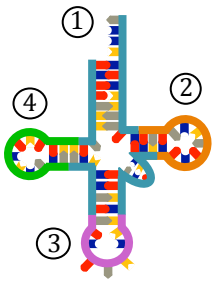
7.3 Translation

Translation Components

Identify the following sites on a tRNA molecule and describe their function



1. Acceptor stem - carries the amino acid
2. T arm - associates with the ribosome (via E, P, A sites)
3. Anticodon - associates with mRNA (via complementary codon)
4. D arm - associates with tRNA-activating enzyme

Describe the process by which amino acids are attached to tRNA molecules

Each tRNA molecule carries a specific amino acid (designated by the codon / anticodon)

Hence, different tRNA molecules associate with specific tRNA-activating enzymes

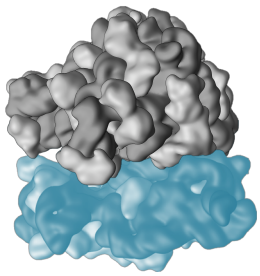
- Enzyme binds ATP to an amino acid (forming a 'charged' amino acid-AMP complex)
- The charged complex is then transferred to the tRNA acceptor stem (and AMP is released)
- The purpose of 'charging' the molecule is to provide the energy needed in translation for peptide bonds

Outline the structure of ribosomes

Ribosomes are composed of a large and a small subunit (made of protein and rRNA)

The small subunit binds to mRNA

The large subunit contains three tRNA binding sites (E, P and A)



Differentiate between the following types of ribosomes

Prokaryotic vs Eukaryotic:

Prokaryotic ribosomes are smaller than eukaryotic ribosomes

Prokaryote = 70S ribosomes ; Eukaryote = 80S ribosomes

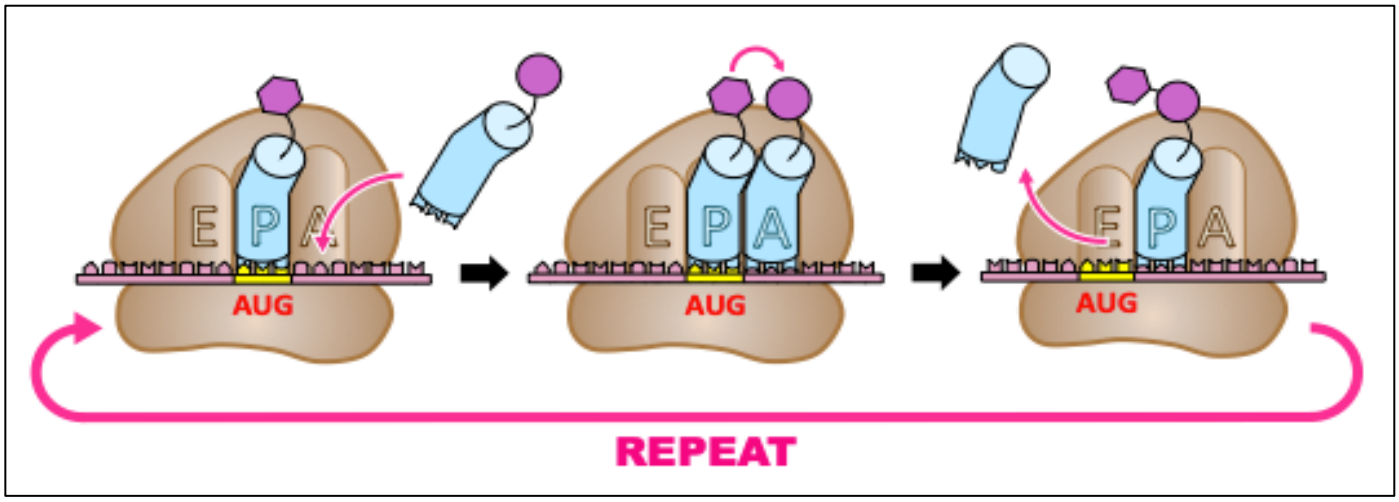
Bound (ER) vs Free (Cytosolic):

Proteins synthesised by bound ribosomes have different destinations to those synthesised by free ribosomes

ER bound ribosomes = Secretory proteins (or lysosome) ; Free ribosomes = Intracellular proteins

Translation Process

Explain, with the aid of the following diagram, the process of translation



Initiation:

Small ribosomal subunit binds to mRNA and moves along it in a 5' - 3' direction until the START codon (AUG)

Specific tRNA (carrying Met) binds to the START codon (via complementary anticodon)

Large ribosomal subunit binds to the tRNA molecule (via the P-site), completing the ribosome

Elongation:

Another tRNA molecule binds to the next codon in the mRNA sequence (via the ribosomal A-site)

The ribosome transfers the amino acid in the P-site to the amino acid in the A-site (via a peptide bond)

Translocation:

Ribosome moves one codon position along the mRNA sequence (in a 5' - 3' direction)

Deacylated tRNA molecule moves to E-site and is released, while tRNA in the A-site moves to the P-site

A new tRNA enters the empty A-site and the elongation and translocation stages are continually repeated

Termination:

The ribosome reaches a STOP codon and a releasing factor is recruited

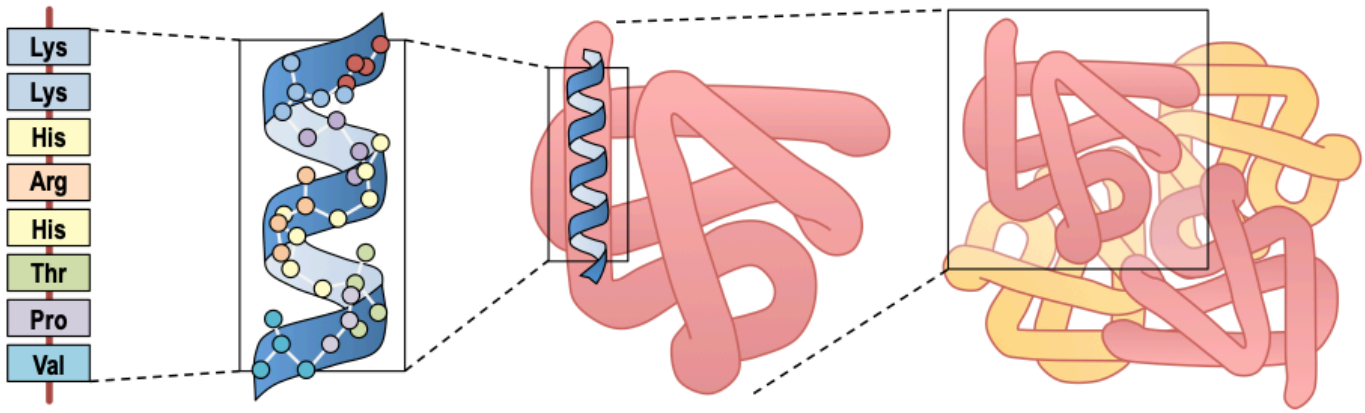
This causes the completed polypeptide chain to dissociate and the ribosome to disassemble

Define polysome

A polysome is a group of ribosomes moving along an mRNA sequence simultaneously

Protein Structure

Explain, with the aid of the diagram, the levels of protein structure and indicate their significance



Primary Structure:

The order / sequence of amino acids within a polypeptide chain

Formed via peptide bonds between the amine and carboxyl groups of adjacent amino acids

Primary structure determines all subsequent levels of protein structure

Secondary Structure:

The folding of a polypeptide chain into repeating arrangements (alpha helices or beta-pleated sheets)

Formed via hydrogen bonds between the amine and carboxyl groups of non-adjacent amino acids

Tertiary Structure:

The overall three dimensional shape of the polypeptide chain

Formed via a variety of bonds / interactions between the variable side chains (R groups)

These interactions may include hydrogen bonds, ionic bonds, disulphide bridges or hydrophobic interactions

Quaternary Structure:

The presence of multiple polypeptides or prosthetic groups to form a biologically active protein

Not all proteins will have a quaternary structure