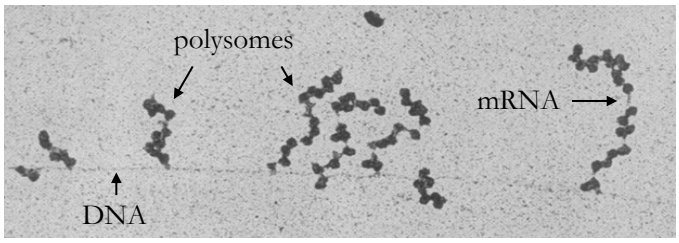
TOPIC 7.3: TRANSLATION

Ribosomes

Ribosomes are the site of polypeptide synthesis (translation)
- They are composed of ribosomal RNA and protein

Ribosomes consist of two subunits:
- Small subunit contains an mRNA binding site
- Large subunit contains three tRNA binding sites (E, P, A)

Multiple ribosomes can translate a single mRNA sequence simultaneously (these are collectively called a **polysome**)



Transfer RNA

Transfer RNA (tRNA) carries amino acids to the ribosome
- Amino acids are attached by tRNA-activating enzymes

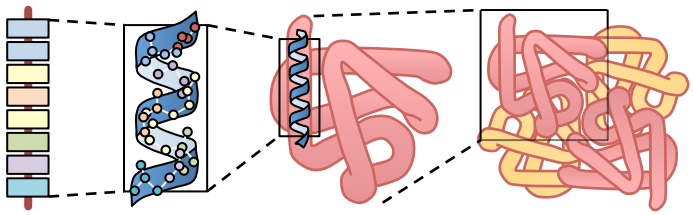
The tRNA-activating enzyme functions in two steps:
- The enzyme joins ATP to an amino acid ('charging')
- 'Charged' amino acid is linked to tRNA (AMP is released)

The purpose of 'charging' the amino acid is to create a high energy bond that can be be used during translation
- Ribosomes use this energy to synthesise peptide bonds

Each tRNA-activating enzyme is specific to a particular amino acid, but may bind multiple tRNA (due to degeneracy)

Protein Structure

Proteins have four levels of structural organisation:
- 1° structure = sequence and number of amino acids
- 2° structure = folding into α-helix or β-pleated sheet
- 3° structure = three-dimensional shape of a polypeptide
- 4° structure = presence of multiple polypeptide chains



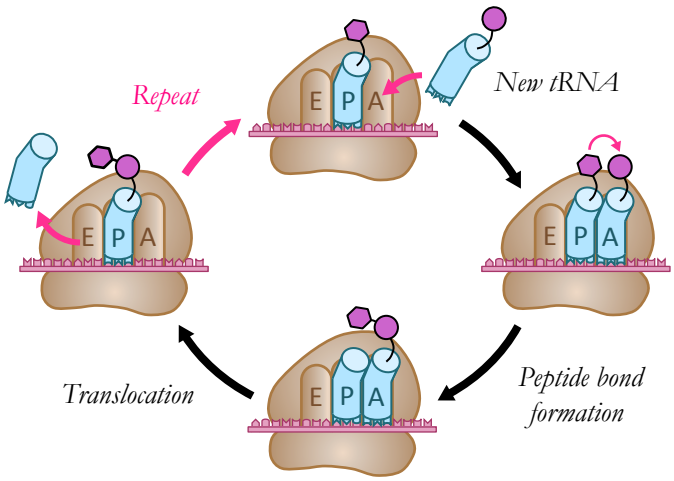
Translation

Translation is the process of polypeptide synthesis and this process involves a repeated cycle of four key events

Initiation *(component assembly)*
- The small ribosomal subunit binds to mRNA and moves in a 5' → 3' direction to the START codon (AUG)
- The complementary tRNA molecule binds to the START codon via its anticodon
- The large subunit aligns itself to the tRNA molecule at its P-site and forms a complex with the small subunit

Elongation / Translocation *(polypeptide synthesis)*
- A tRNA molecule pairs with the next codon (via A-site)
- The ribosome covalently attaches the amino acid in the P-site to the amino acid in the A-site (via peptide bond)
- The ribosome moves along one codon position and the deacylated tRNA molecule is released (from the E-site)
- The elongation and translocation processes continue along the mRNA coding sequence in a 5' → 3' direction

Termination *(component disassembly)*
- When a ribosome reaches a STOP codon, a polypeptide is released and the ribosome disassembles into subunits



Protein Destinations

In prokaryotes, the absence of a nuclear membrane allows translation to occur immediately after transcription

In eukaryotes, translation will occur at one of two locations:
- Free ribosomes *(cytosolic)* synthesise intracellular proteins
- Bound ribosomes *(rER)* synthesise proteins destined for secretion from the cell or for use in lysosomes