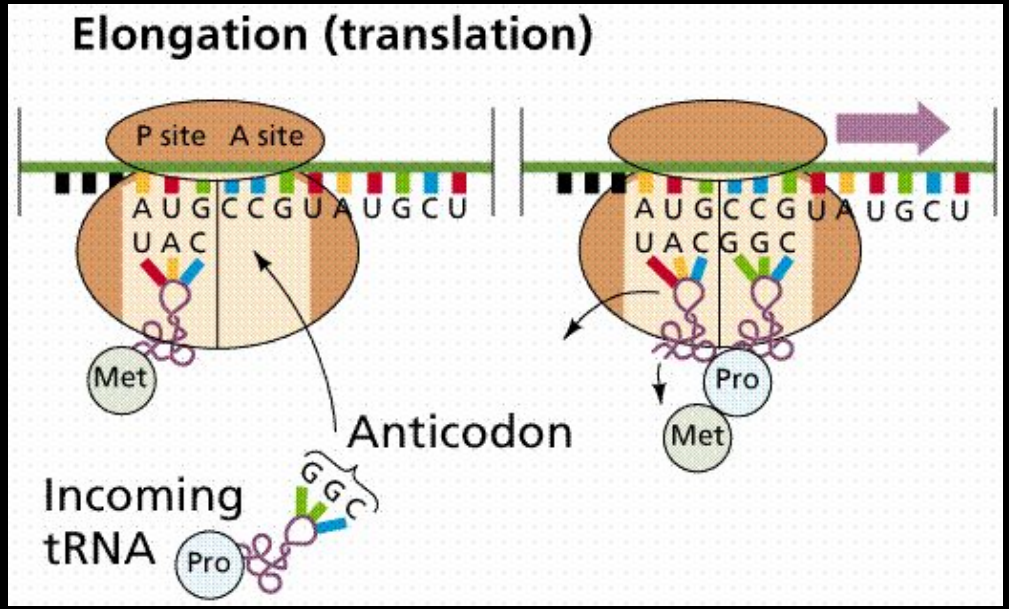
5. The ribosome moves one codon along the mRNA (in a 5’ – 3’ direction):



- The tRNA in the P site is moved to the E site and then released
- The tRNA in the A site is moved into P site

Elongation continued

6. Another tRNA binds, complementary to the next codon on the mRNA, binds to the A site.



7. Steps 2, 3, and 4 are repeated until a stop codon is reached.

Bellringer

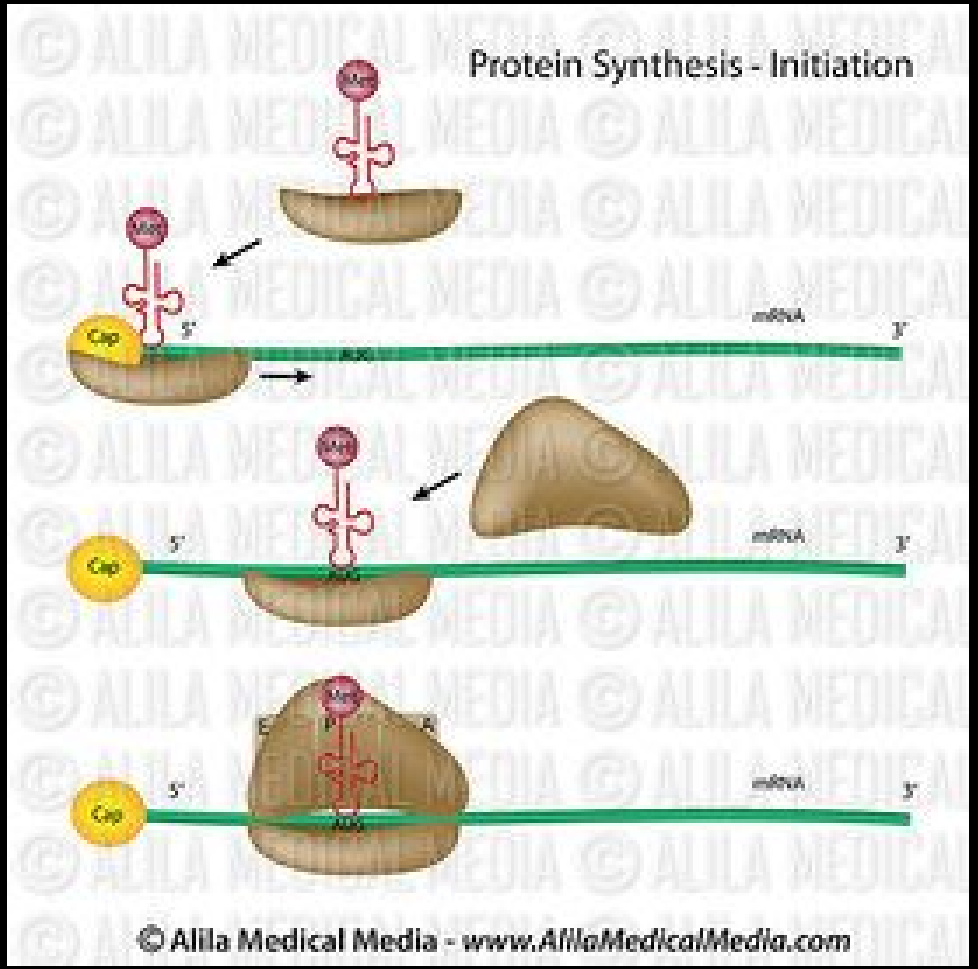
What is the purpose of initiation and elongation in translation in gene expression?

https://www.youtube.com/watch?v=5bLEDd-PSTQ

Review

Translation purpose: changing RNA into protein

Steps: Initiation, Elongation, Termination

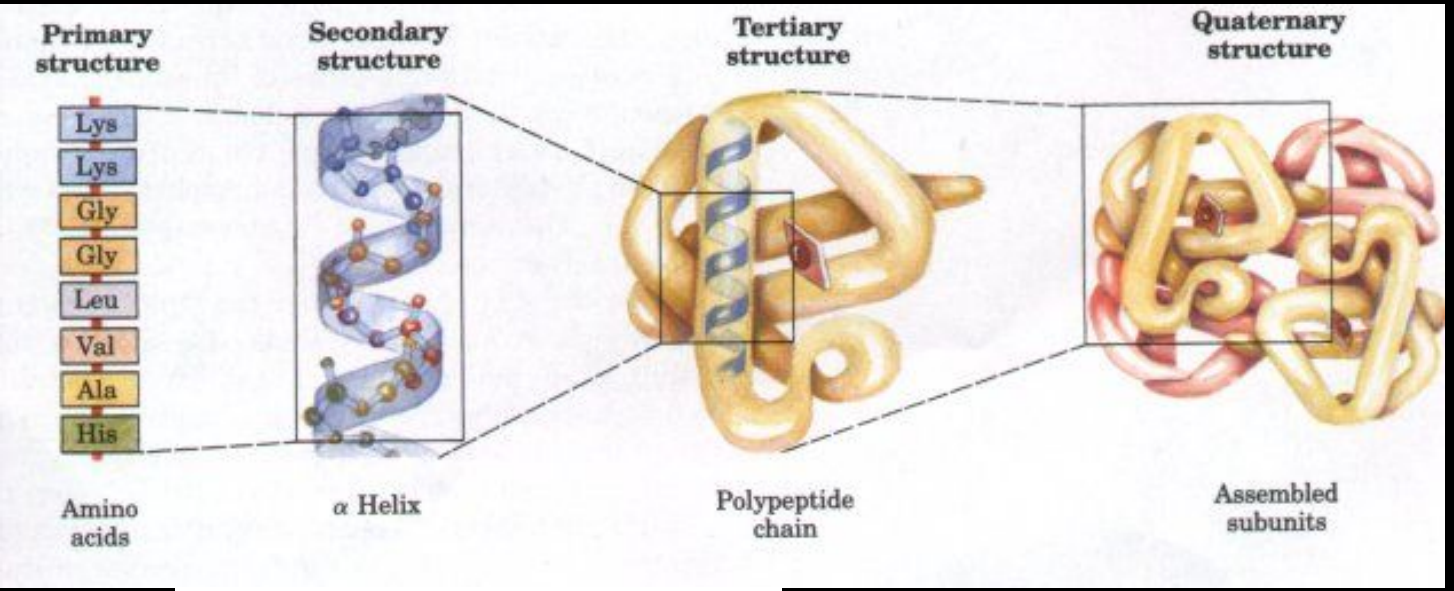


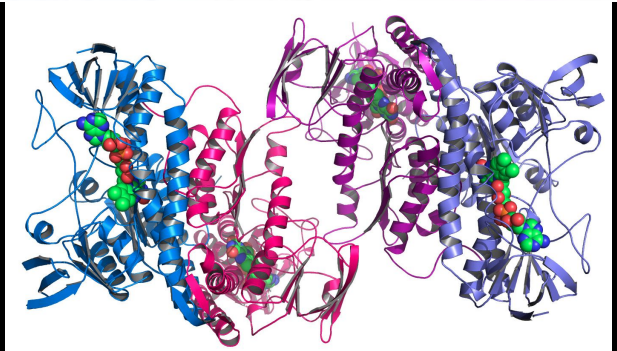
7.3U3 Disassembly of the components follows termination of translation

Step 3: Termination

1. When a stop codon is reached translation is stopped:
    a. a release factor attaches to the A site
    b. the polypeptide chain is released
    c. the ribosome complex dissembles ready for reuse translating another mRNA molecule

Structure and Function of Protein

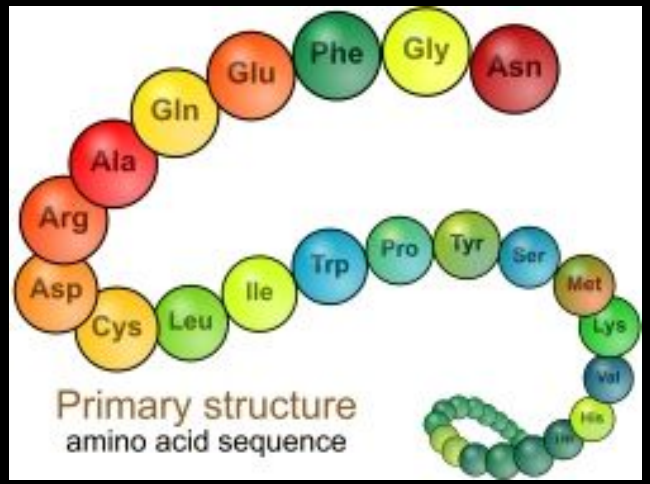




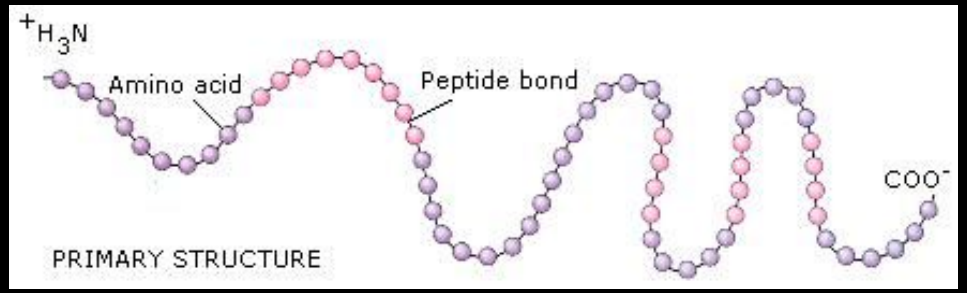
Proteins have a variety of functions in the body

- Blood clotting
- Insulin
- Antibodies
- Digestion

7.3U7 : The sequence and number of amino acids in a polypeptide is the primary structure

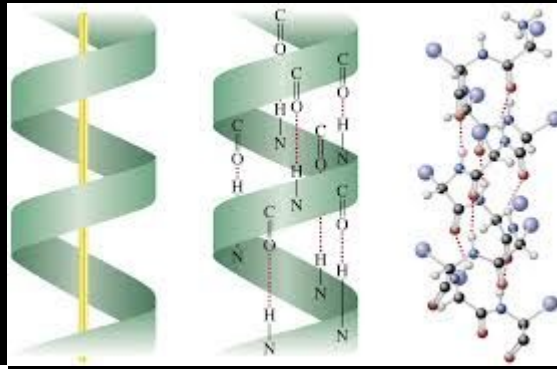


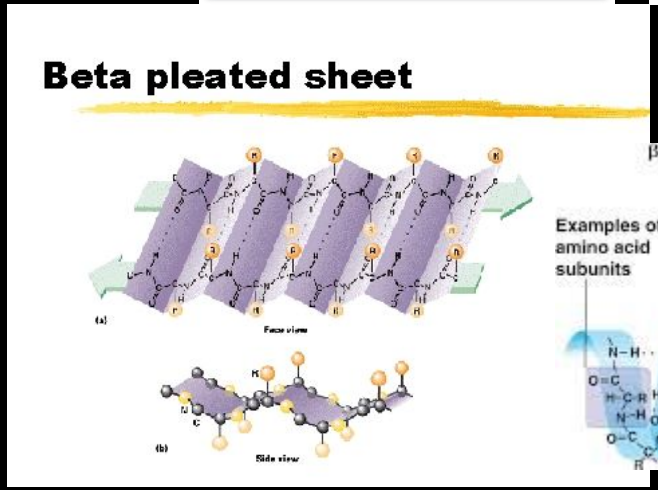
- Linear sequence of amino acids
- Example: Transthyretin transports Vitamin A



7.3U8 The secondary structure is the formation of alpha helices and beta pleated sheets stabilised by hydrogen bonding

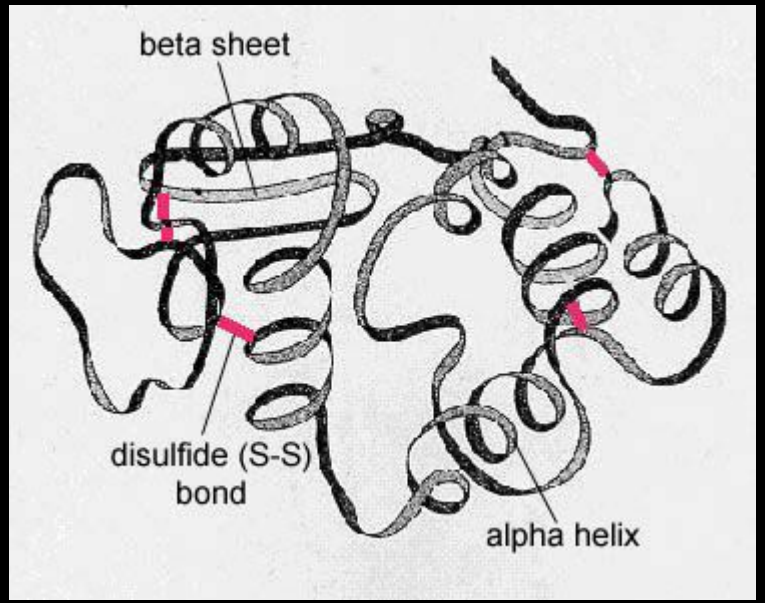
- Coils and folds from Hydrogen bonds between polypeptides
- α helix
- β pleated sheet

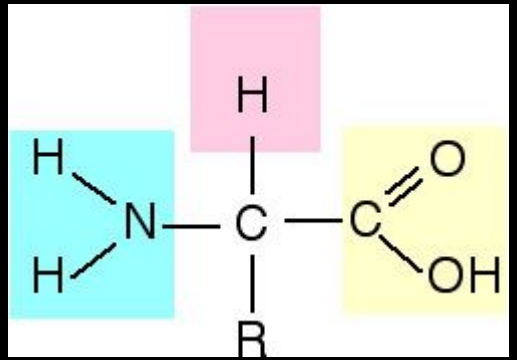




7.3U9 the tertiary structure is the further folding of the polypeptide stabilised by interactions between R groups

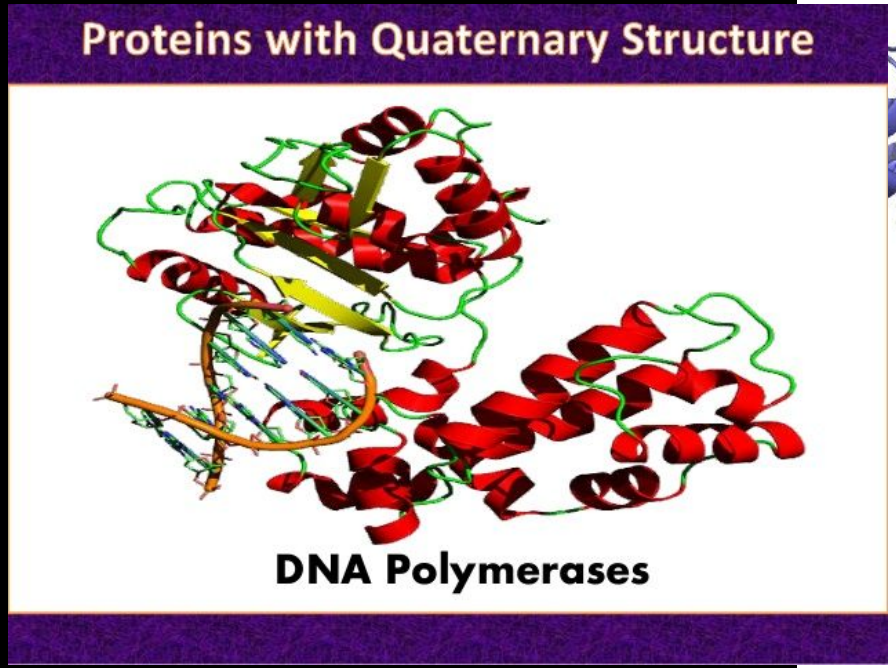
- R groups from nucleotide bases
- Disulfide bridges complete the folding with covalent bonds

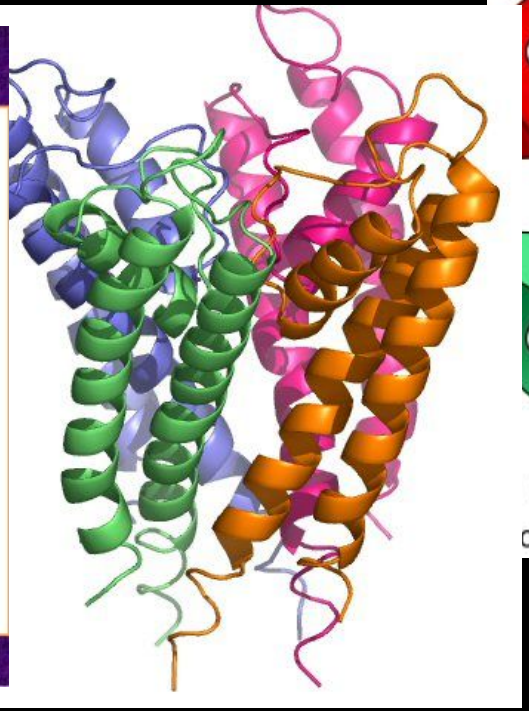


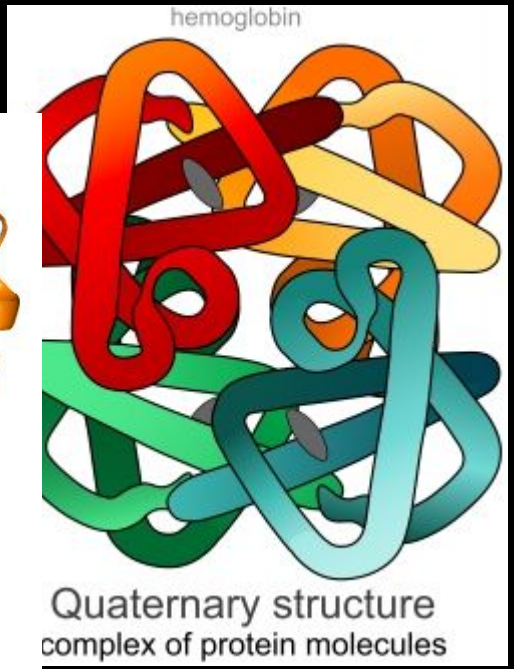


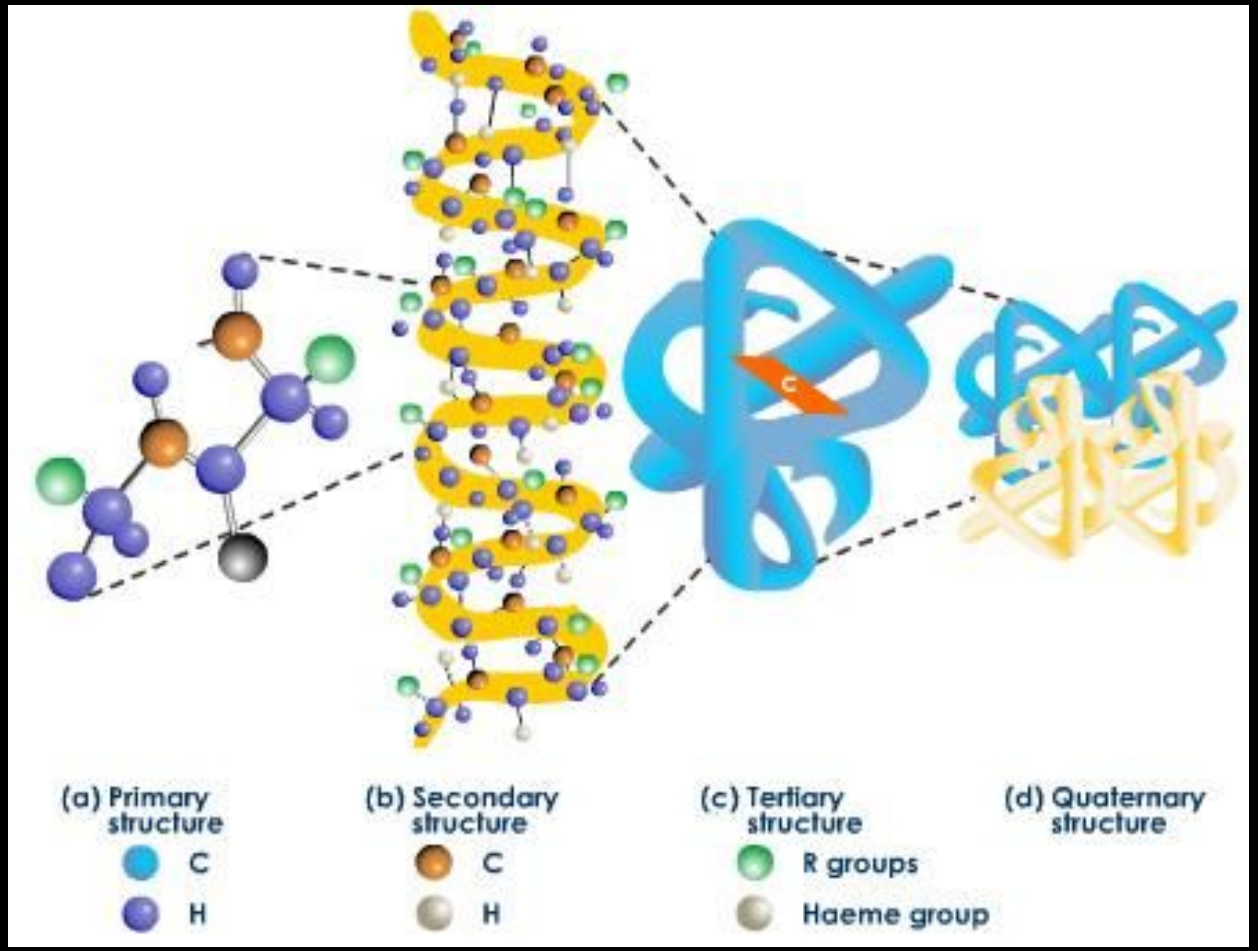
7.3U10 The quaternary structure exists in proteins with more than one polypeptide chain

- Ex: collagen, hemoglobin









Protein variety comes from combinations of primary, secondary, tertiarty and quatenary structures

http://pdb101.rcsb.org

A polysome is a structure that consists of multiple ribosomes attached to a single mRNA

Multiple ribosomes translating mRNA simultaneously enables the cell to quickly create many copies of the required polypeptide.

Electron micrograph showing a polysome

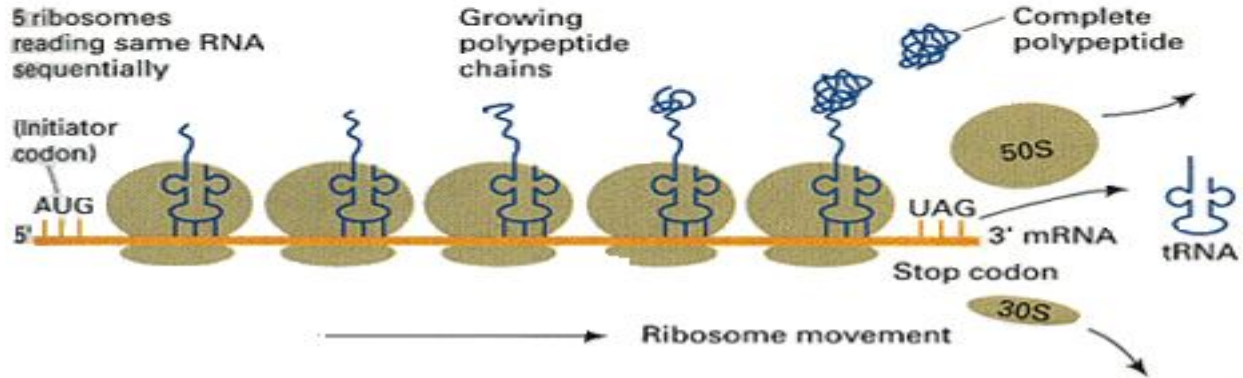


Diagram of a generalised polysome

http://urei.bio.uci.edu/~hudel/bs99a/lecture21/polysome.gif

Bellringer

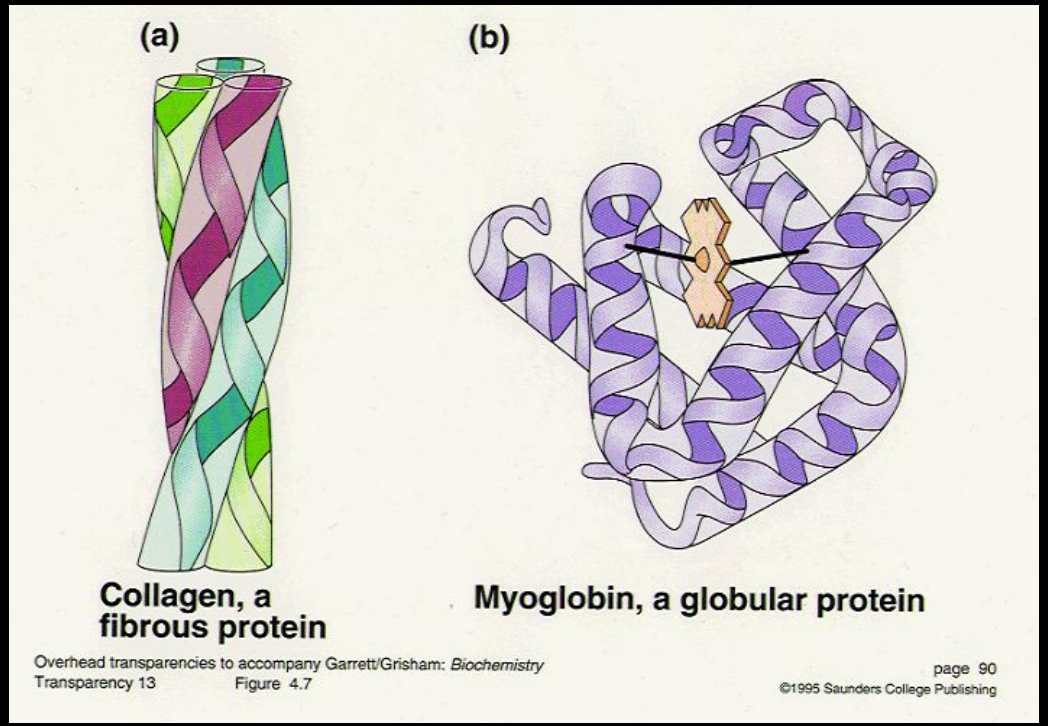
What is the central dogma of biology?

A. Replication→ Transcription→ DNA
B. Transcription → Translation → Protein
C. DNA → Translation → Protein
D. Translation → Transcription→ Protein

Protein

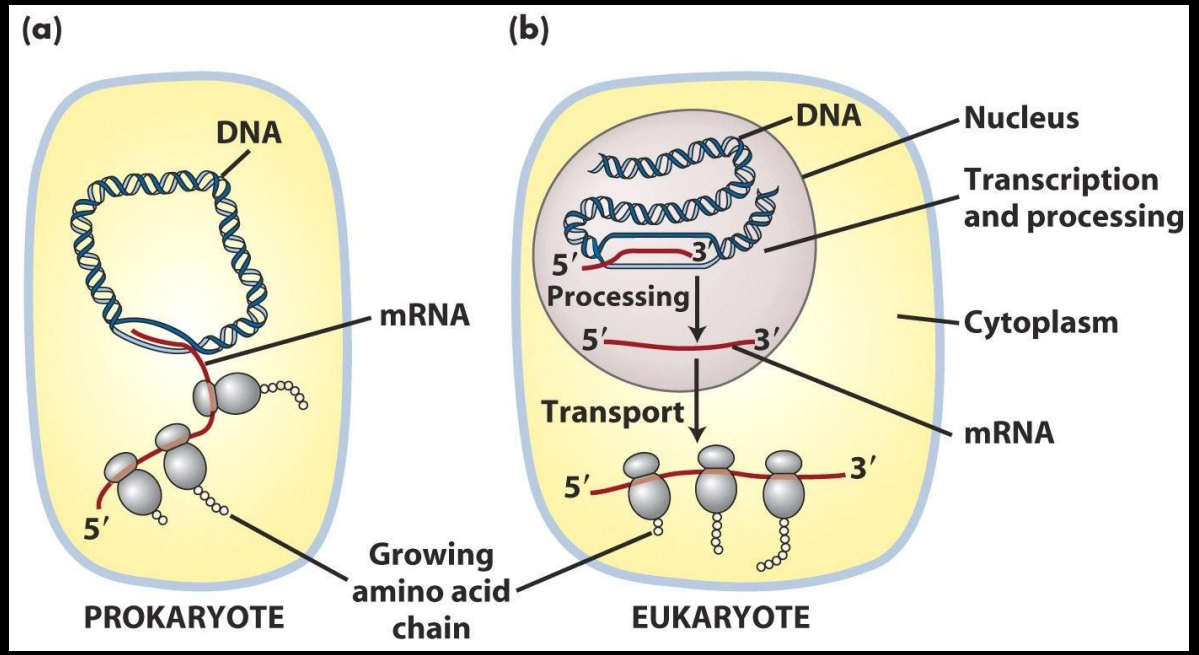
Fibrous = helix or sheets

Globular= 3D, tertiary structure



7.3U6 Translation can occur immediately after transcription in prokaryotes due to the absence of a nuclear membrane

Ribosomes are next to chromosomes in prokaryotes whereas in eukaryotes the mRNA needs to be relocated from the nucleus to the cytoplasm (through the nuclear membrane)



7.3.S2 The use of molecular visualization software to analyse the structure of eukaryotic ribosomes and a tRNA molecule.

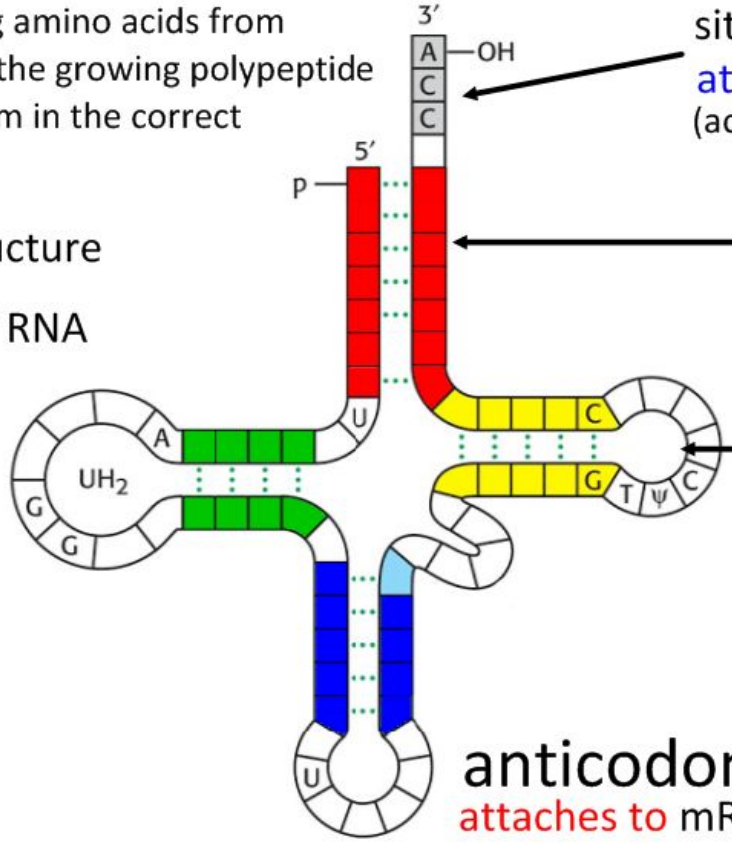
http://pdb101.rcsb.org/motm/15

The structure of tRNA matches its function.

Function: to bring amino acids from the cytoplasm to the growing polypeptide and to attach them in the correct location.

Clover-leaf structure

single chain of RNA



site attaches to amino acid at 3' terminal end (acceptor loop)

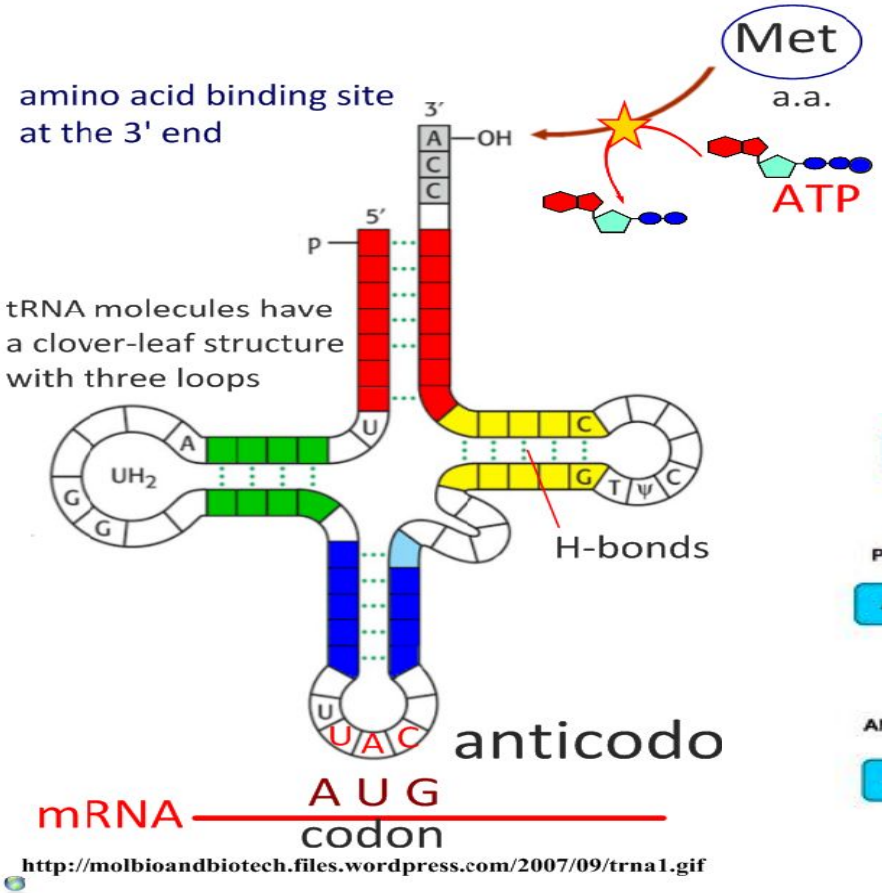
double stranded sections are base paired (H-bonds)

bases in these loops are not base paired

there are 3 loops

anticodon (3 bases)
attaches to mRNA codons

tRNA is activated by a tRNA activating enzyme

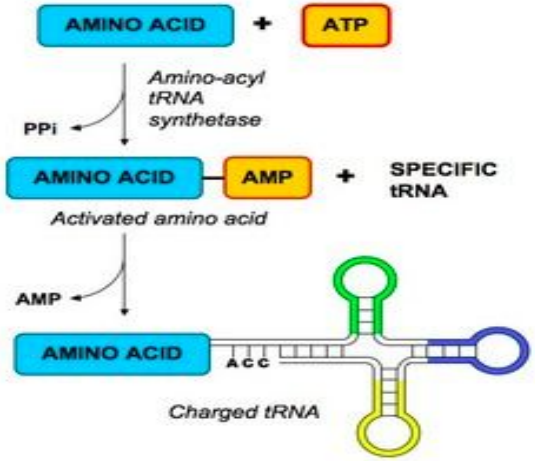


http://molbioandbiotech.files.wordpress.com/2007/09/trna1.gif

tRNA delivers amino acids to the growing polypeptide chain in translation.

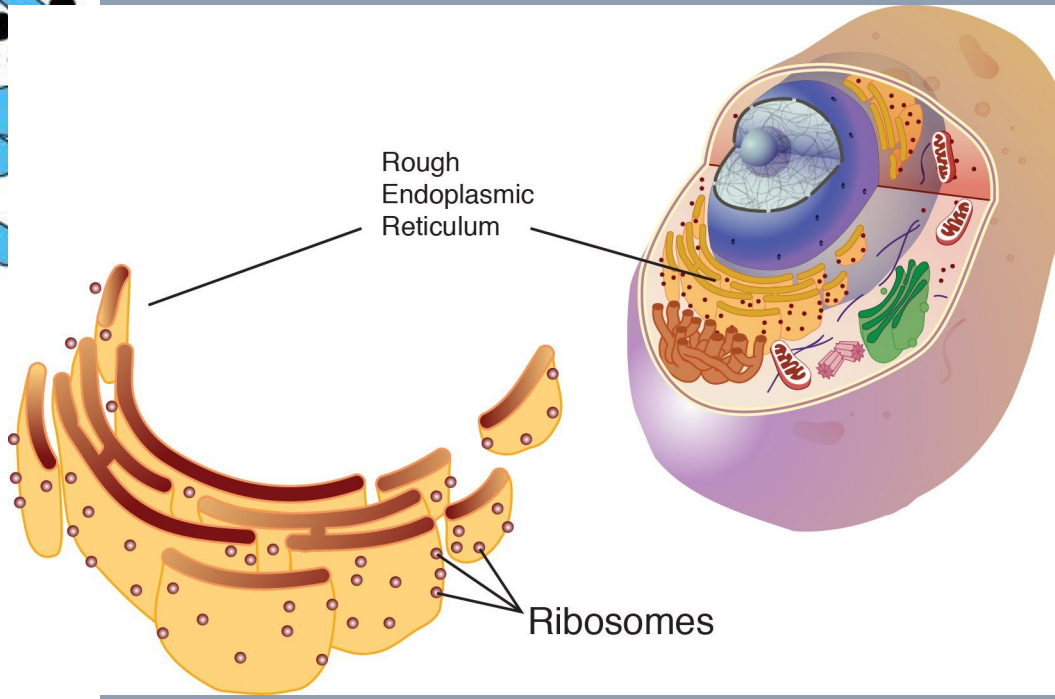
It picks up new amino acids when activated by a specific tRNA activating enzyme. This uses ATP.

There are 20 of these enzymes, corresponding to the 20 amino acids, for which the tRNA molecule has the complementary anticodon.

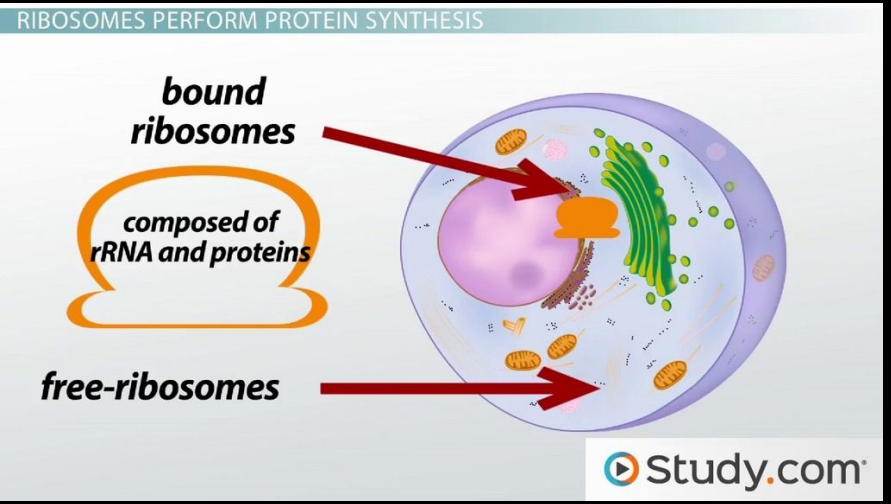


The **energy** in the **bond** linking the tRNA molecule to the amino acid will be **used** in translation to form a **peptide bond** between adjacent

http://www.ib.bioninja.com.au/_Media/trna_activation_med.jpeg


Rough
Endoplasmic
Reticulum
Ribosomes

7.3U4: Free ribosomes synthesize proteins for use primarily within the cell



- Ribosomes floating in cytoplasm
- Proteins for internal use stay in cytoplasm

7.3U5 Bound ribosomes synthesise proteins primarily for secretion or for use in lysosomes

- Ribosomes on endoplasmic reticulum are sent out of cell because ER is part of packaging in the exit system