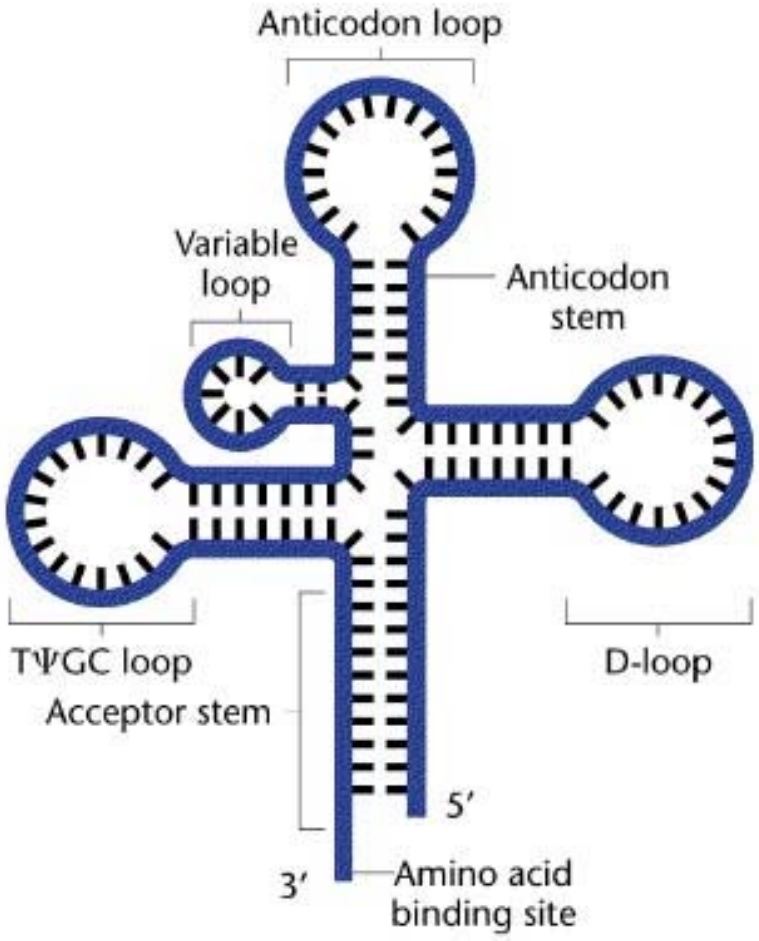
# Translation

# From RNA to Protein

# Nucleic Acid to Protein




- How does the information in codons of mRNA get translated into amino acids in polypeptides?
- Through adapter molecules: tRNA
- tRNA has anticodon that base pairs with the codon in mRNA and carries an amino acid corresponding to that codon.

# Transfer RNAs (tRNAs)

Any cell contains different types of tRNA molecules sufficient to incorporate all 20 amino acids into protein.

Some tRNAs can recognise more than one codon.

Short, about 80 nucleotides in length.

Complex secondary and tertiary structures.

Folding follows rules – complementary base pairs

Stems and loops

Contain non-standard base pairs

Contain modified bases

# Post-transcriptional processing of tRNA

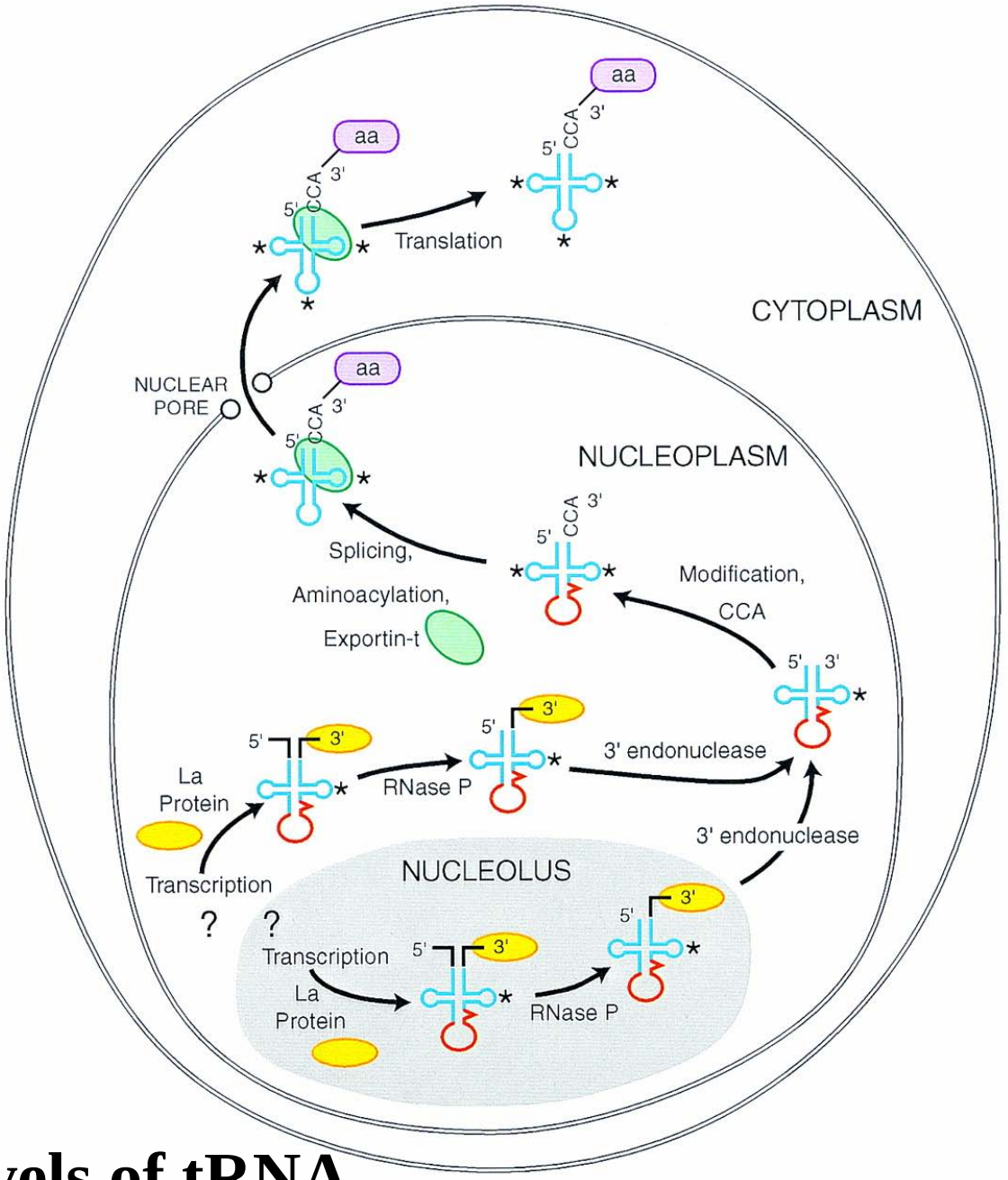
Removal of introns

Separation of multiple tRNAs

Processing of the 5’ (RNaseP), addition of 3’ CCA

Base modification

- Methylation
- Deamination
- Reduction




# The trials and travels of tRNA

# What is the correspondence between the mRNA nucleotides and the amino acids of the protein?

Proteins are formed from 20 amino acids in humans.

**Codons of one nucleotide:**

**A**
**G**
**C**
**U**

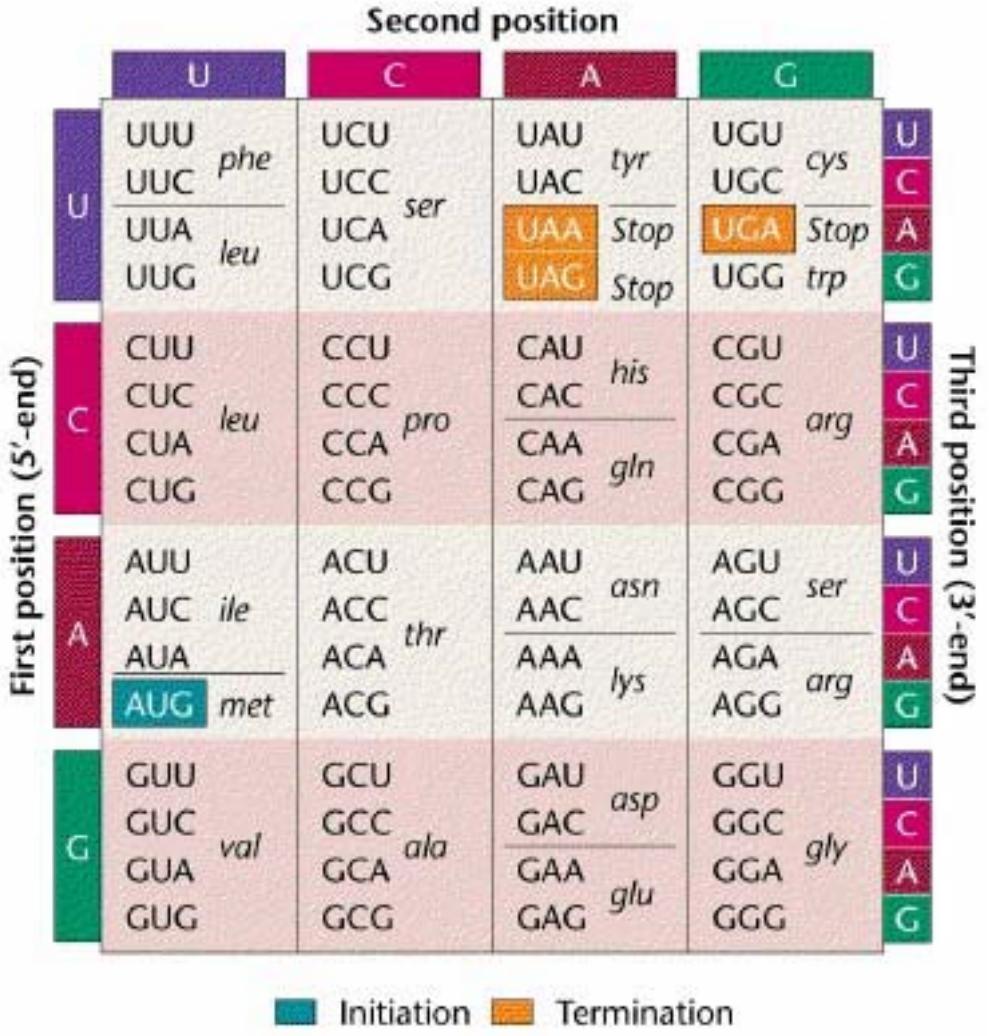
**Can only encode 4 amino acids**

**Codons of two nucleotides:**

**AA GA CA UA**
**AG GG CG UG**
**AC GC CC UC**
**AU GU CU UU**

**Can only encode 16 amino acids**

# Note that 3rd Base Position is Variable




The genetic code is nearly universal.

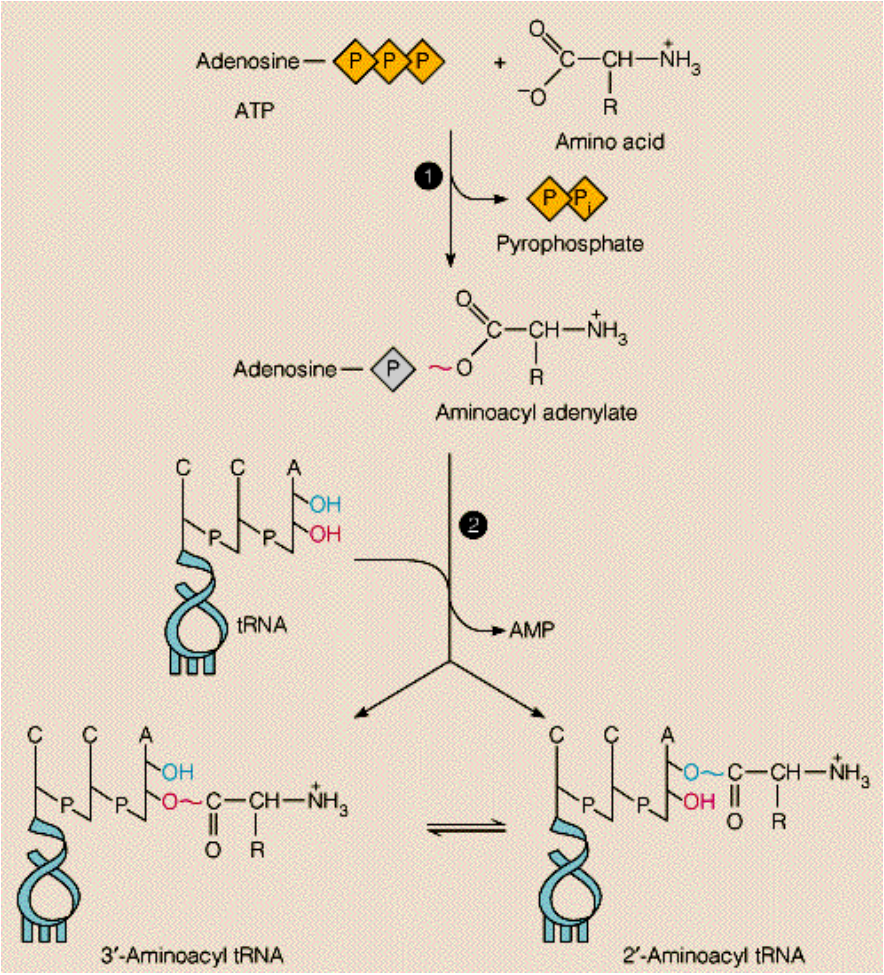
Exceptions:

yeast mitochondria

*Tetrahymena*

*Mycoplasma*

# Coupling of amino acids to tRNAs

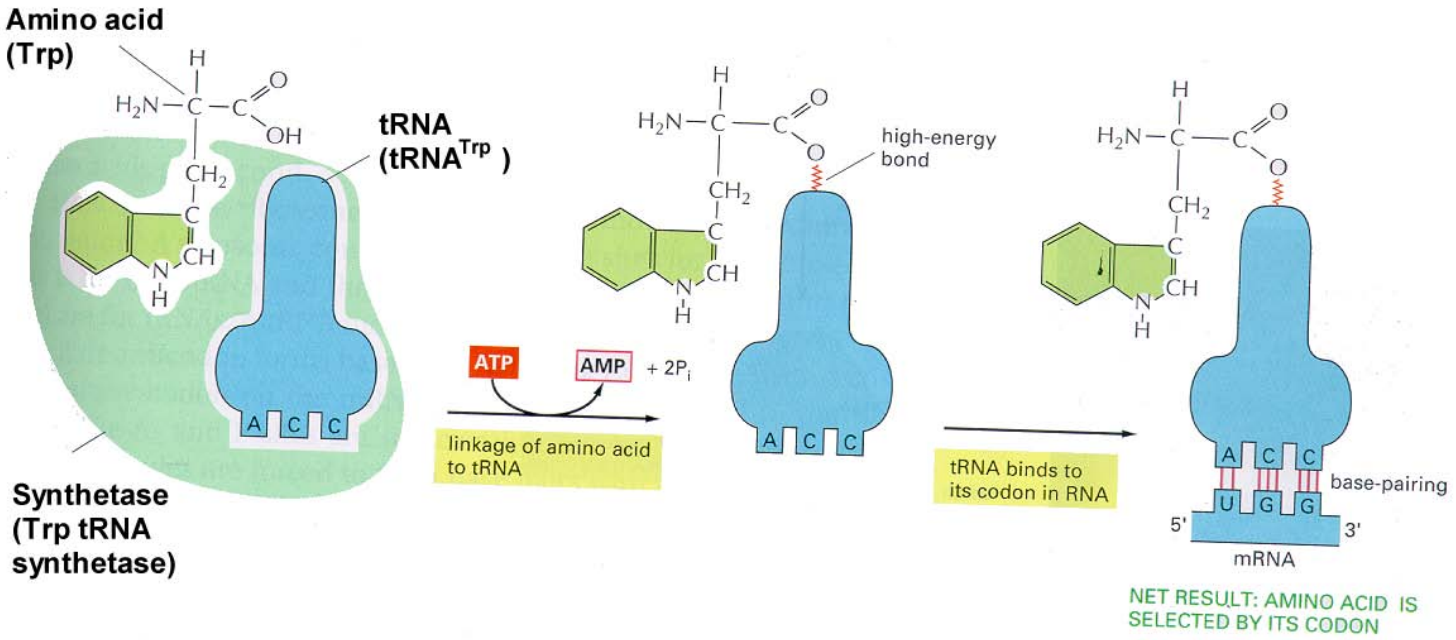



1. The amino acid is accepted by the aminoacyl-tRNA synthetase enzyme and is adenylated

2. The proper tRNA is accepted by the enzyme and the amino acid residue is transferred to the 2’ or 3’ OH of the 3’-terminal residue of the RNA

All reactions occur on the synthetase enzyme.

# The Two Steps of Decoding




The genetic code is translated by means of two adaptors that act one after another.

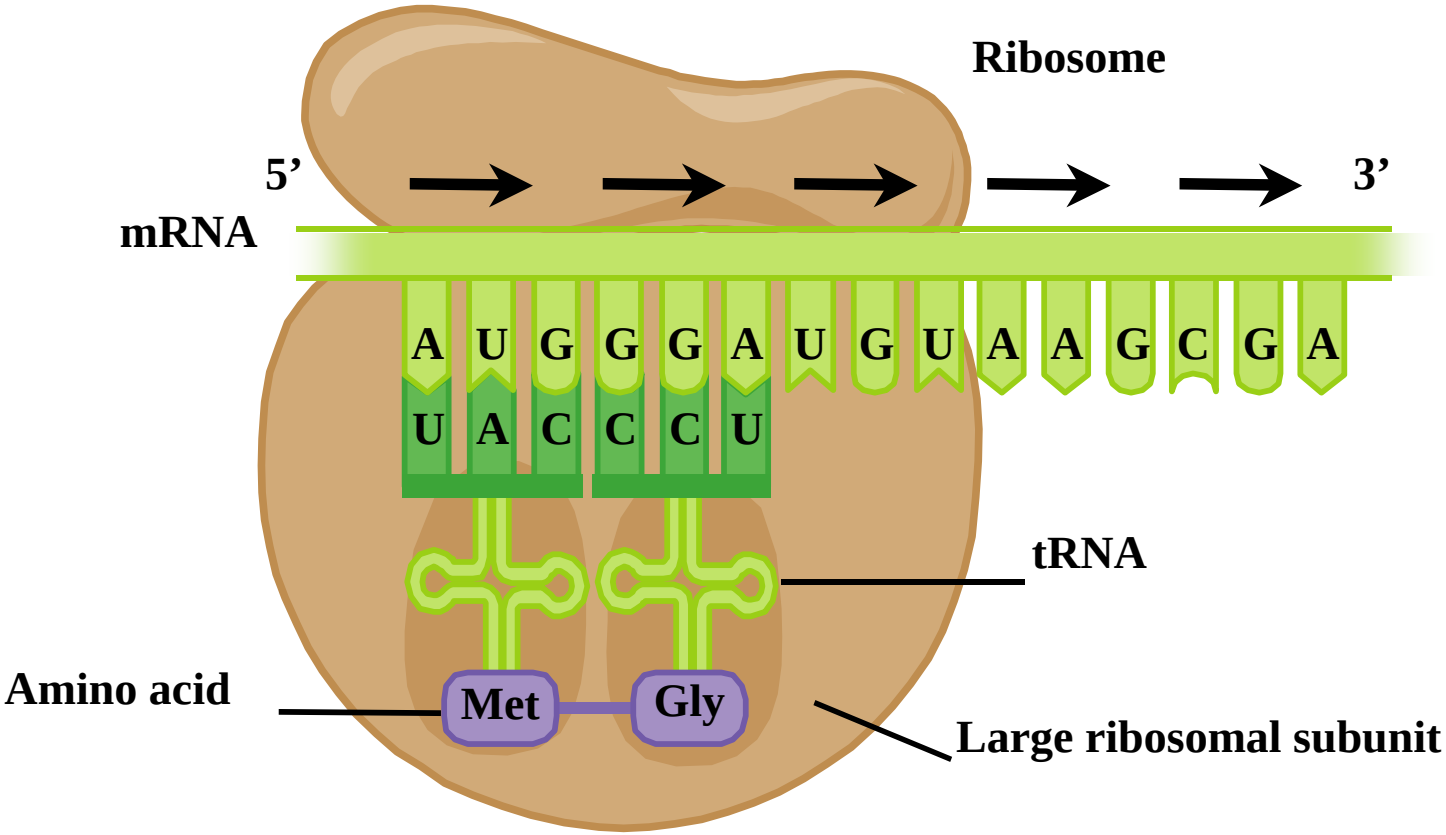
# Translation – where all the guys from the last hour come together…

Initiation - translation begins at start codon
(AUG methionine)

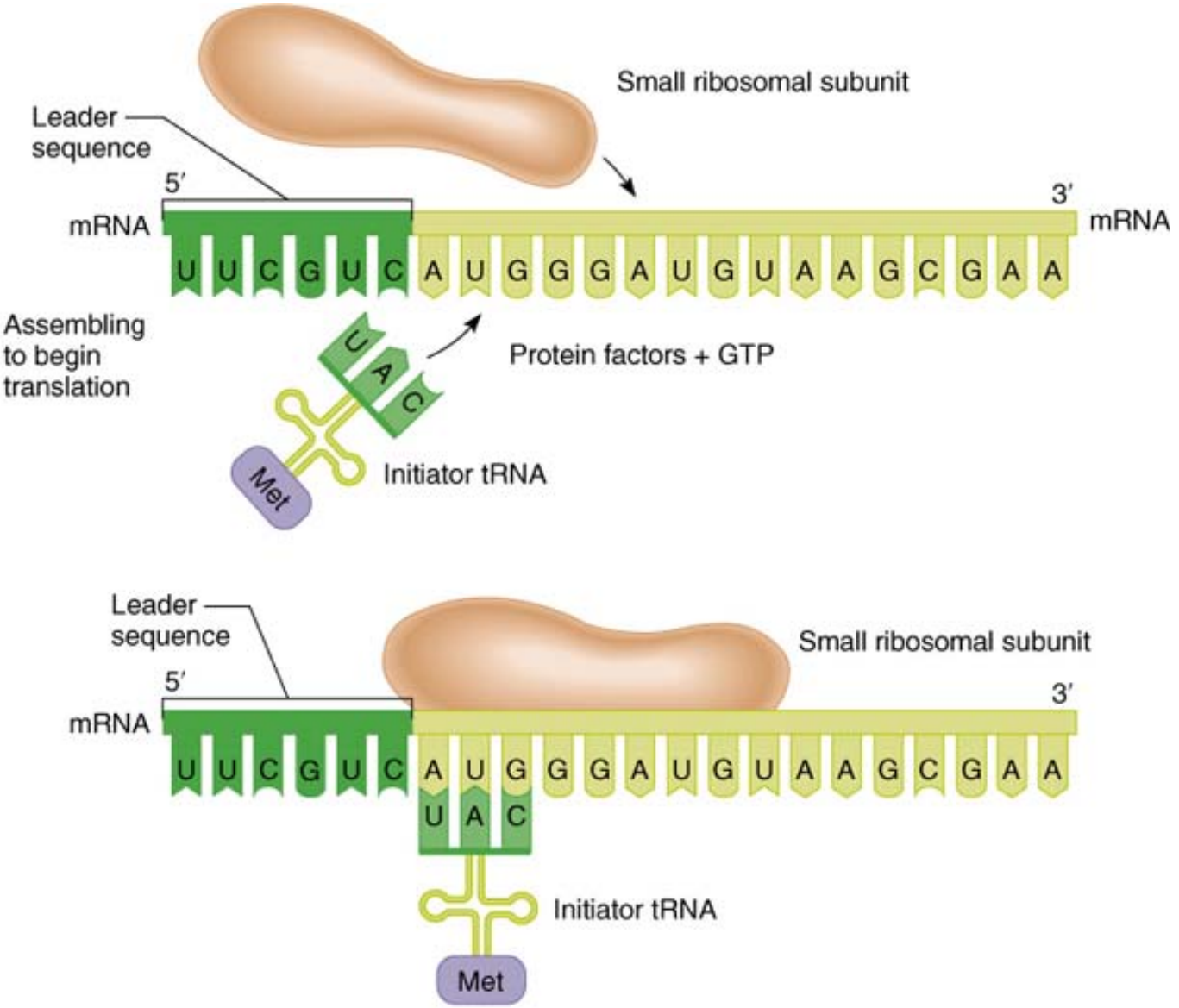
Elongation - the ribosome uses the tRNA anticodon to match codons to amino acids and adds those amino acids to the growing peptide chain

Termination - translation ends at the stop codon
UAA, UAG or UGA

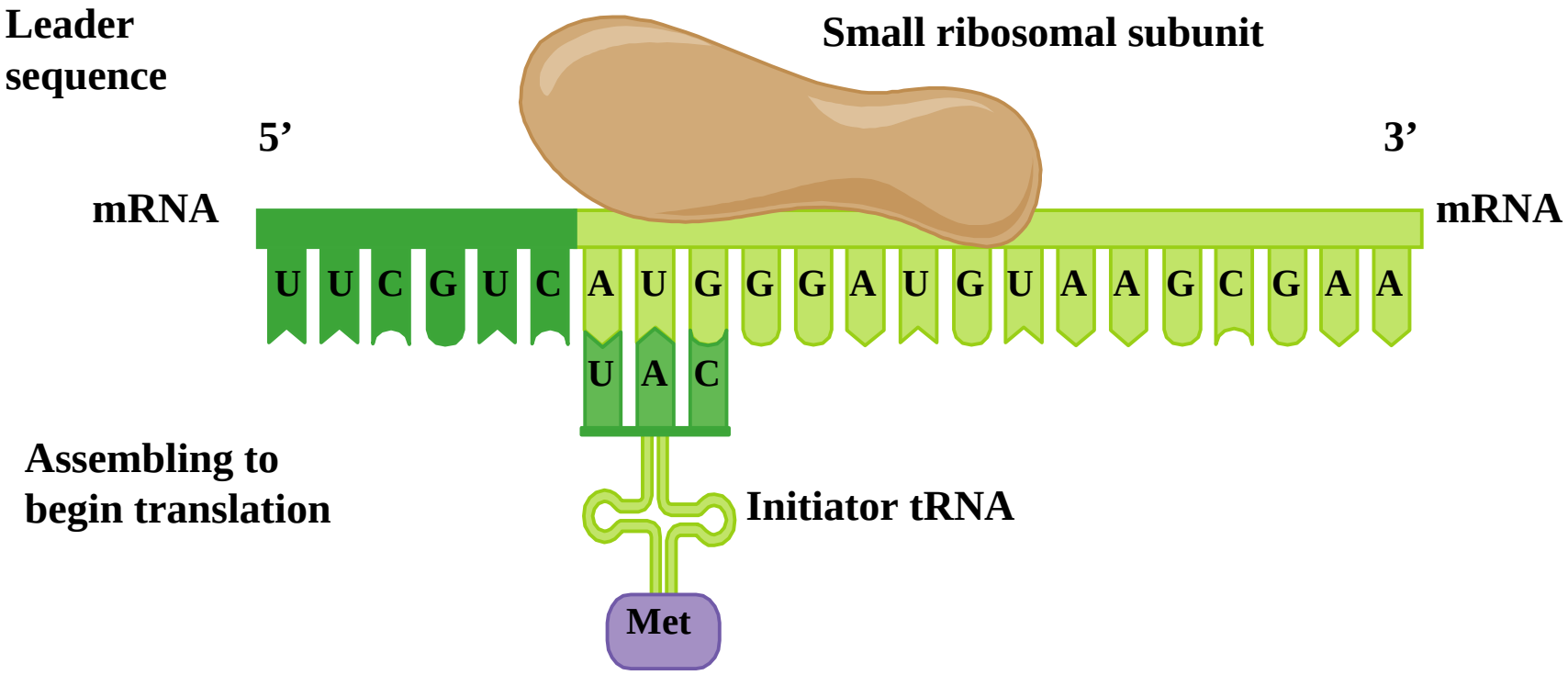
# Translation Elongation



# Translation initiation



# Translation initiation



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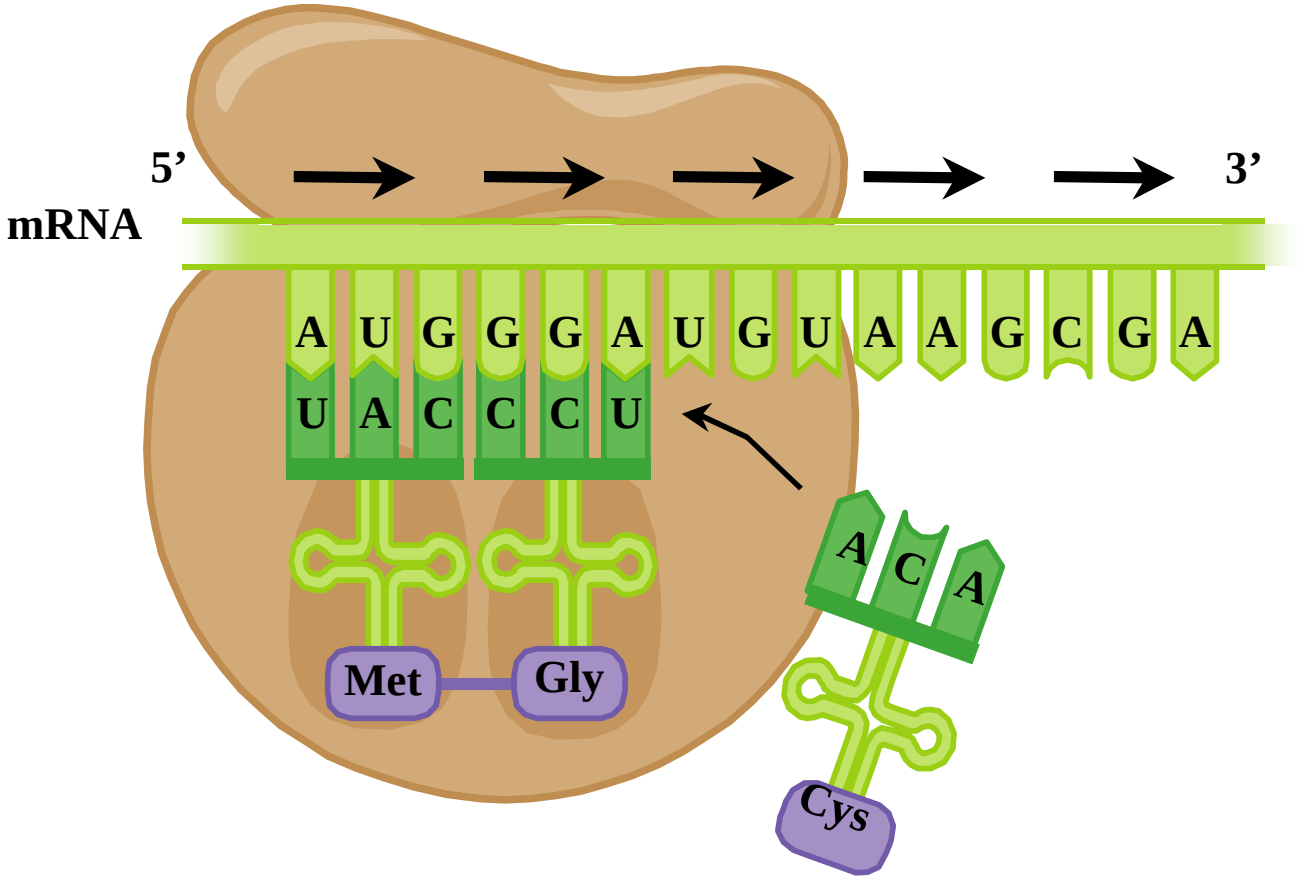

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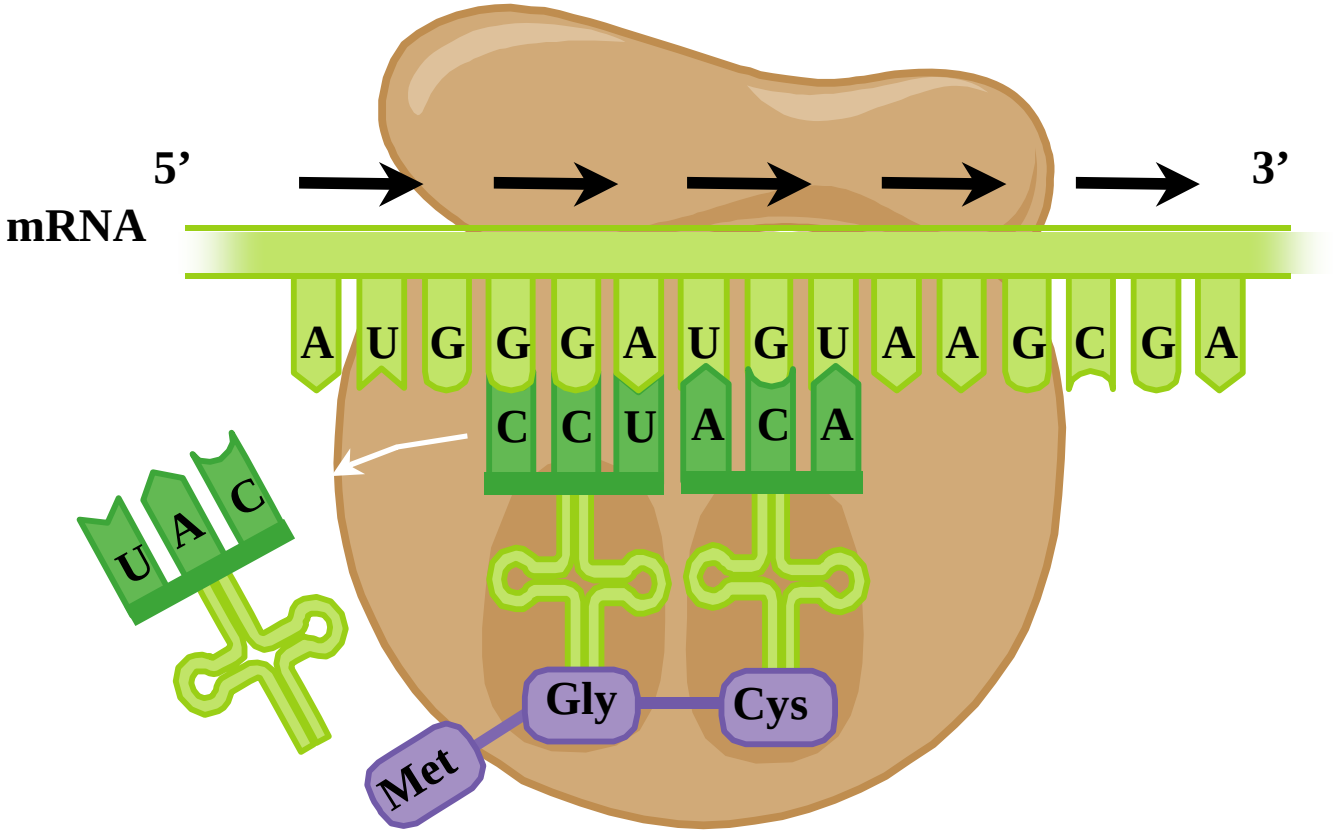

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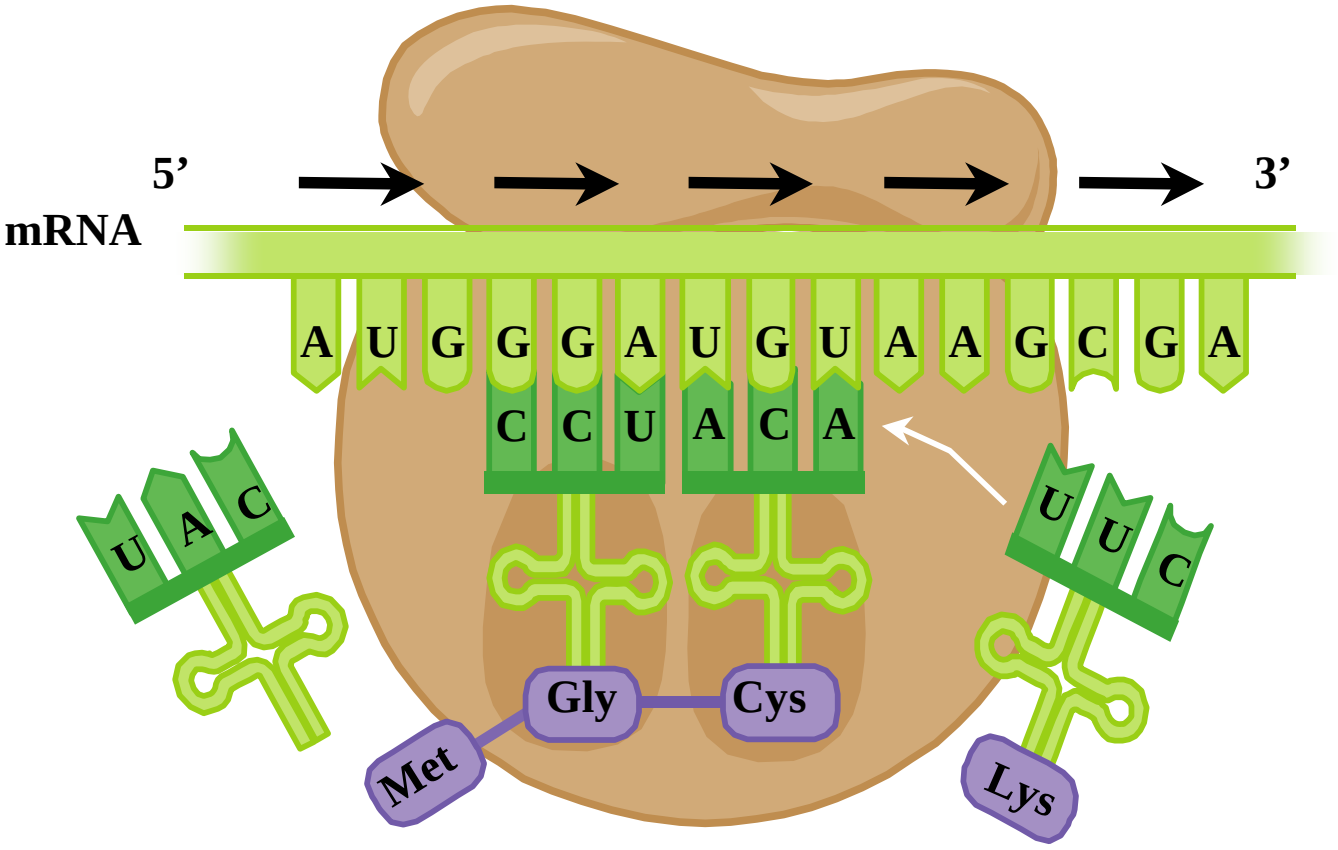

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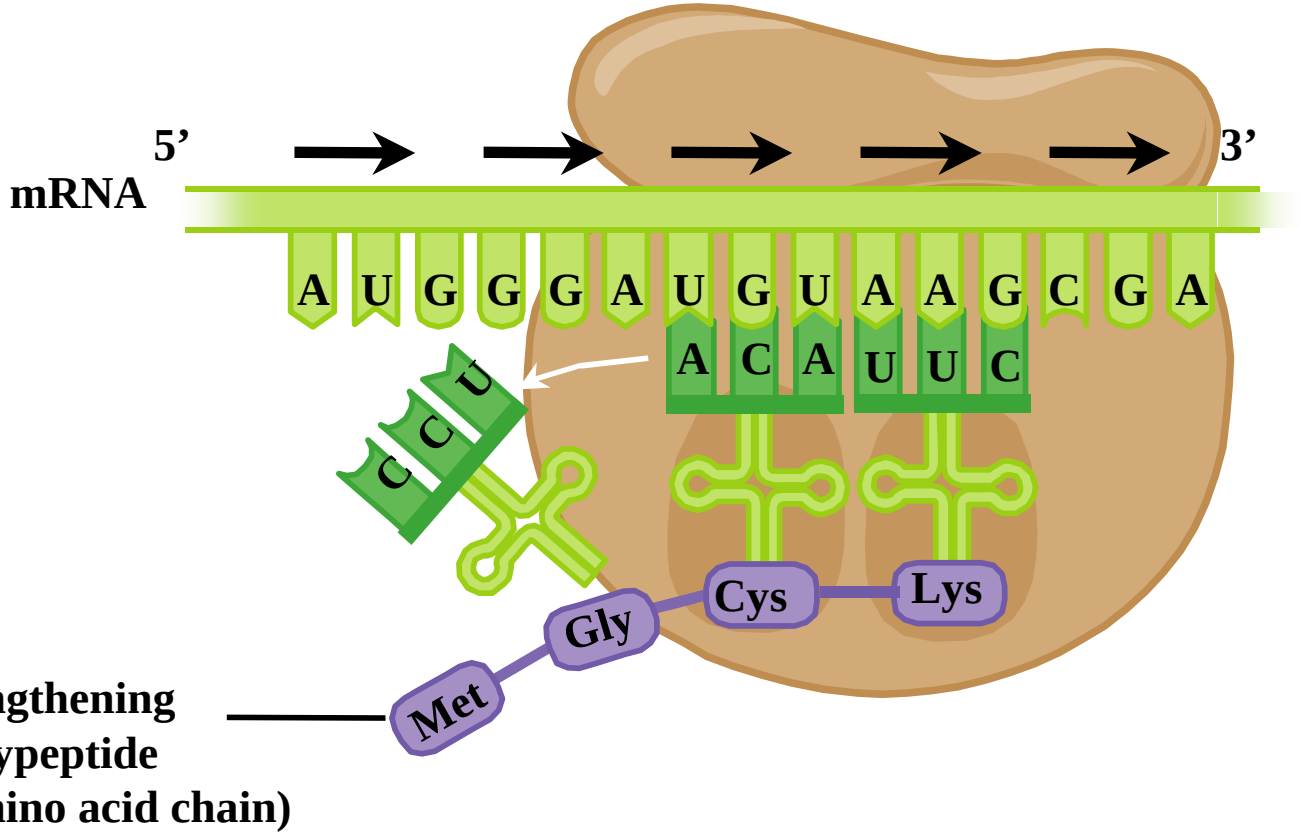

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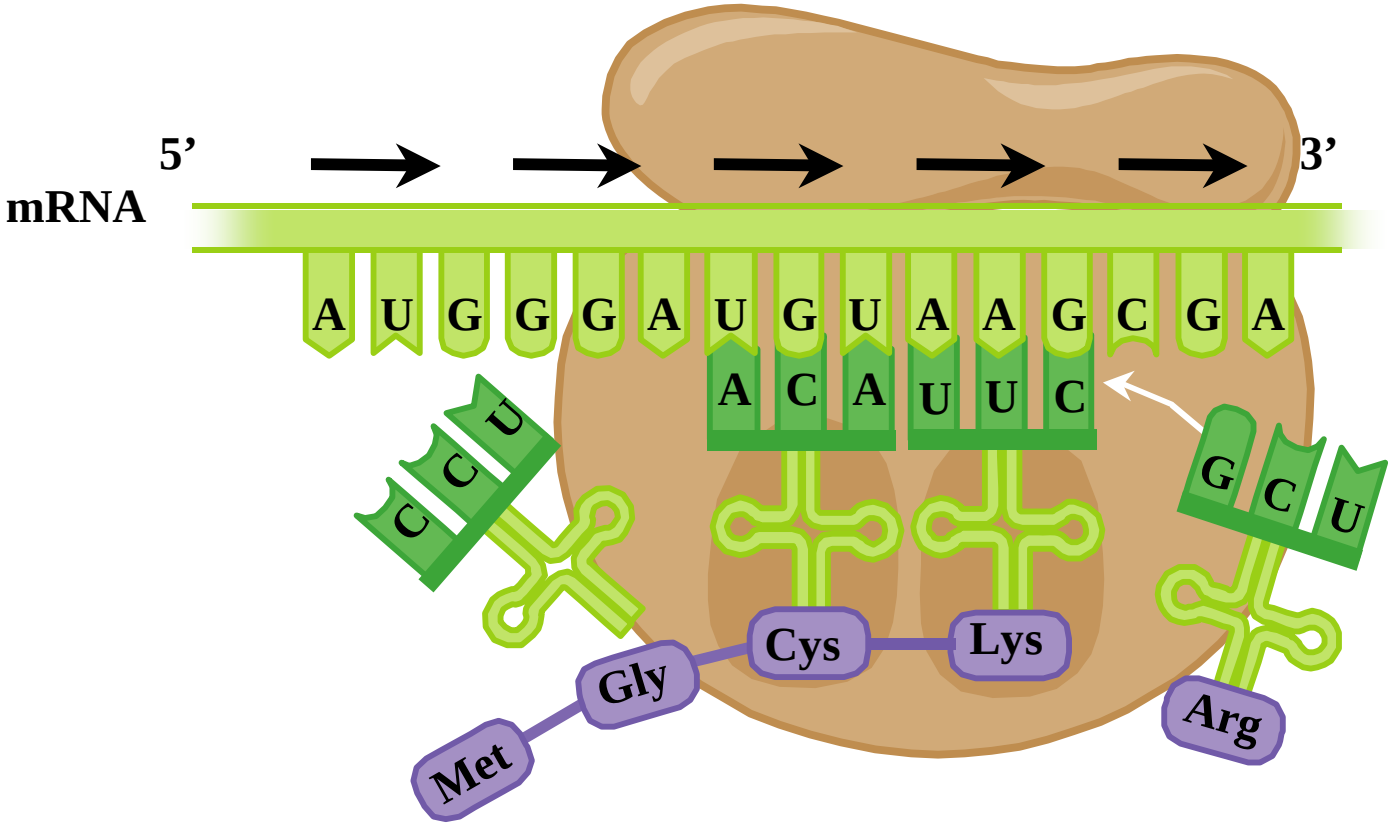

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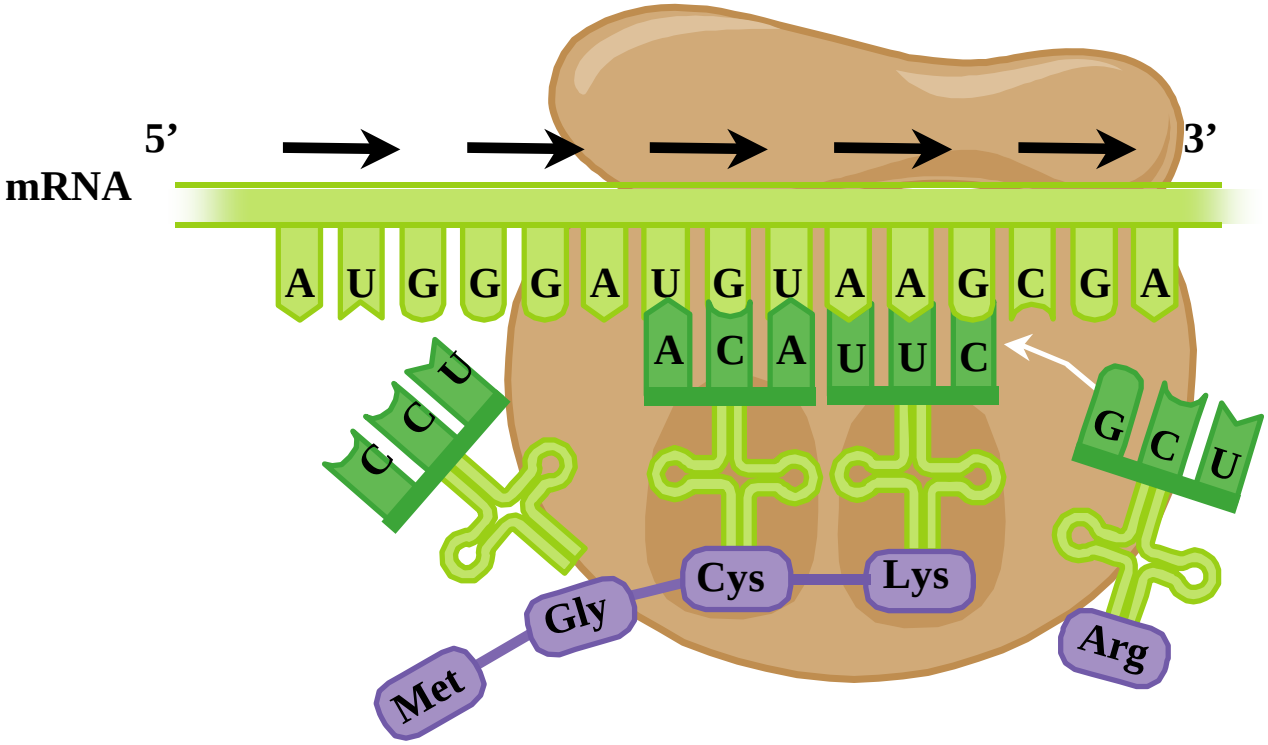

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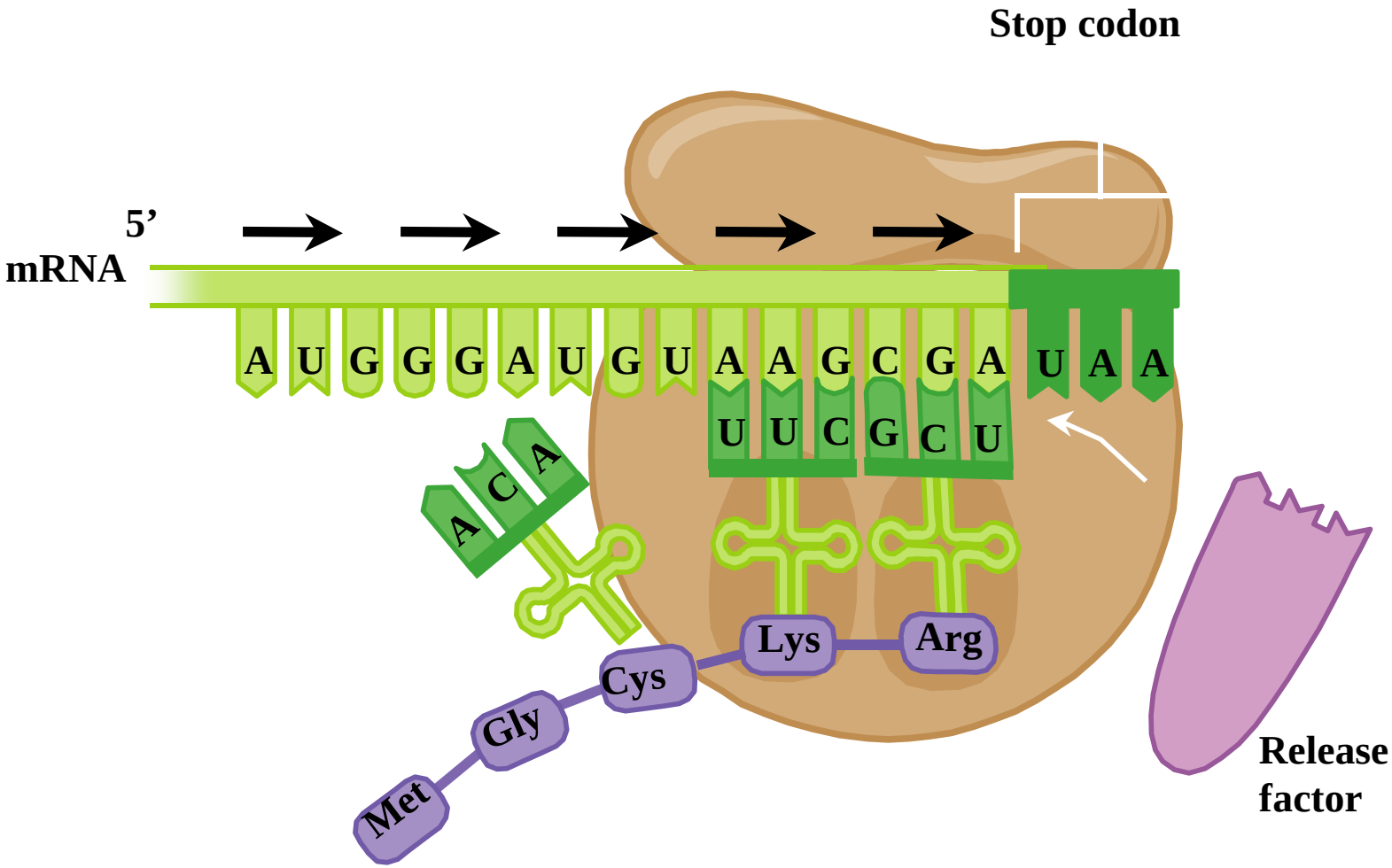

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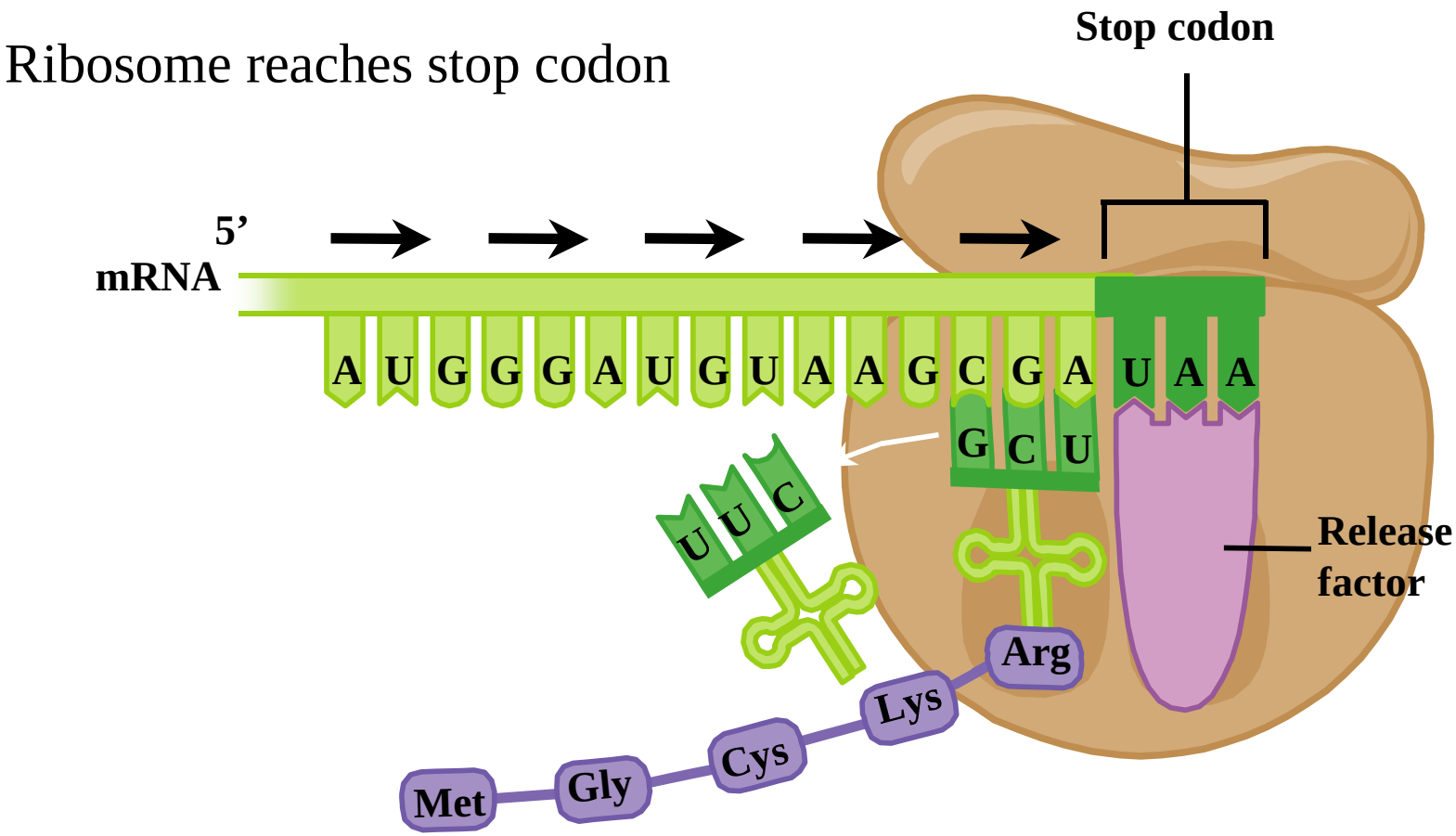
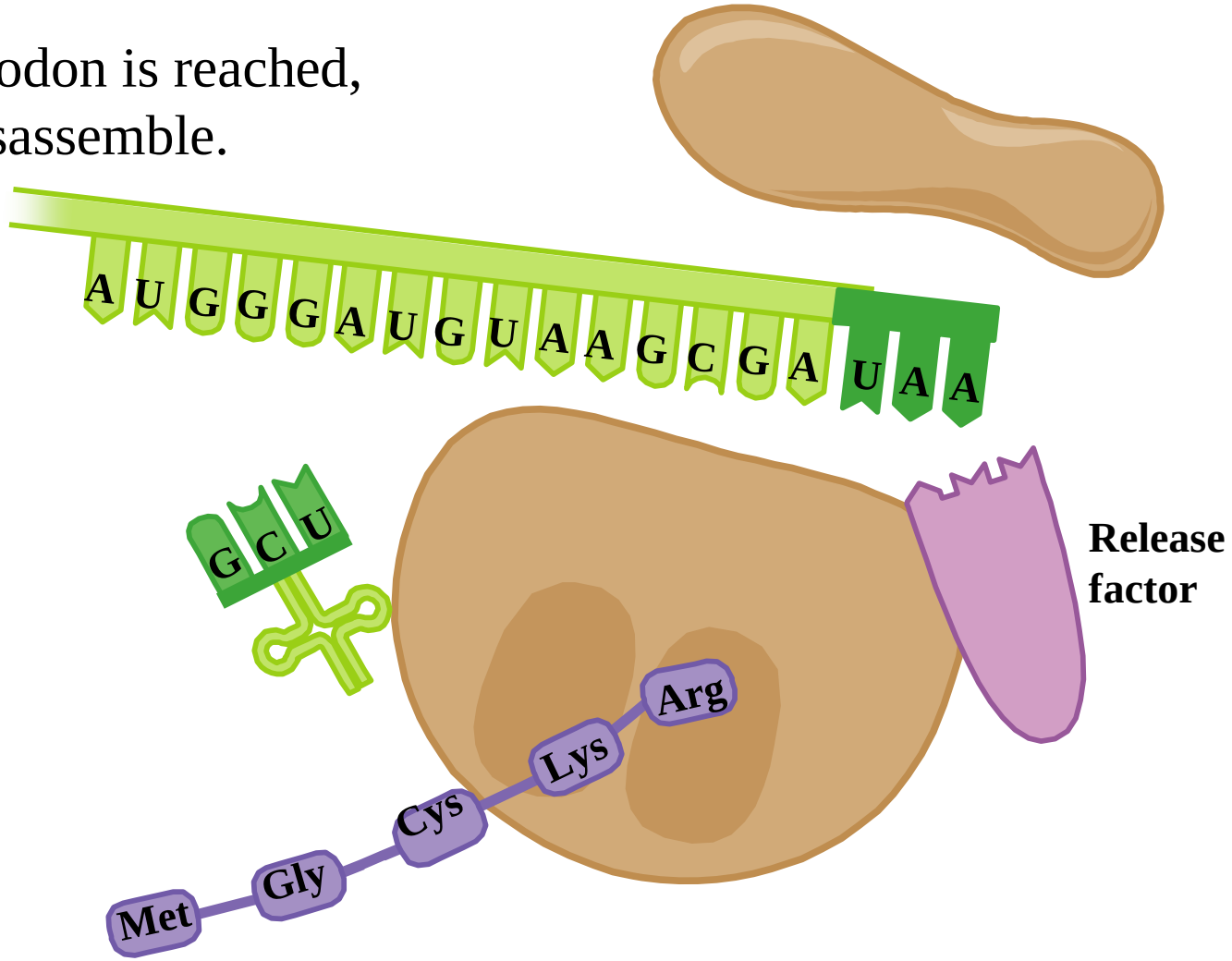


# Translation Termination

Once stop codon is reached, elements disassemble.



# Translation: multiple copies of a protein are made simultaneously