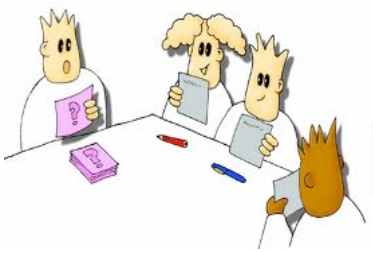
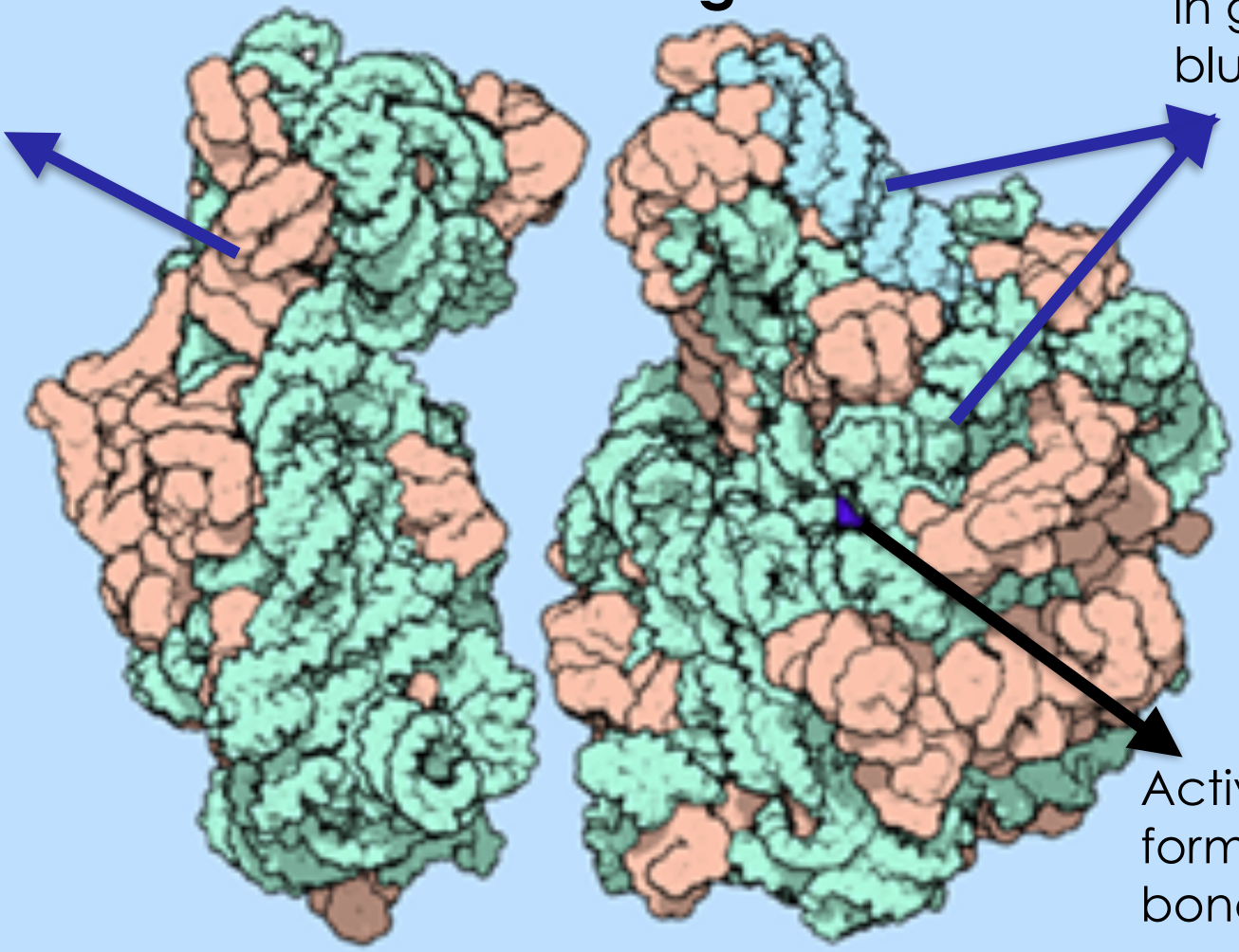


16
A C
G U
②
4
③
①
14
15
12
⑤
9
⑥
1 2 3 4 5
10
11
13
⑦
⑧
nuclear pore
cytoplasm

Translation

Ribosome Structure and Make up



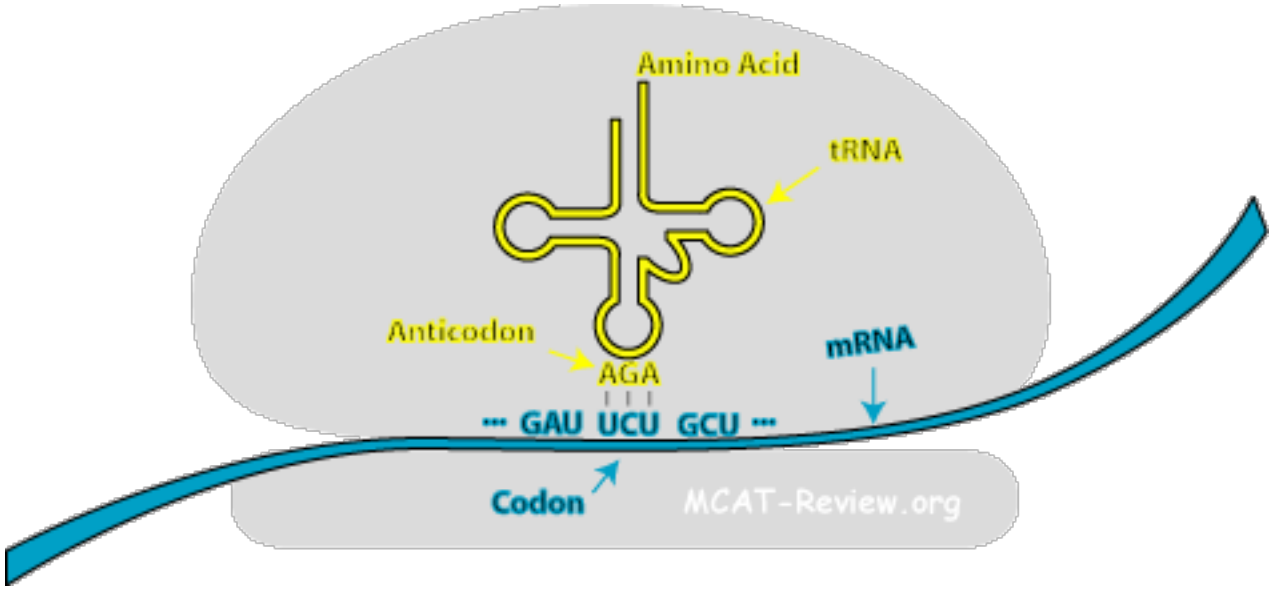
Protein makeup in peach

rRNA makeup in green and blue

Active site that forms peptide bonds between a.a.

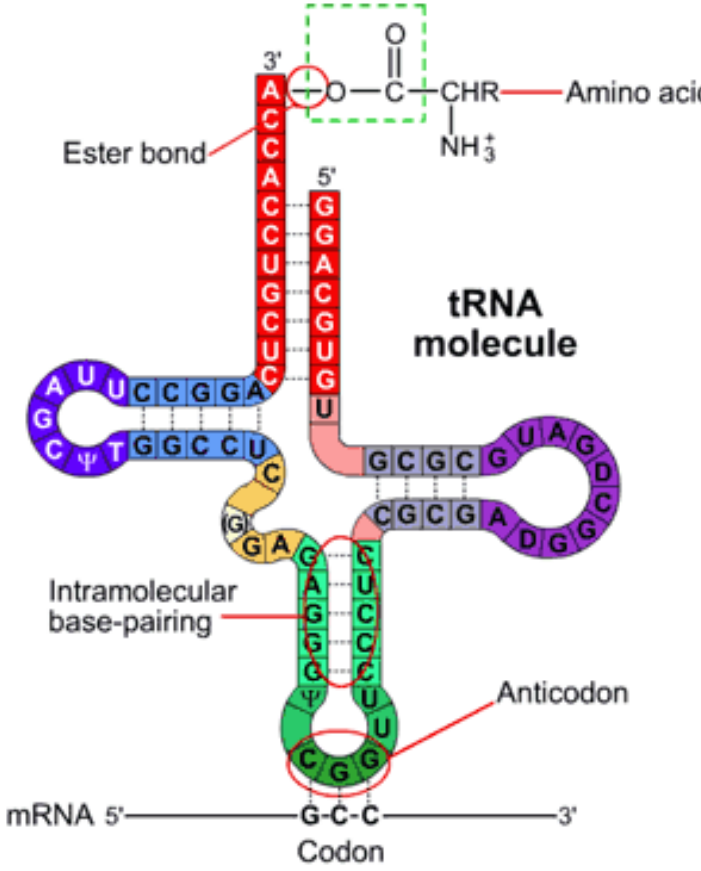
Translation

- information coded in mRNA is translated to a polypeptide chain

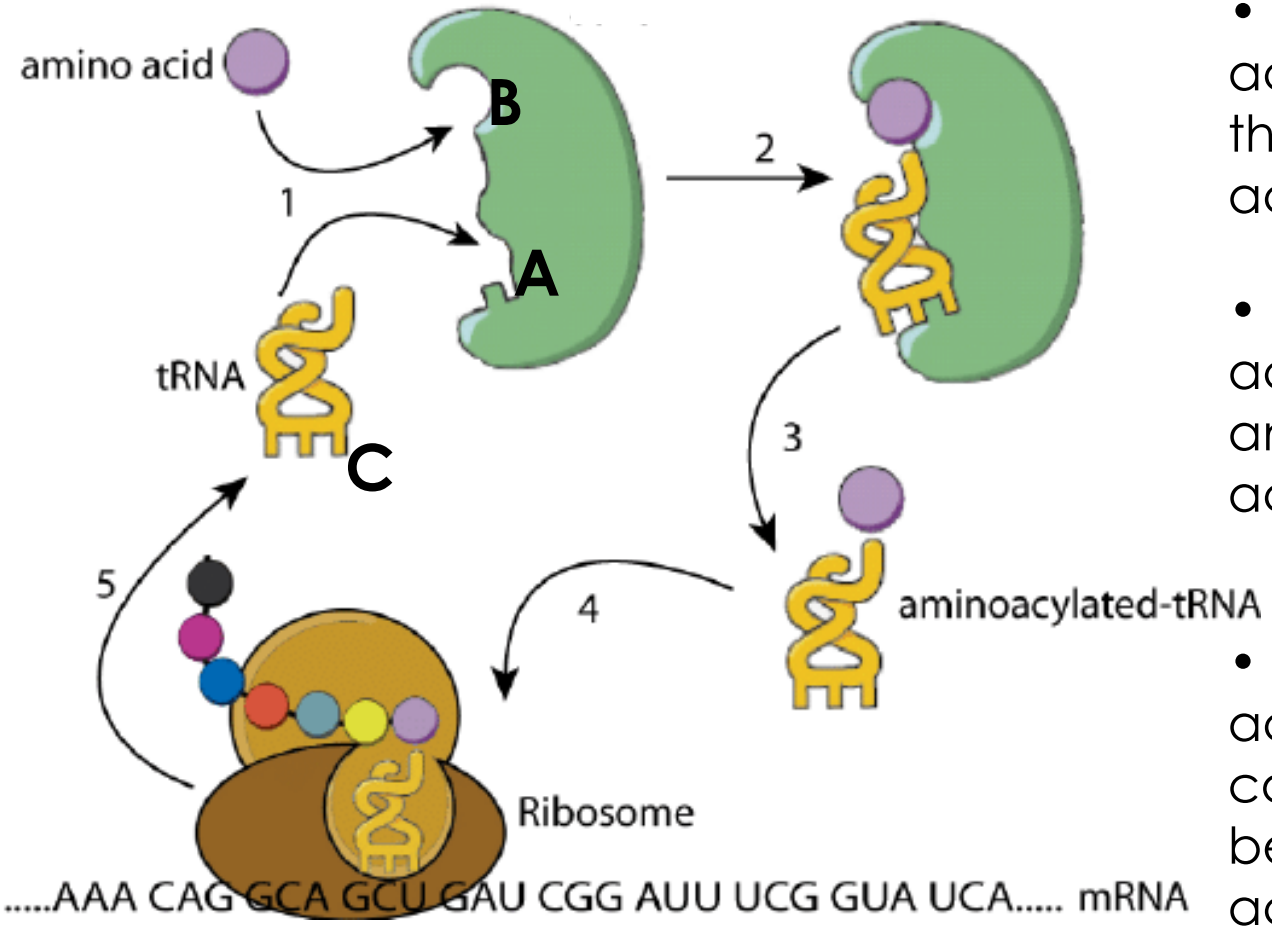


Transfer RNA (tRNA)

- single-stranded nucleic acid with a cloverleaf structure (folds onto itself)
- **anticodon** (sequence of 3 bases) is complementary to the **codon** on mRNA
- when “charged” with an amino acid it is called an **aminoacyl-tRNA**



State

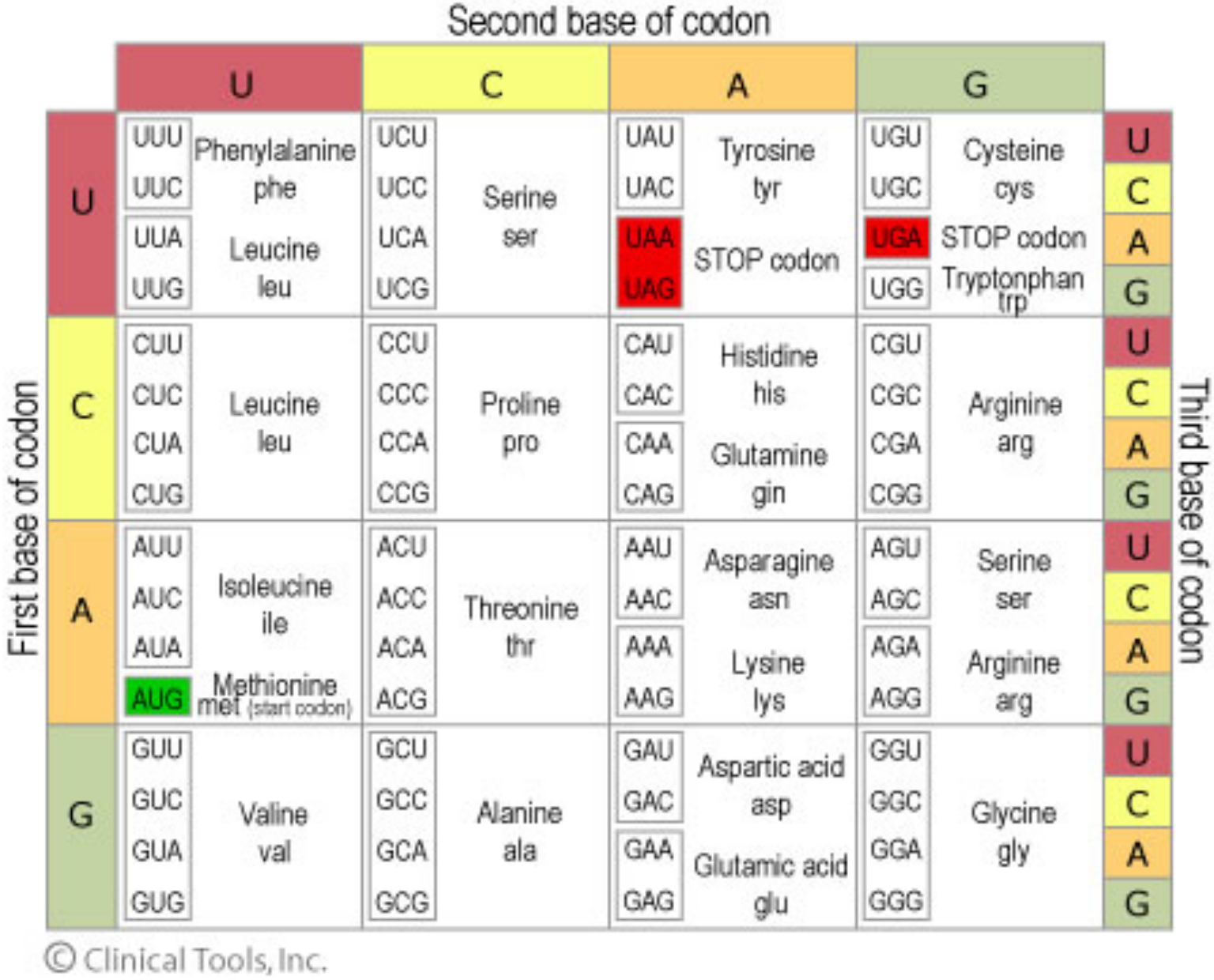


- there are 20 different activating enzymes for the 20 different amino acids and correct tRNA
- each has a specific active binding sites, **A** and **B** for specific amino acid and tRNA
- ATP energy is used to activate the enzyme causing the bonding between the amino acid and tRNA

tRNA

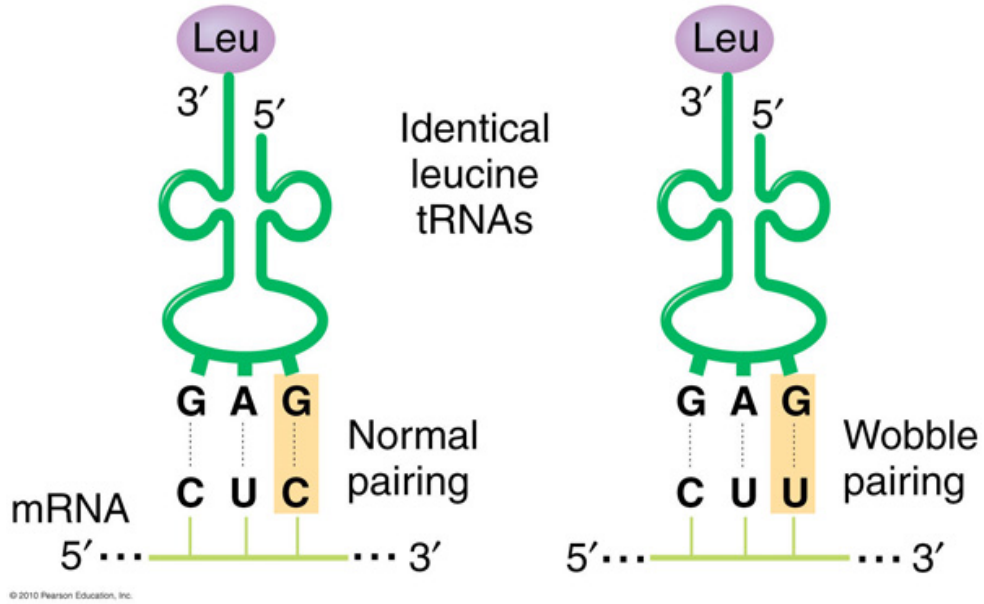
- **aminoacylation** is addition of amino acids to the 3' end by an enzyme

- **aminoacyl-tRNA** = tRNA with corresponding amino acid attached



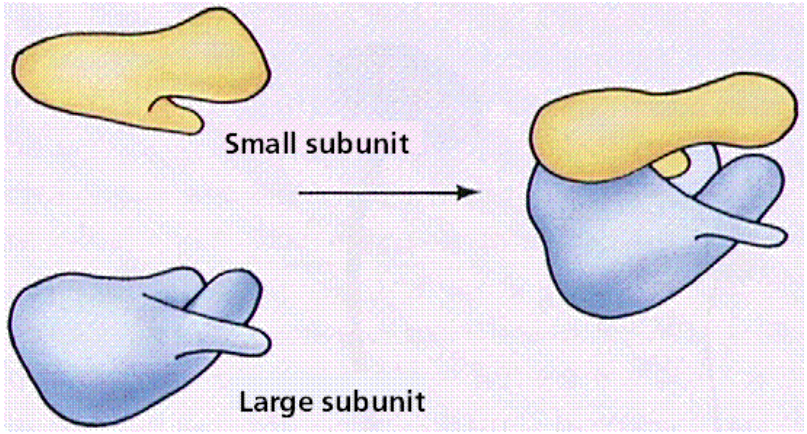
Wobble Hypothesis

- tRNA can recognize more than one codon by flexible pairing between the third base of the codon
- benefits: not as many tRNAs actually needed & point mutations in the 3rd position of a codon are suppressed



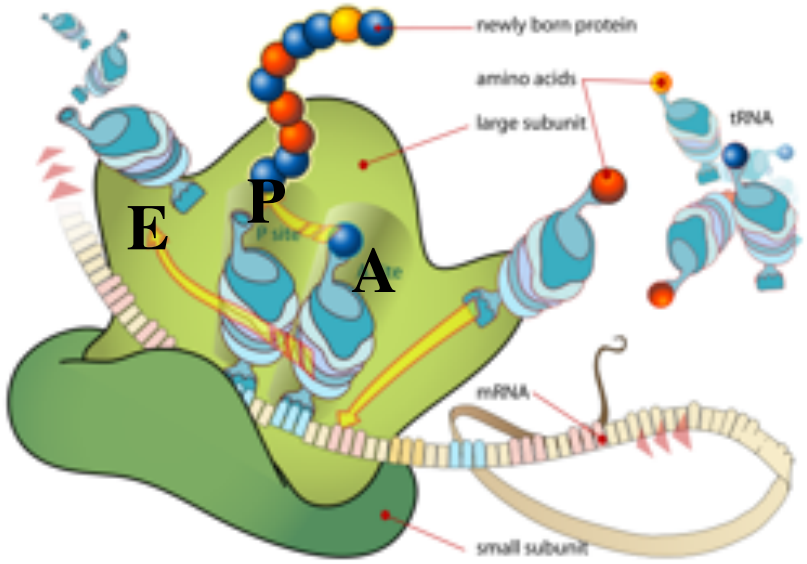
Ribosomes

- consist of two subunits- large and small
- subunits clamp the mRNA between them



Ribosome Binding Sites

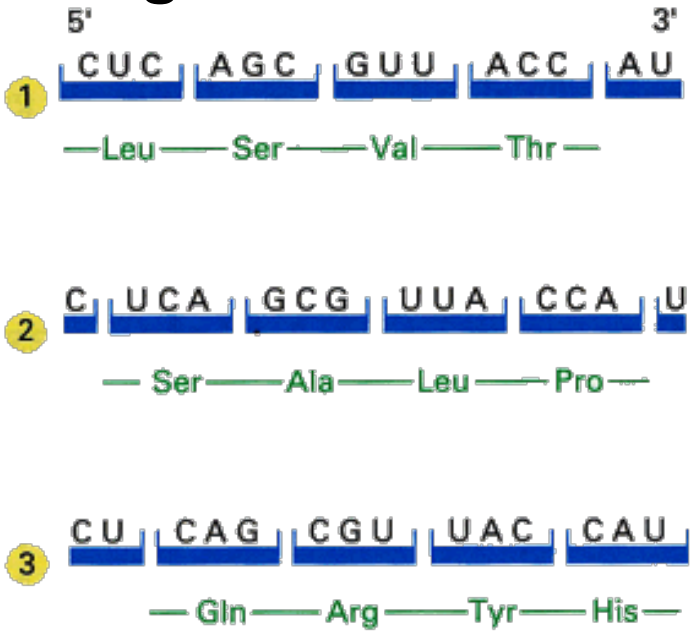
- **A site** (aminoacyl site): where incoming aminoacyl tRNA binds
- **P site** (peptidyl site): where tRNA with the growing polypeptide is
- **E site** (exit site): where tRNA leaves the ribosome



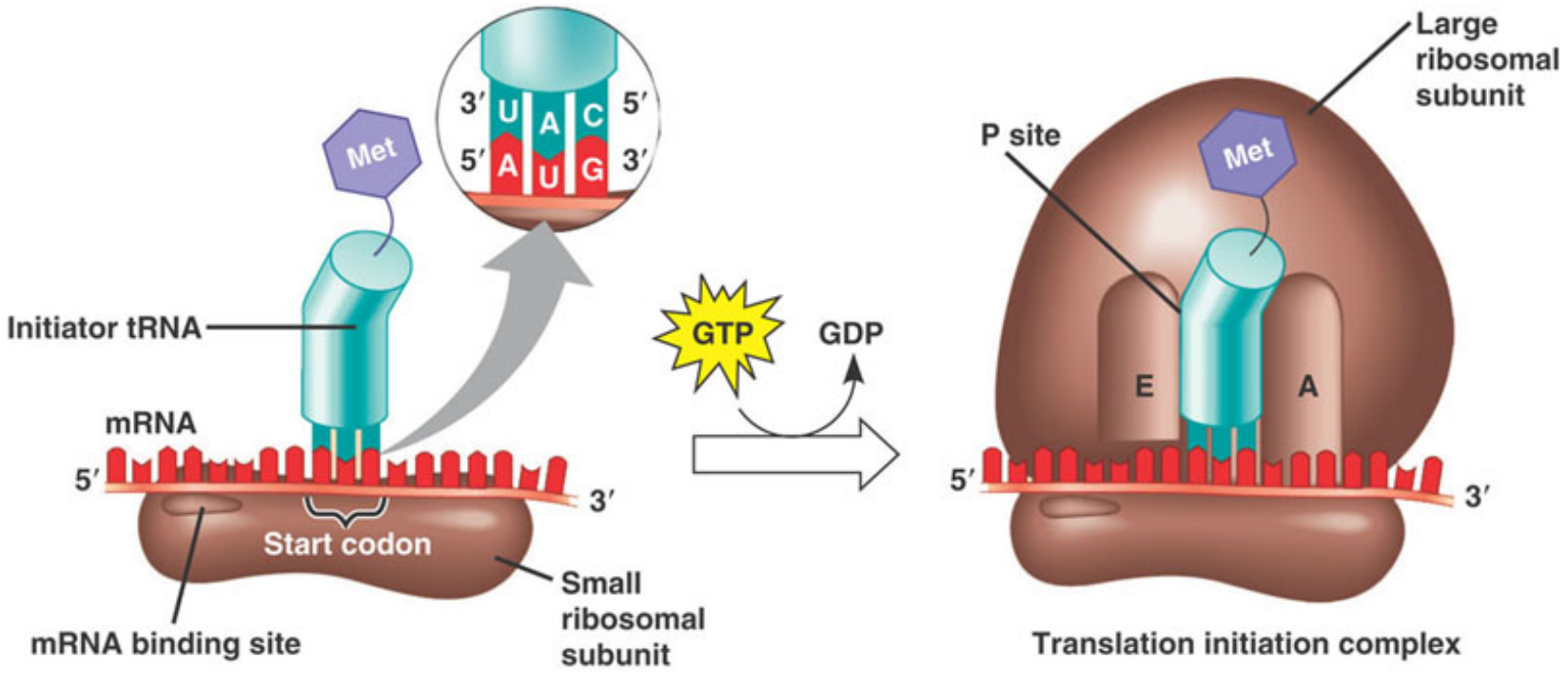
Translation 3 Stages - initiation, elongation, termination

1. Initiation

- the ribosome and the first aminoacyl tRNA (met) recognizes the 5’ cap and the start codon **(AUG)** of the mRNA
- AUG (methionine) is always the first codon to ensure the correct **reading frame**



Initiation


3′ U A C 5′
5′ A U G 3′
Met
Initiator tRNA
mRNA
5′
3′
Start codon
mRNA binding site
Small ribosomal subunit
GTP
GDP
Large ribosomal subunit
P site
Met
E
A
5′
3′
Translation initiation complex

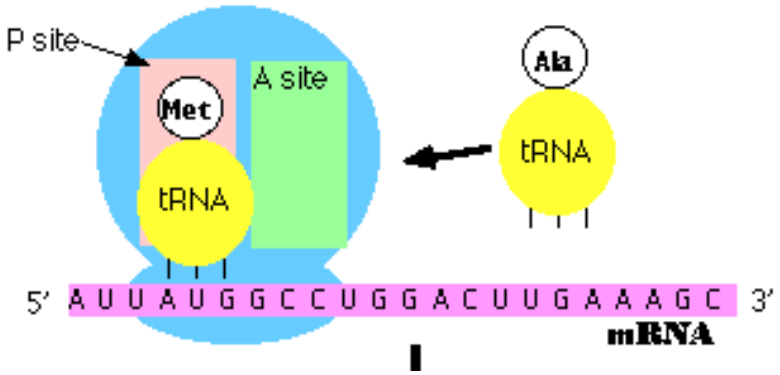
Elongation

- the initiator tRNA (with methionine) enters the **P site** on the ribosome
- tRNA carrying the second amino acid enters the **A site**
- peptide bond forms between the methionine and the second amino acid

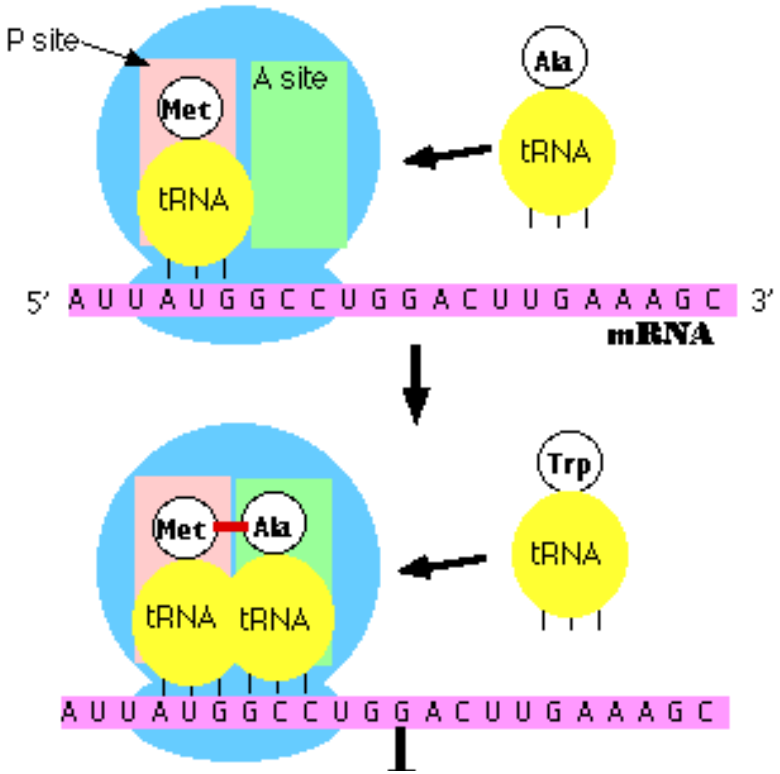
Elongation

- the ribosome shifts one codon
  - the methionine tRNA is released
  - the second tRNA moves into the P site
  - the third tRNA enters the A site
- peptide bond is formed between the second and third amino acids
- elongation continues on in this manner

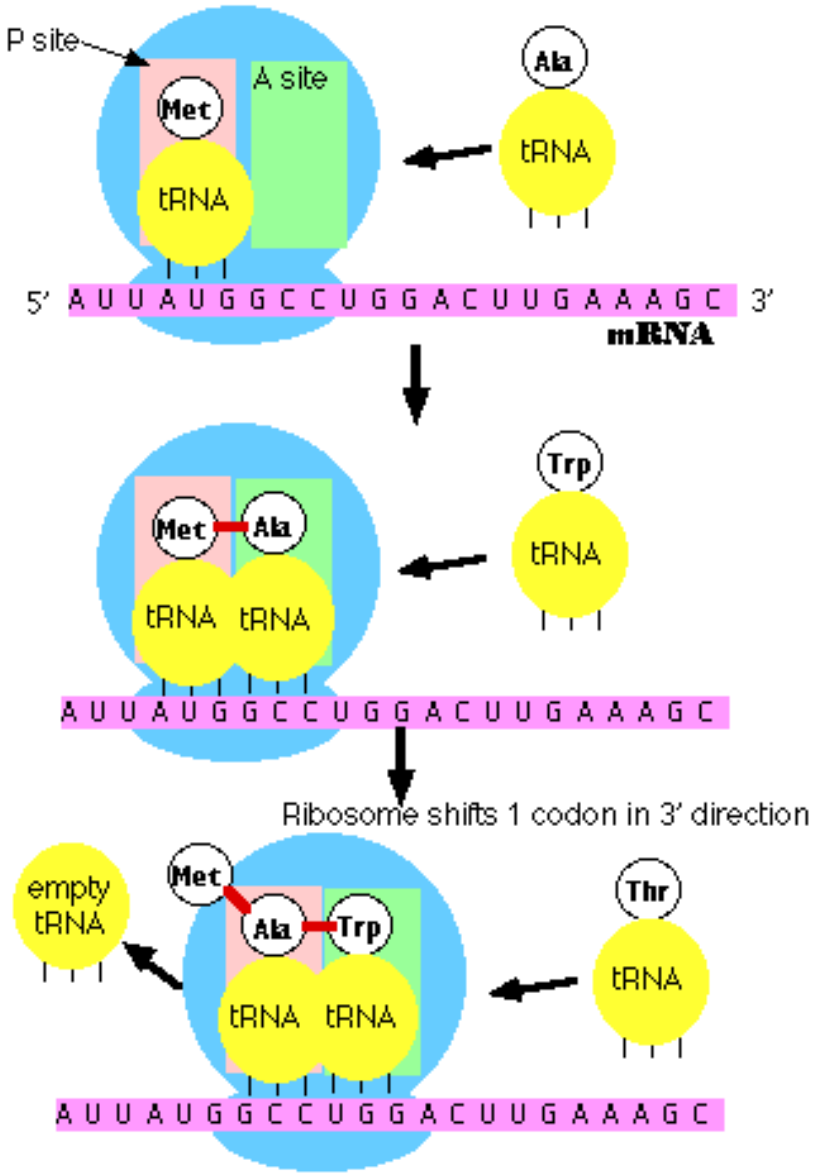
Elongation


P site
A site
Met
tRNA
Ala
tRNA
5′ A U U A U G G C C U G G A C U U G A A A G C 3′
mRNA

Elongation

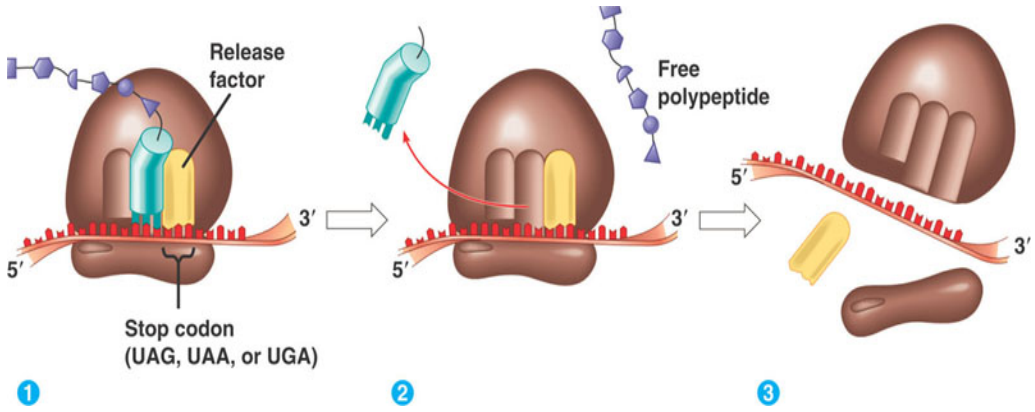

P site
A site
Met
tRNA
Ala
tRNA
5′ A U U A U G G C C U G G A C U U G A A A G C 3′
mRNA
Met
Ala
tRNA
tRNA
Trp
tRNA
A U U A U G G C C U G G A C U U G A A A G C

Elongation


P site
A site
Met
tRNA
Ala
tRNA
5′ A U U A U G G C C U G G A C U U G A A A G C 3′
mRNA
Met
Ala
tRNA tRNA
Trp
tRNA
A U U A U G G C C U G G A C U U G A A A G C
Ribosome shifts 1 codon in 3′ direction
empty tRNA
Met
Ala
Trp
tRNA tRNA
Thr
tRNA
A U U A U G G C C U G G A C U U G A A A G C

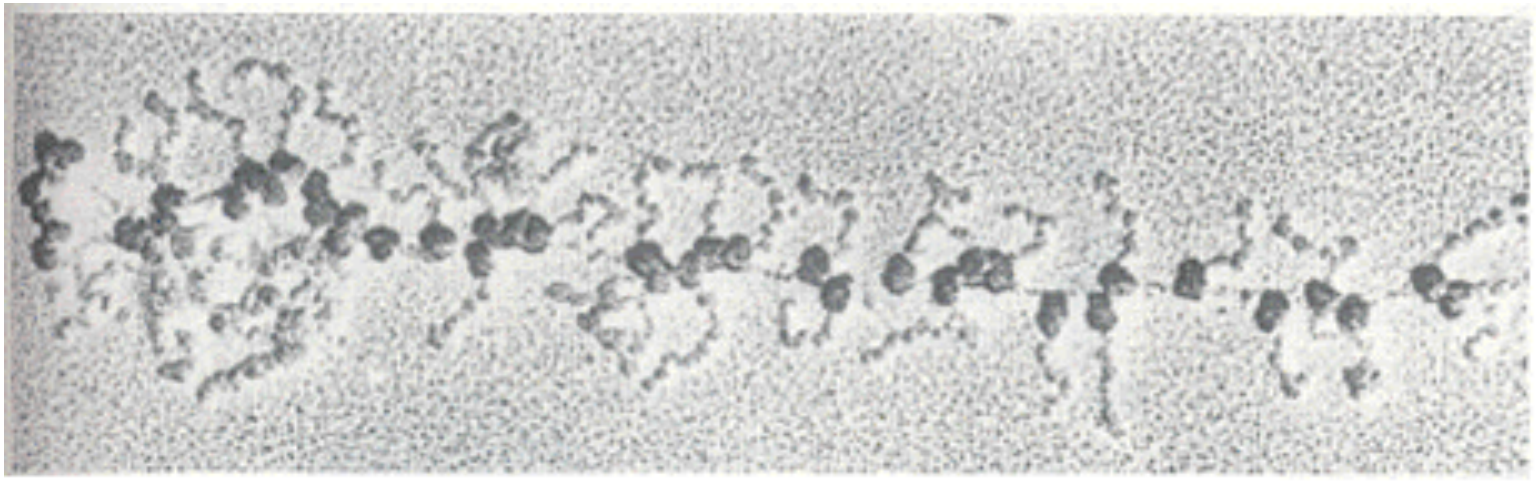
Termination

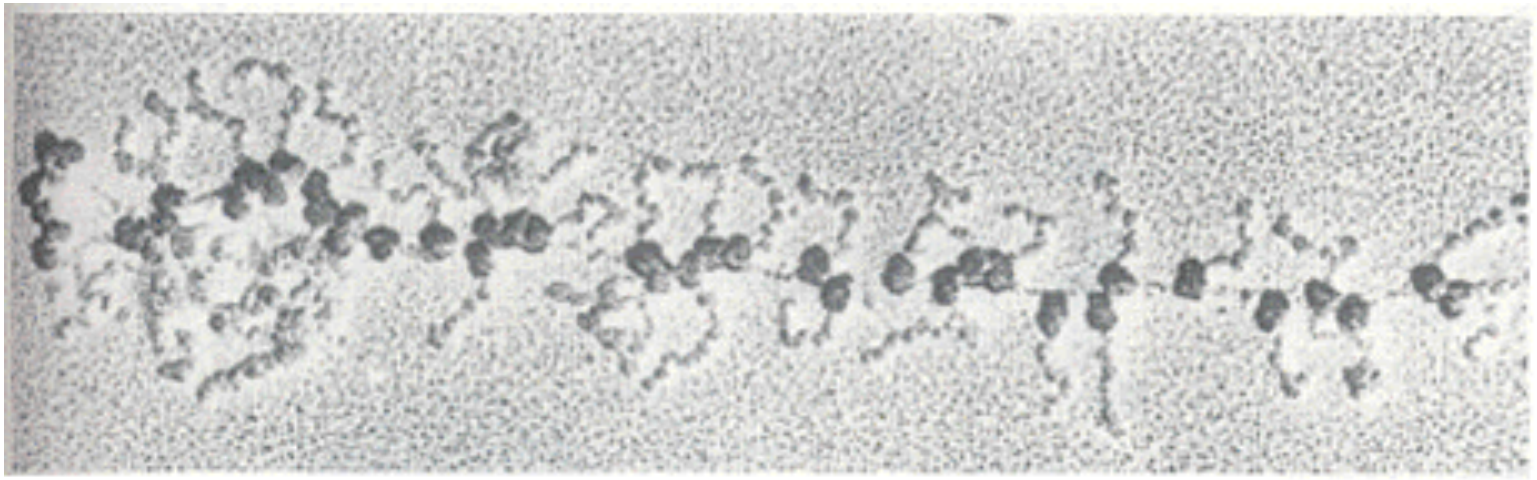
- stop codons: UGA, UAG and UAA
- **release factor protein** binds to A site, polypeptide is released from P site, and the 2 subunits of the ribosome separate

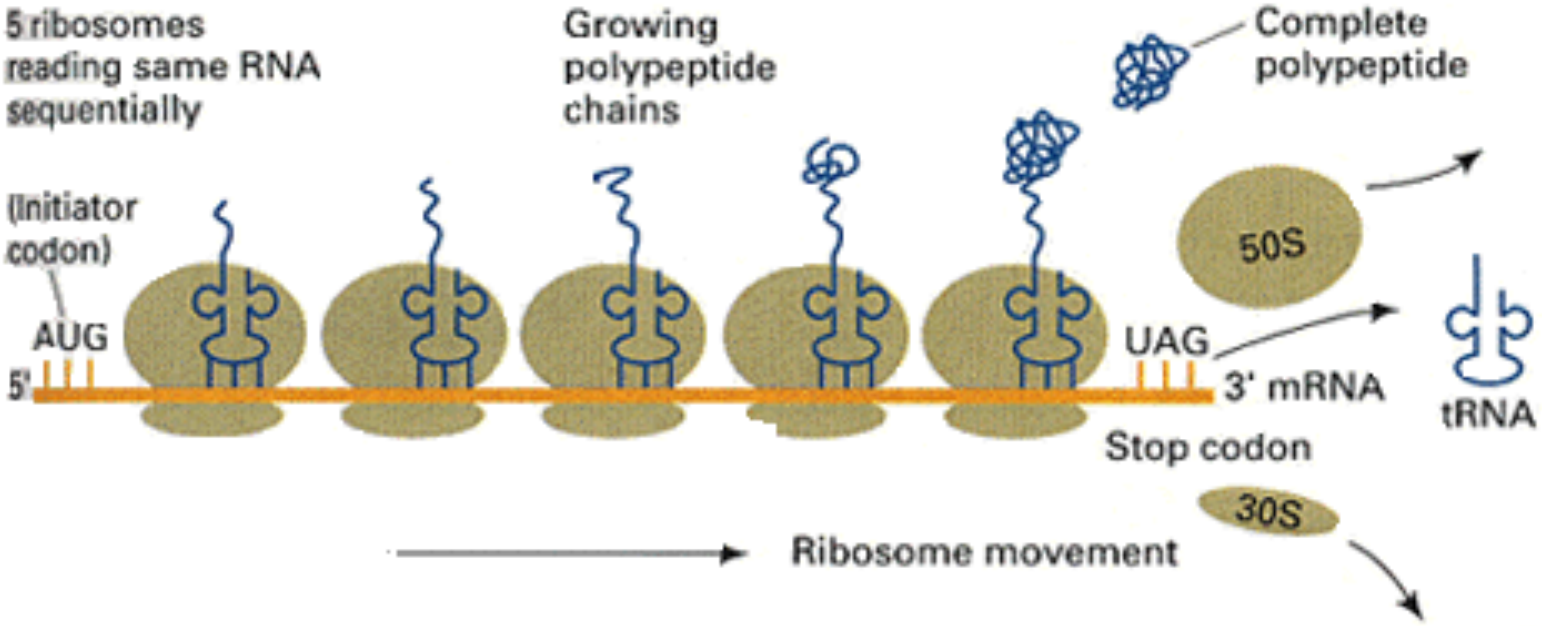


Eukaryotes vs. Prokaryotes

- **polysome** = complex formed when multiple ribosomes attach to the same mRNA
- in prokaryotic cells, translation and transcription can happen at the same time



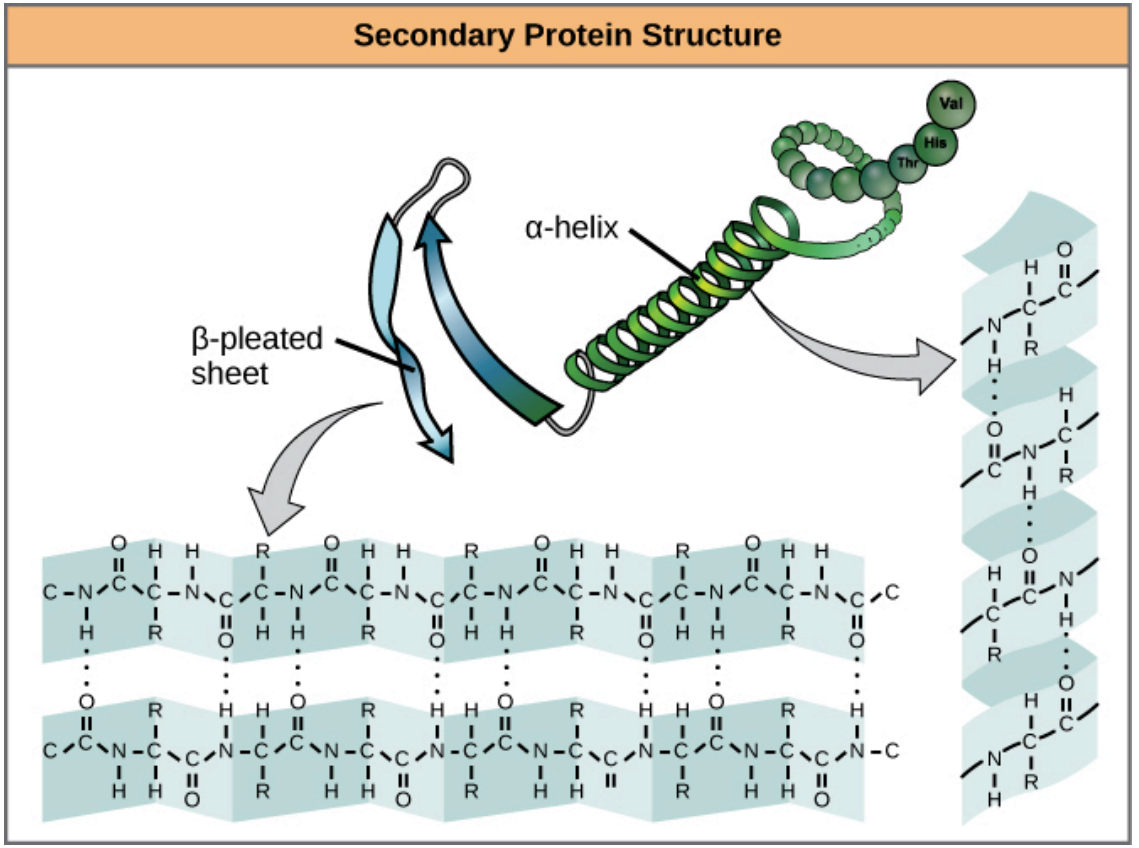



5 ribosomes reading same RNA sequentially
Growing polypeptide chains
Complete polypeptide
(Initiator codon)
AUG
5'
50S
UAG
3' mRNA
tRNA
Stop codon
30S
Ribosome movement

Post **Translational** Modifications

Polypeptide chains, after translation, may undergo some modifications which include;

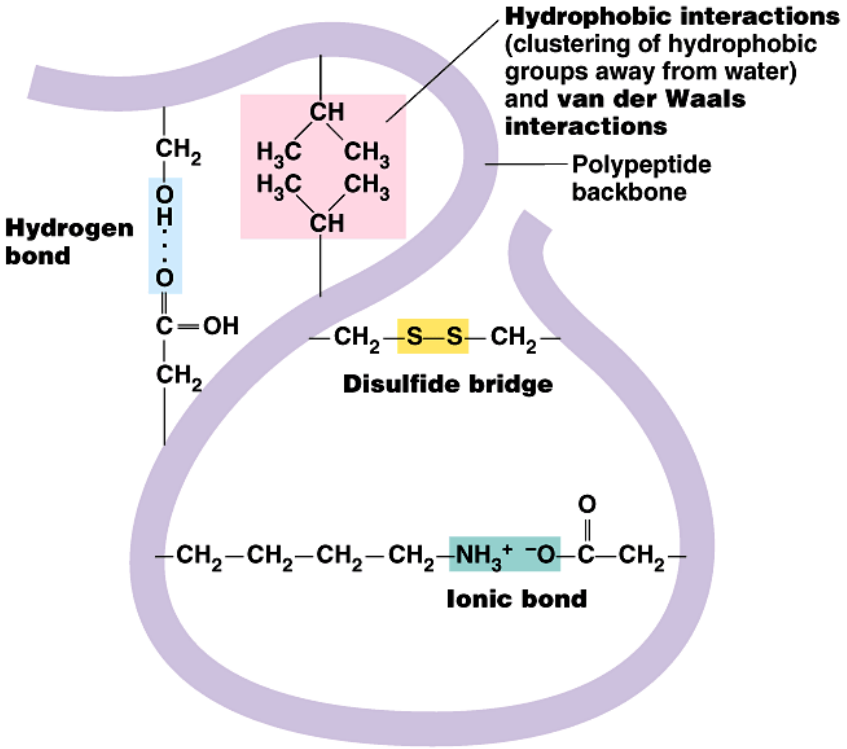
Forming of secondary structure … (beta pleats or alpha helix)



Post **Translational** Modifications

Polypeptide chains, after translation, may undergo some modifications which include;

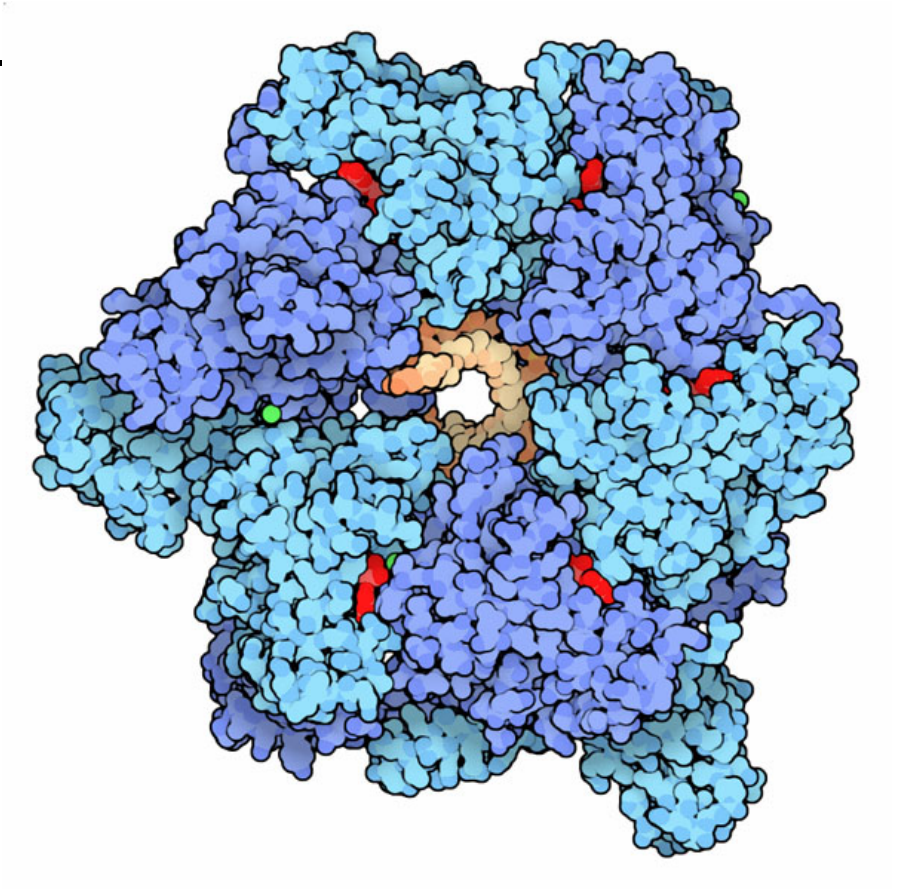
Forming of secondary structure … (beta pleats or alpha helix)
Forming of tertiary structure…



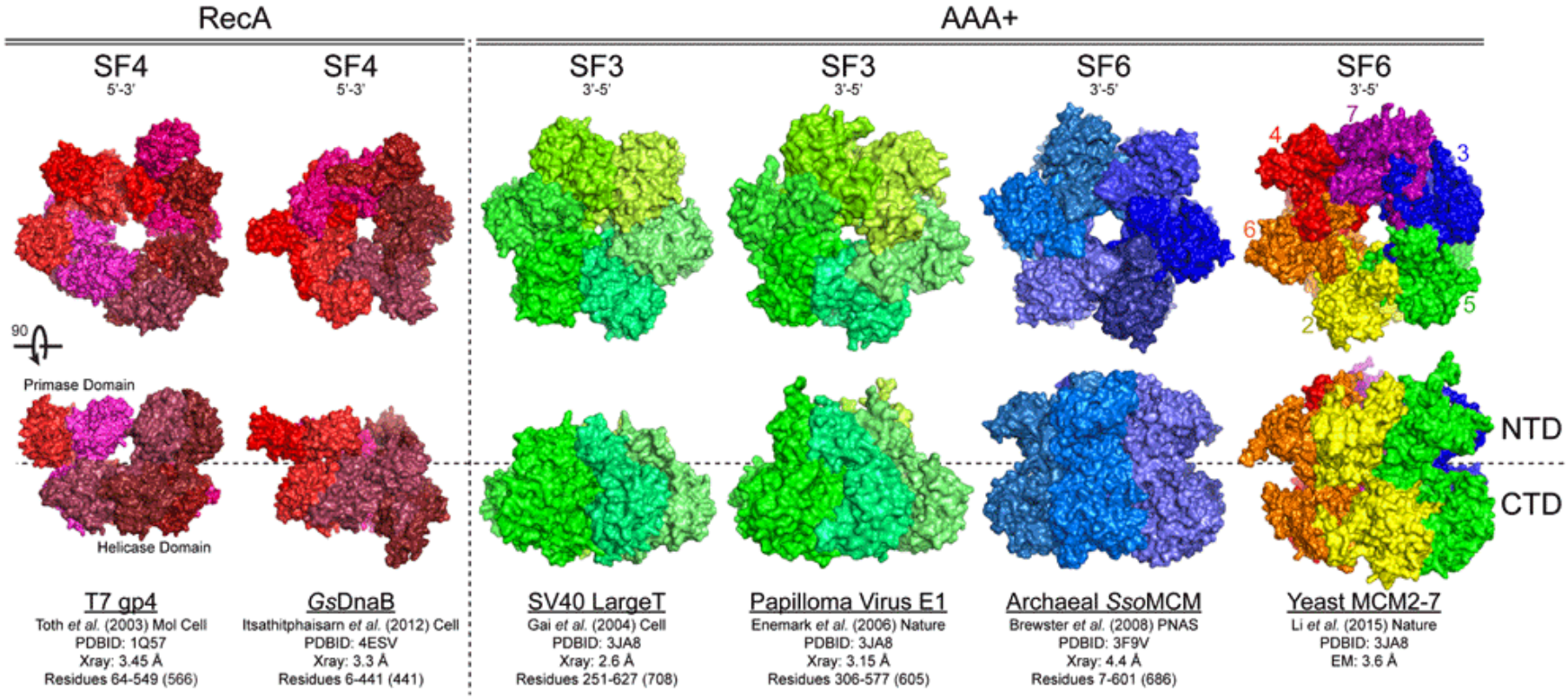
Post **Translational** Modifications

Polypeptide chains, after translation, may undergo some modifications which include;

Forming of secondary structure … (beta pleats or alpha helix)
Forming of tertiary structure…
Forming of quartenary structure….



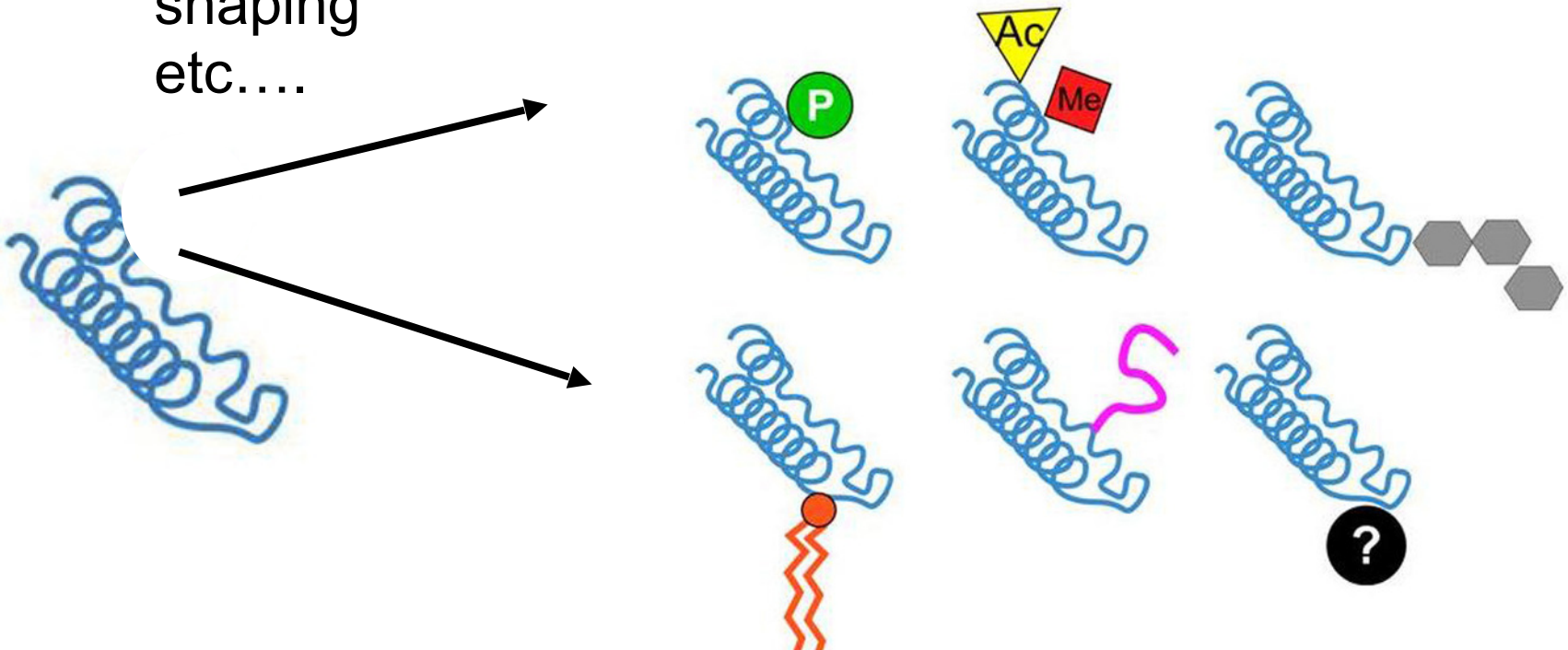
Post **Translational** Modifications

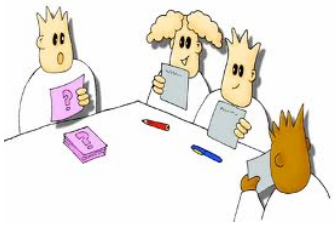


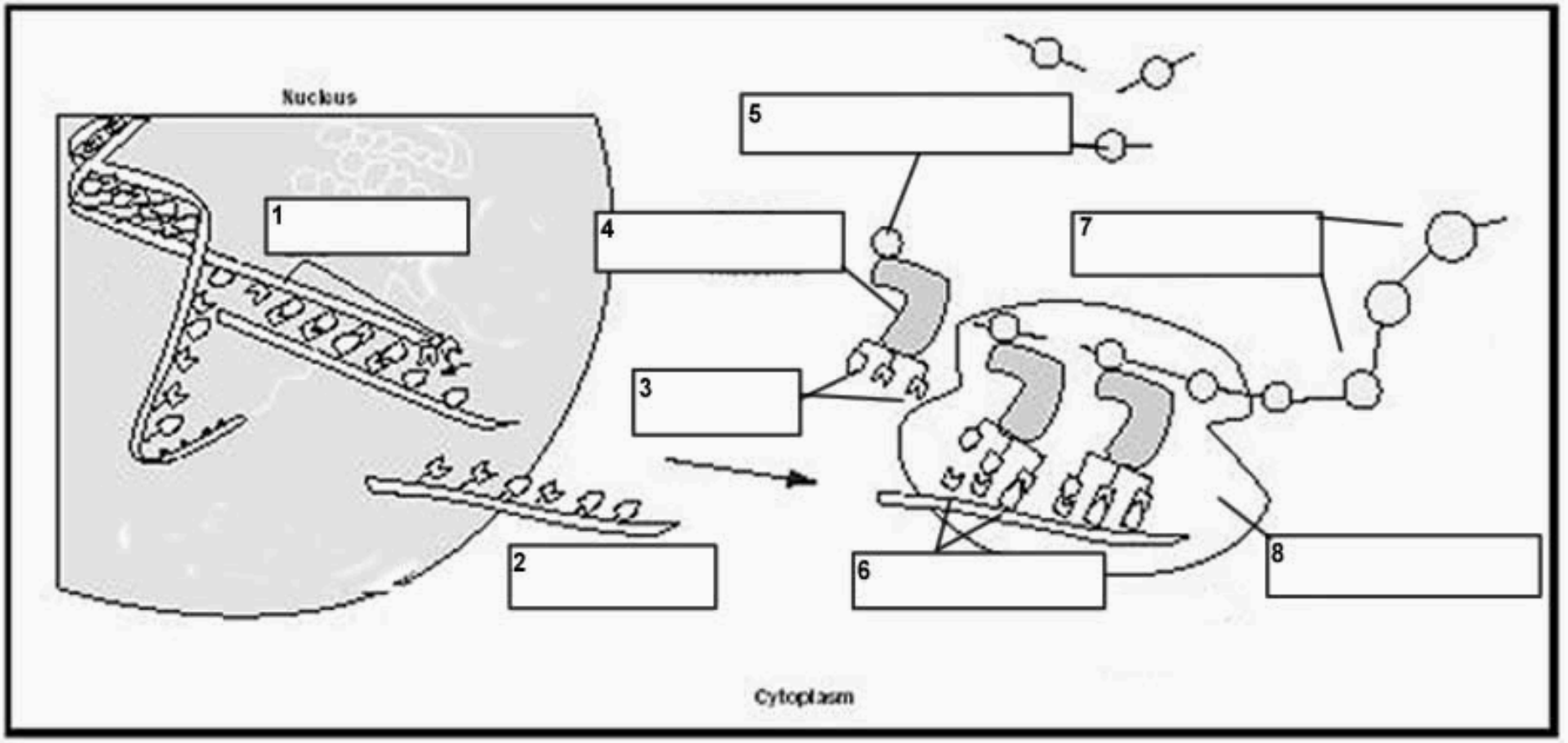
Post **Translational** Modifications

Quartenary structure may undergo some modifications which include addition of prosthetic groups (not peptide) ;

- phosphate groups
- adding carbohydrate
- adding lipids
- shaping
- etc….






Nuckus
1
2
3
4
5
6
7
8
Cytoplasm

1. A strand of messenger RNA is transcribed from an original strand of DNA. The original bases on the DNA template strand were T-A-C-G. What is the base sequence on the RNA strand produced from this?
   (A)U-A-G-C
   (B)T-A-G-C
   (C)C-G-A-U
   (D)A-U-G-C

1. Some events that take place during the synthesis of a specific protein are listed below.

   1 Messenger RNA attaches to a ribosome.
   2 DNA serves as a template for RNA production.
   3 Transfer RNA bonds to a specific codon.
   4 Amino acids are bonded together.
   5 RNA moves from the nucleus to the cytoplasm.

The correct order of these events is _____?

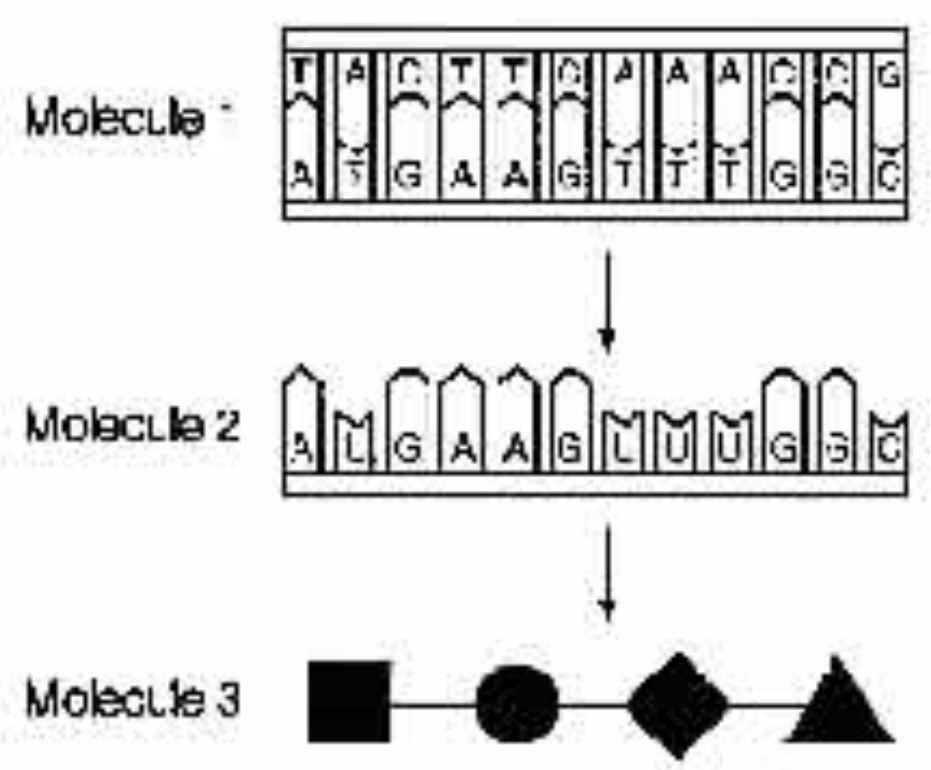
(A)2 --> 5 --> 1 --> 3 --> 4
(B)2 --> 3 --> 5 --> 4 --> 1
(C)4 --> 1 --> 5 --> 3 --> 2
(D)3 --> 2 --> 1 --> 5 --> 4

1. Which chemical components may be parts of a molecule of transfer RNA?
   (A)ribose, phosphate group, uracil base
   (B)glucose, amino group, thymine base
   (C)deoxyribose, phosphate group, guanine base
   (D)maltose, carboxyl group, uracil base

Use this diagram (and your own knowledge) to answer questions 9-13.
The diagram represents molecules involved in protein synthesis.

1.In plant cells, molecule 1 is found in the _____?

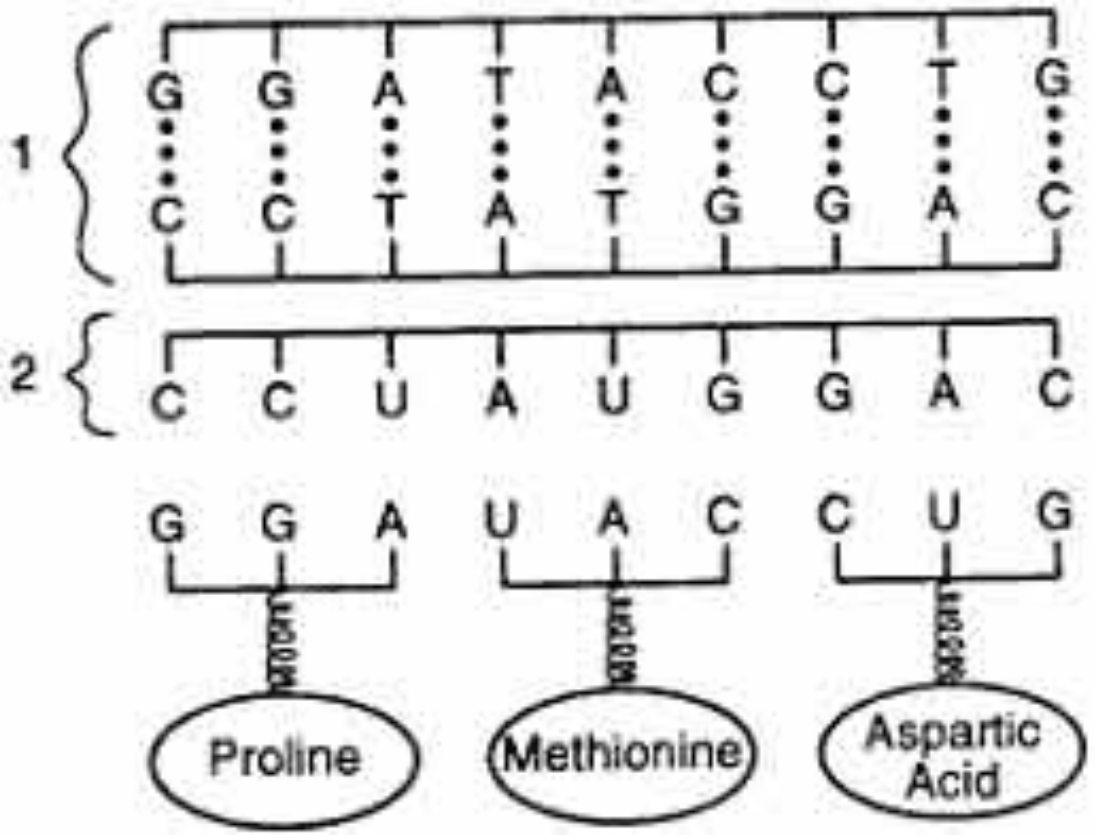
(A)centriole
(B)cell wall
(C)nucleus
(D)ribosome



Use this diagram (and your own knowledge) to answer question. The diagram represents molecular structures involved in protein synthesis.

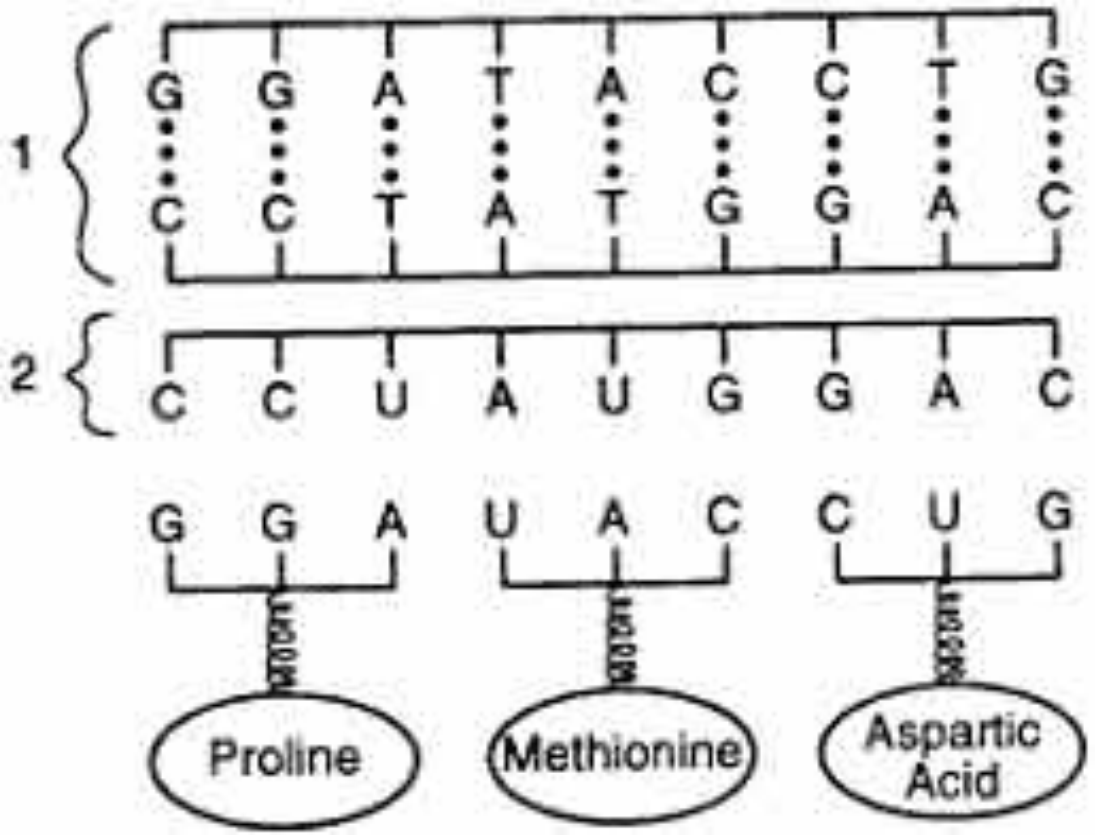
1.The DNA code on the template for aspartic acid is _____?

(A)C-T-G
(B)C-C-T
(C)C-C-U
(D)C-U-G



1.Proline, methionine, and aspartic acid represent three types of _____?

(A)fatty acids
(B)hormones
(C)amino acids
(D)enzymes



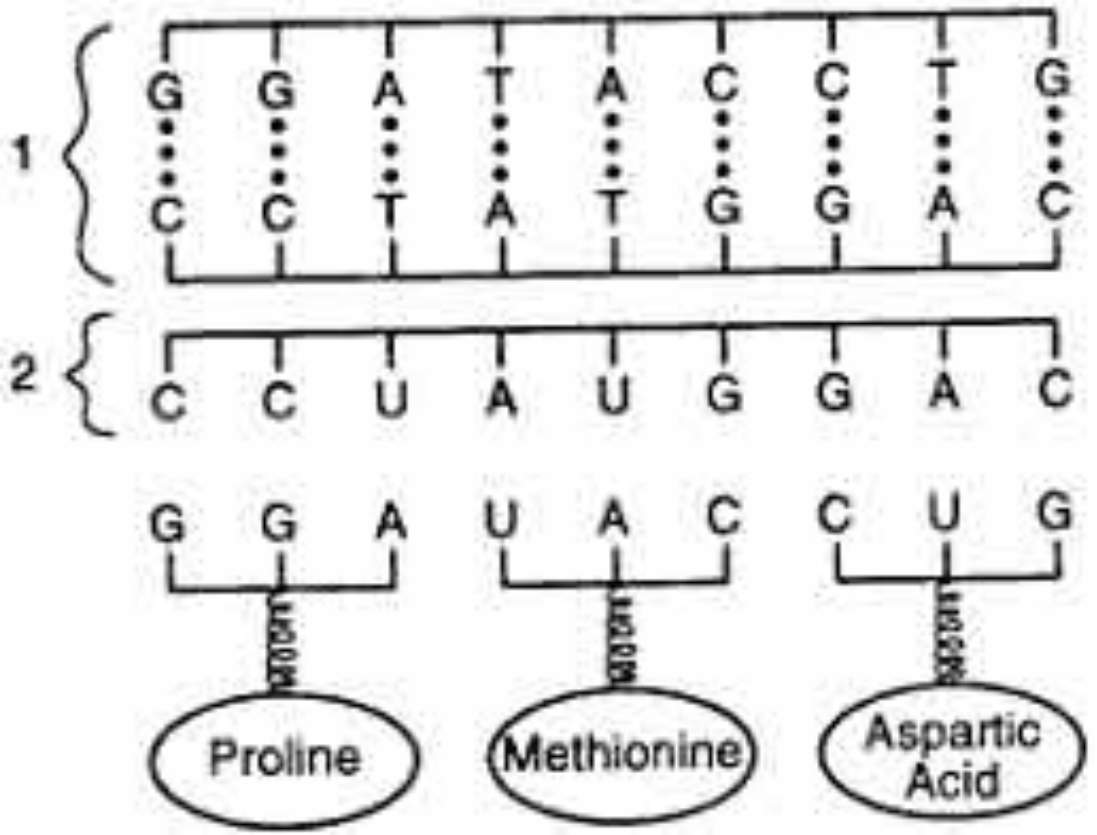
1.Structure 2 is synthesized in the _____.

(A)nucleus

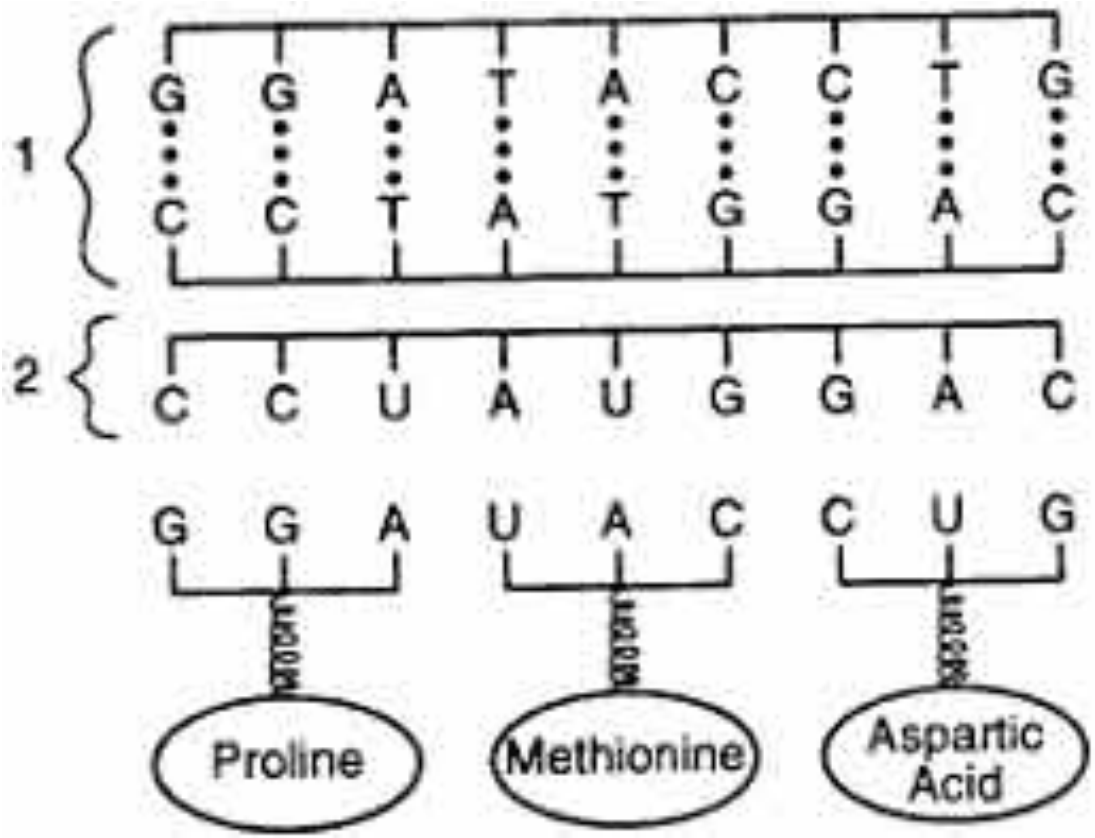
(B)ribosome

(C)vacuole

(D)lysosome



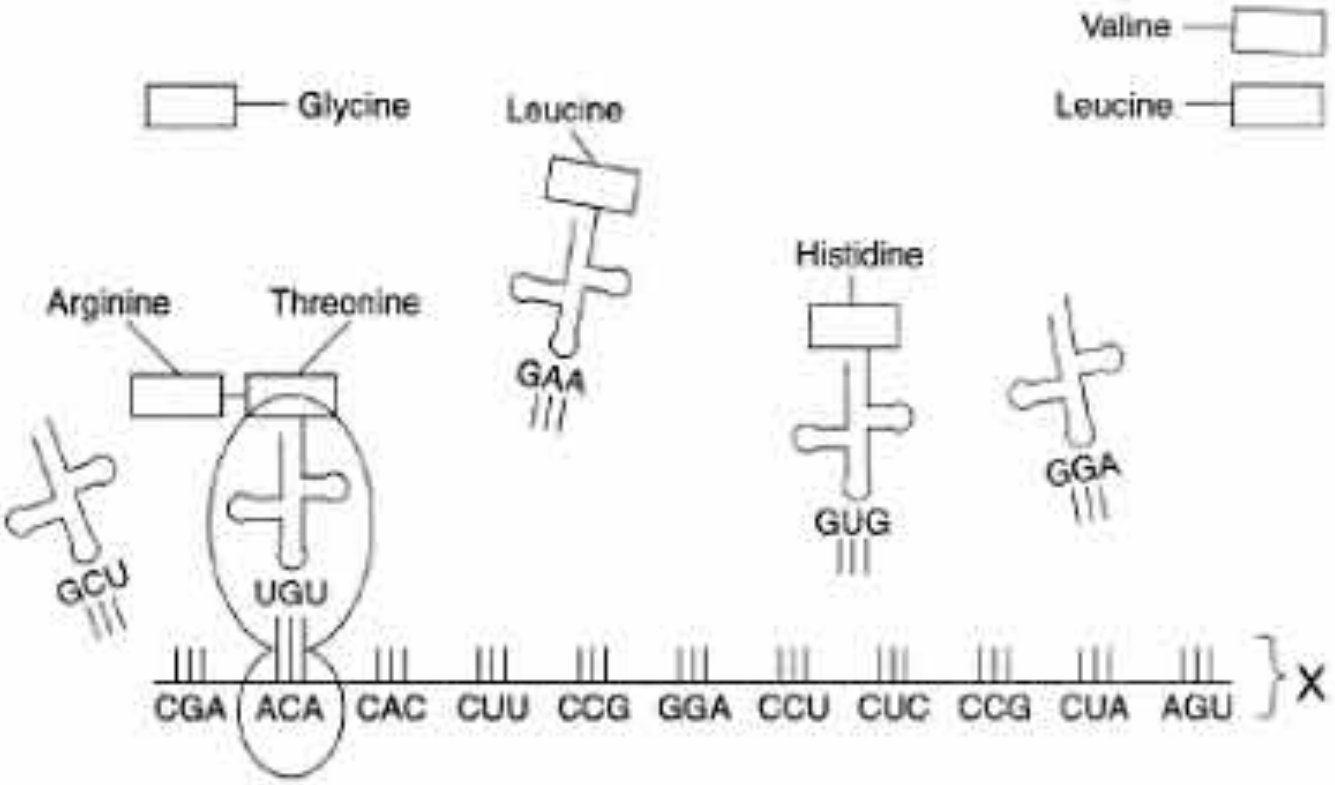
1. Structure 1 represents _____?
   (A)part of a polypeptide chain
   (B)a portion of an RNA molecule
   (C)a portion of a DNA molecule
   (D)the building blocks of proteins



Use this diagram for questions 1 and 2.

1. The synthesis of structure X occurred in the _____?
   - (A)chloroplast
   - (B)ribosome
   - (C)cytoplasm
   - (D)nucleus

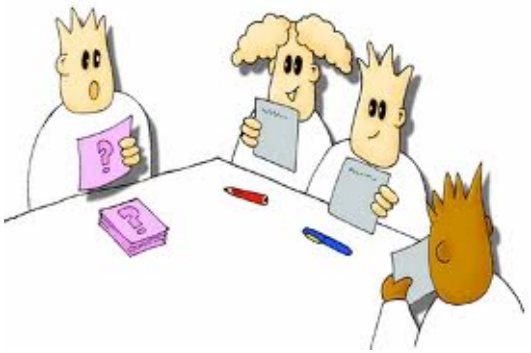
2. Which amino acid would be transferred to the position of codon CAC?
   - (A)leucine
   - (B)valine
   - (C)glycine
   - (D)histidine



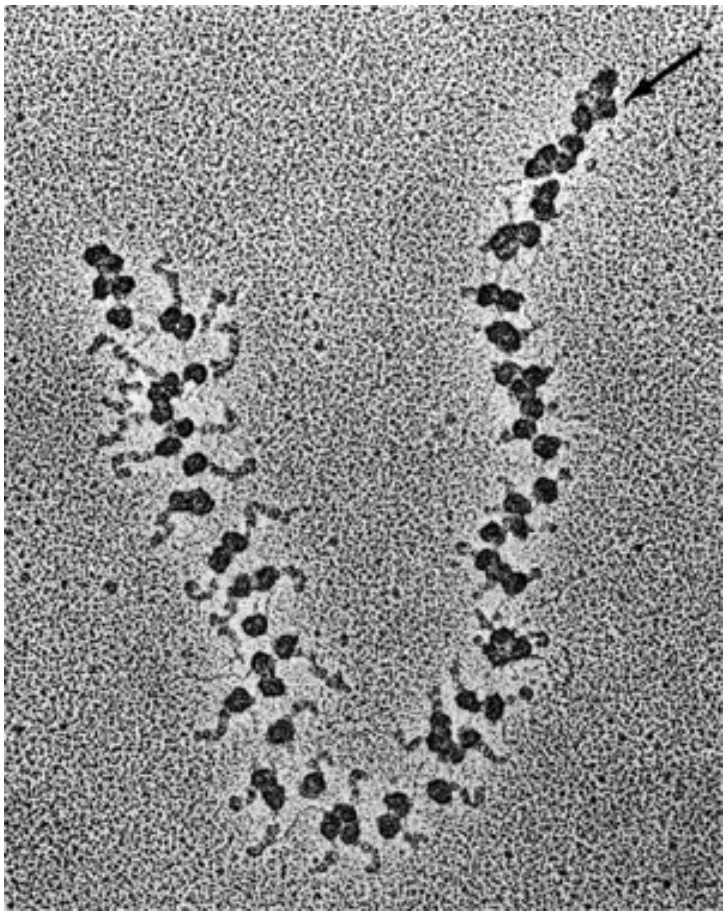
Animations

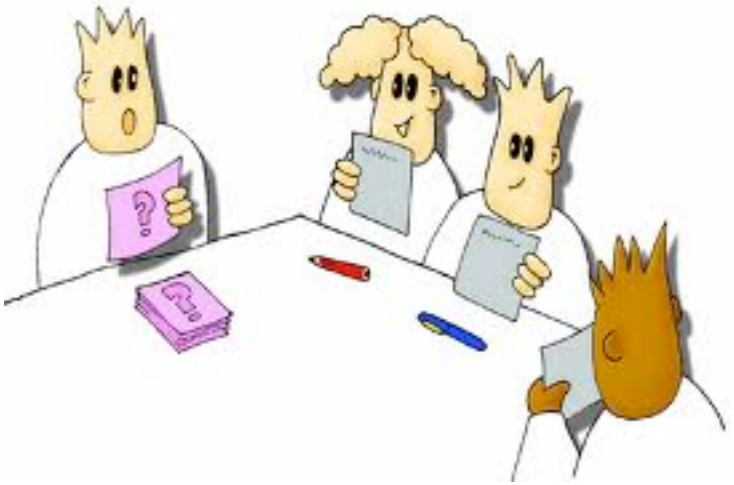
- Narrated animation with quiz:
- Narrated animation (McGraw-Hill) with quiz:

http://highered.mcgraw-hill.com/sites/0072943696/student_view0/chapter3/animation__how_translation_works.html



» Explain what is happening in this here.





» In human DNA there are some examples of a single gene complex coding up to 500 different proteins. Explain how this is possible. There are at least two relevant facts.

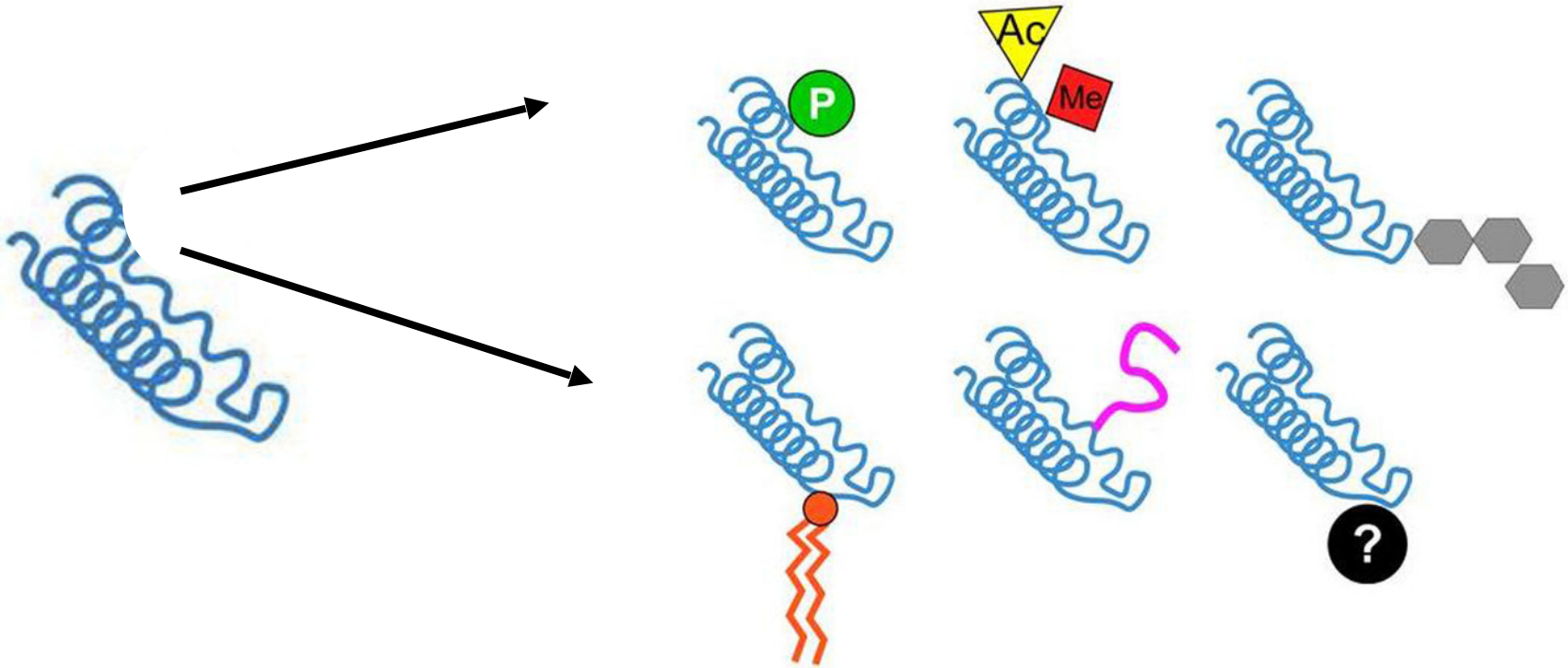
» Genes exposed to UV radiation often undergo DNA mutations (i.e., substitutions in nucleotides). However, these mutations are not always detected in the resulting protein. Explain.

AUG GGU GUG AGG

Use the above short sequence to help demonstrate the importance of having the correct **reading frame**. Make reference to how methionine helps set up the reading frame.

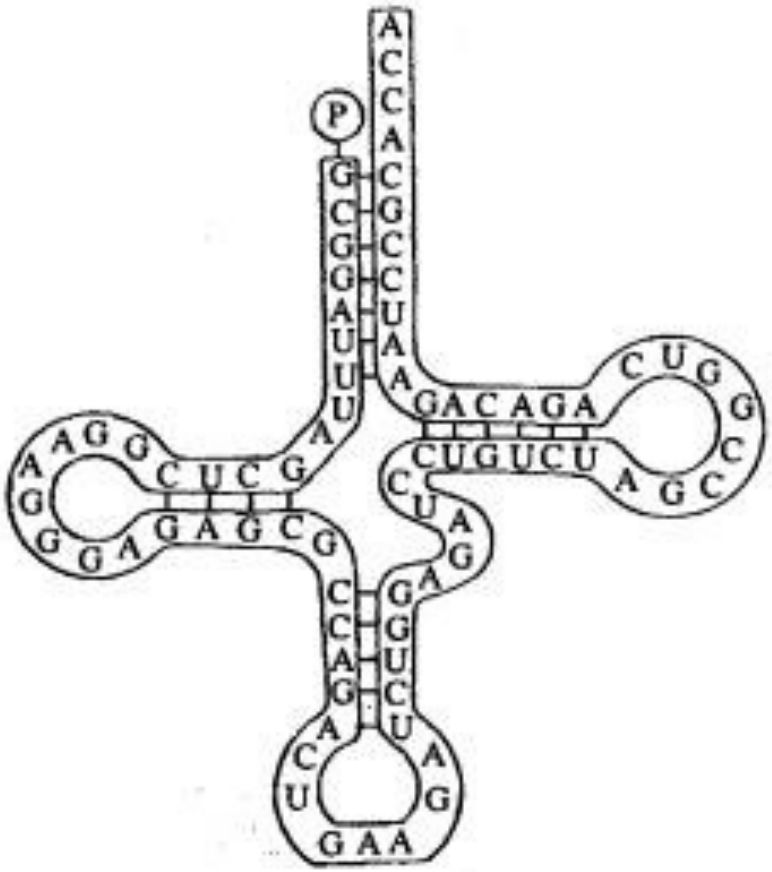
tRNAs cluster together on ribosomes before they release the amino acids.

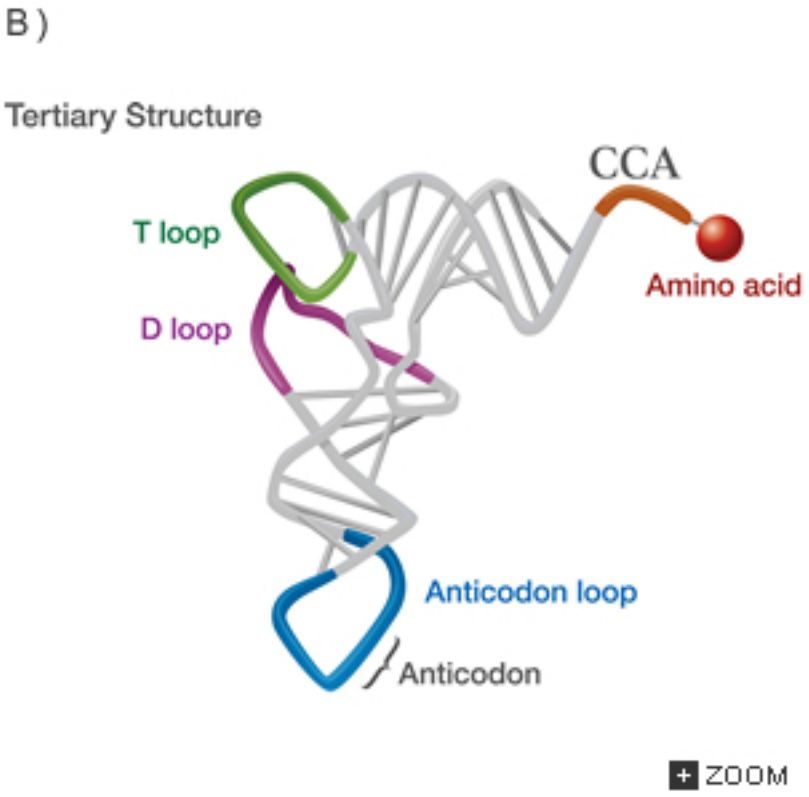
Comment on the accuracy of this statement.



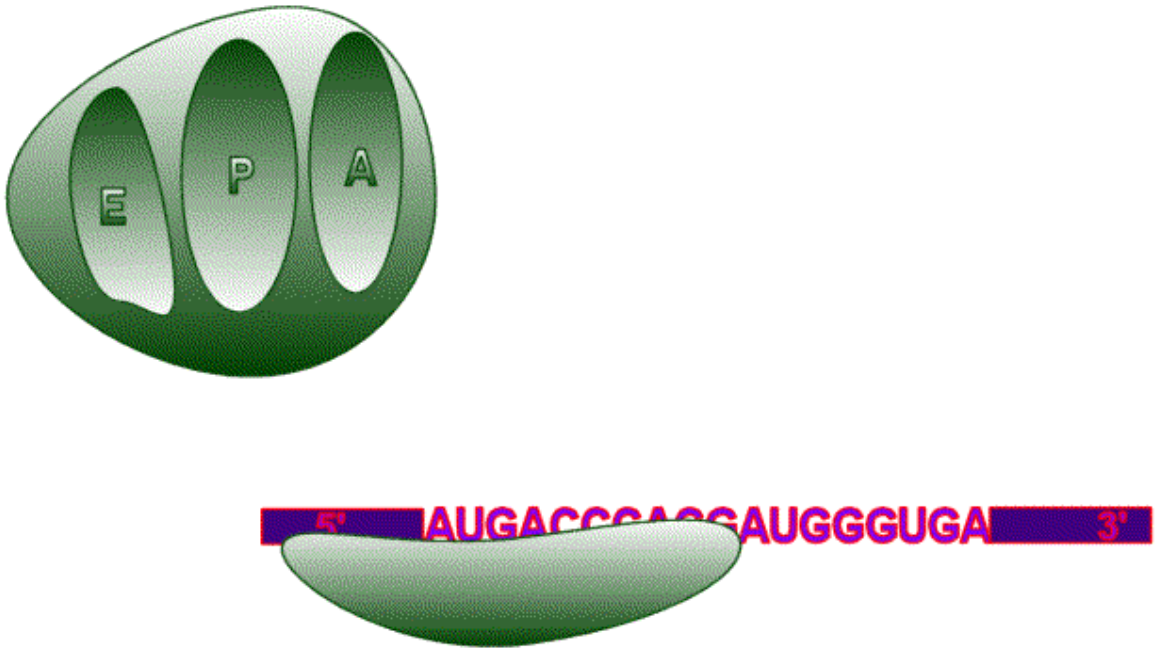
» Examine the diagram above showing post translational modifications. Suggest which protein is (i) a lipoprotein; (ii) a glycoprotein; (iii) has been phosphorylated.

What are these?

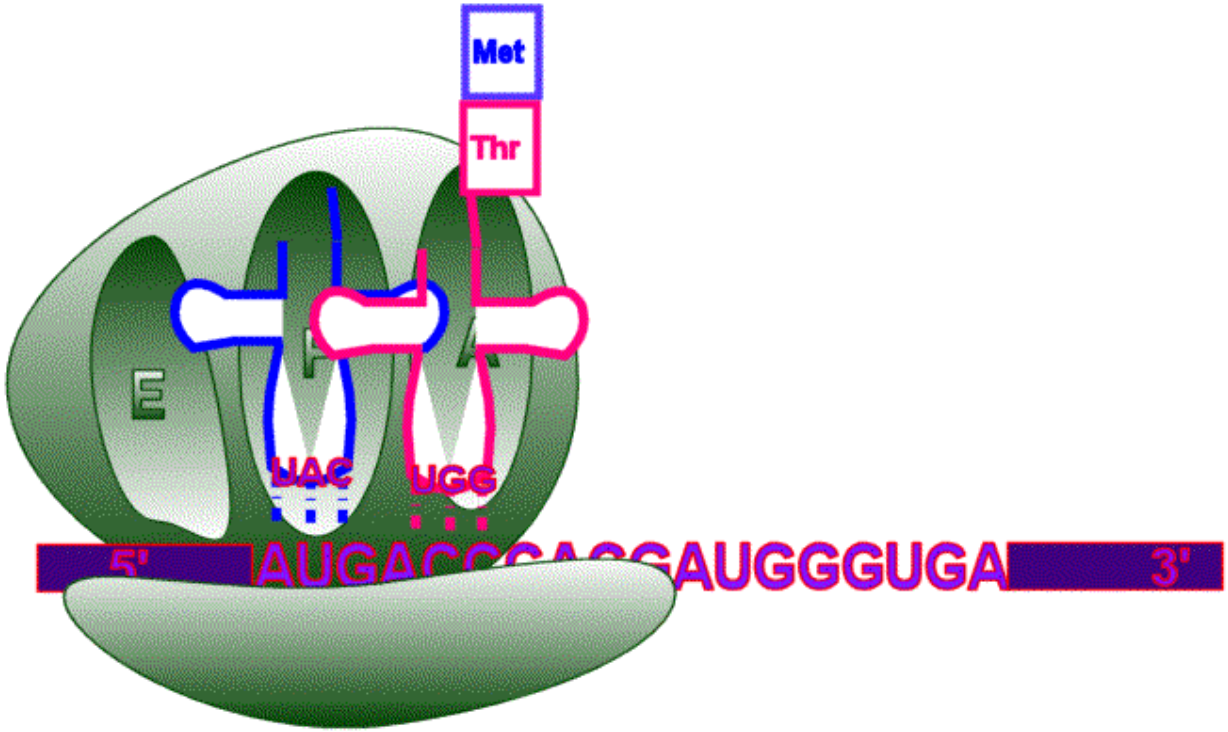




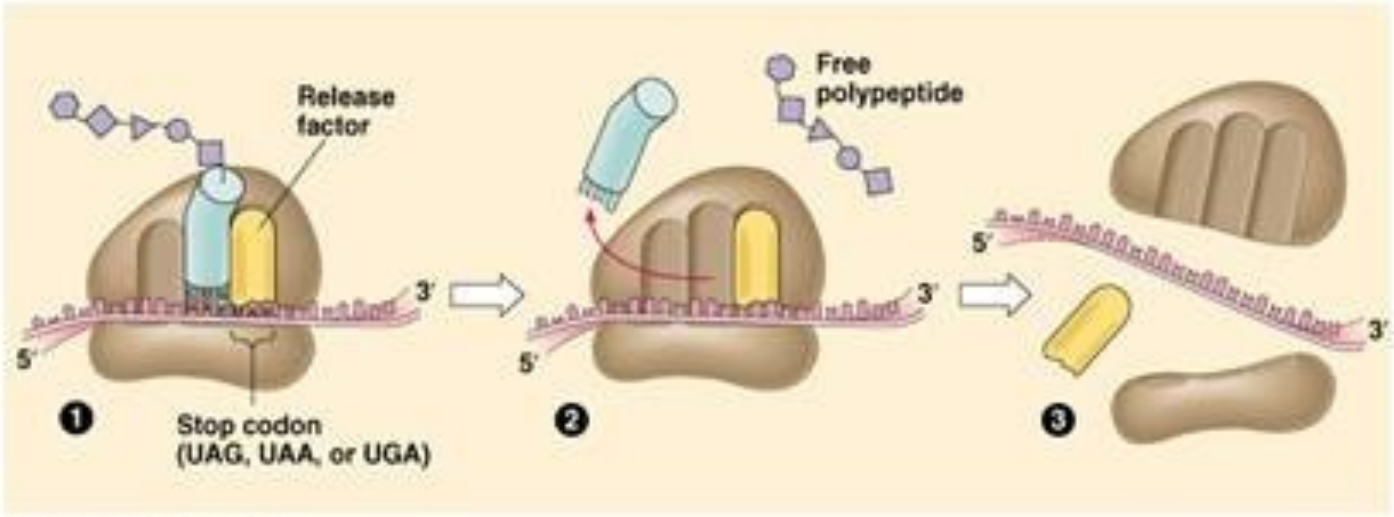
What is happening?



And Now?



What is the role of the Yellow structure in the figure?



- D.B.Q. —> pg 369 and pg̀ 371
- Questions 372 # 2 and 3