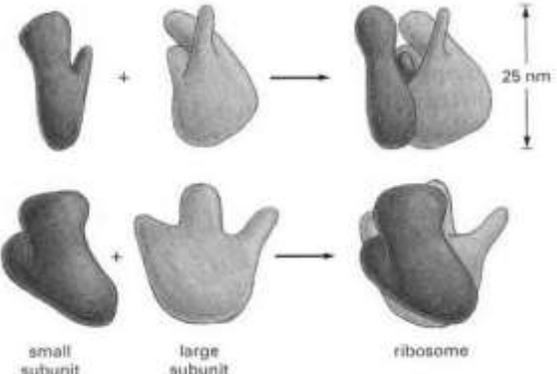


the nitty gritty of ...

# Translation

Translation occurs at the ribosome:

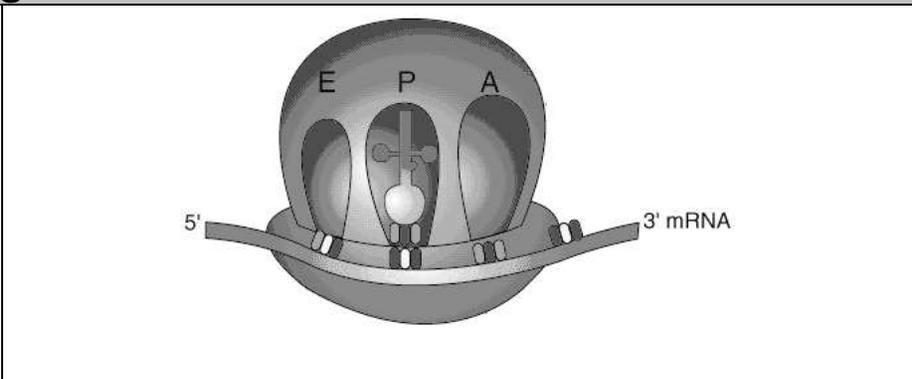
Structure	Location
<ul style="list-style-type: none"><li>• Ribosome is made of rRNA (ribonucleic acid) and protein enzymes</li><li>• Ribosome's are composed of two subunits<ul style="list-style-type: none"><li>○ In <i>E. coli</i>, the small subunit is composed of 21 proteins and one RNA molecule and the large subunit is composed of 35 proteins and two RNA molecules</li></ul></li></ul>  <p>small subunit      large subunit      ribosome</p>	<ul style="list-style-type: none"><li>• Ribosomes that synthesize proteins for use within the cell are suspended in the cytoplasm.</li><li>• Ribosomes that synthesize proteins destined for:<ul style="list-style-type: none"><li>○ secretion (by exocytosis)</li><li>○ the plasma membrane (e.g., cell surface receptors)</li><li>○ lysosomes</li></ul>are attached to the <b>endoplasmic reticulum</b>. As the polypeptide is synthesized, it is extruded into the interior of the ER. Then, before these proteins reach their final destinations, they undergo a series of processing steps in the Golgi apparatus.</li></ul>

## Binding Sites

The mRNA attaches to the small ribosomal subunit in the "mRNA binding site"

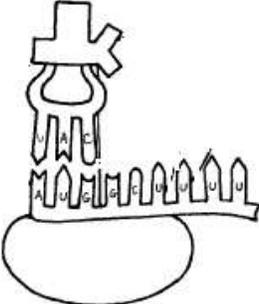
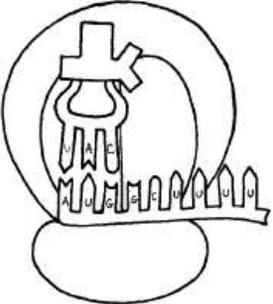
The large ribosomal subunit has three tRNA binding sites:

- The A site is where the tRNA bringing in the next amino acid is positioned
- The P site is where the tRNA holding the polypeptide chain is positioned
- The E (exit) site is where tRNA's that have given up their amino acid to the growing chain leave the ribosome

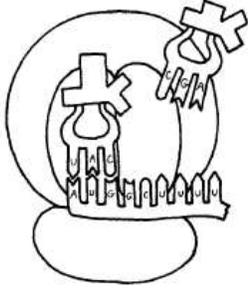
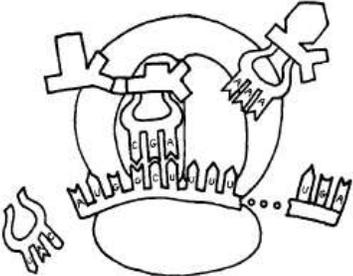


# Steps of Translation

## STEP 1: INITIATION

<p>1. The mRNA moves from the nucleus to the ribosome via the nuclear pore</p>	<p>2. The small ribosomal subunit binds to the mRNA at the start codon. The mRNA codon for the start of protein synthesis is AUG, which codes for the amino acid methionine (met)</p>	<p>3. The tRNA with the complementary anti-codon bonds to the mRNA-small ribosomal subunit complex.</p> 	<p>4. The large ribosomal subunit then binds, forming a functional ribosome.</p> 
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## STEP 2: ELONGATION

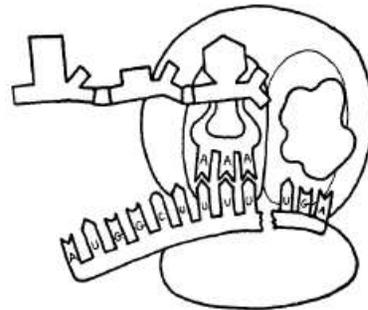
<p><b>Codon recognition</b></p> <ol style="list-style-type: none"> <li>mRNA codon in the A site</li> <li>tRNA with complementary ANTI-CODON hydrogen bonds to the codon in the A site</li> <li>the tRNA brings the appropriate amino acid to the ribosome</li> </ol> 	<p><b>Bond formation</b></p> <ol style="list-style-type: none"> <li>The large ribosomal subunit makes a peptide bond (a type of covalent bond) between the amino acid in the A site and the amino acid in the P site.</li> <li>The mRNA molecule is read and new amino acids are added in the 5' → 3' direction</li> </ol>	<p><b>Translocation</b></p> <ol style="list-style-type: none"> <li>The ribosome moves towards the 3' end of the mRNA strand</li> <li>Because of the move of the ribosome, what there is a shift in the tRNA bindings site (A → P → E)</li> <li>tRNA leaves the ribosome from the E site</li> </ol> 
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How does the tRNA “know” which amino acid to bring to the ribosome?

**STEP 3: TERMINATION**

9. Adding of amino acids to the polypeptide chain continues until there is a STOP codon on the RNA (UAA, UGA, or UAG)

10. A “release factor” binds to the stop codon and releases the amino acid chain.



11. The ribosome dissociates into the two subunits and the amino acid chain can now fold into its secondary, tertiary and/or quaternary structure to become a functional protein!

