RIBOSOMES

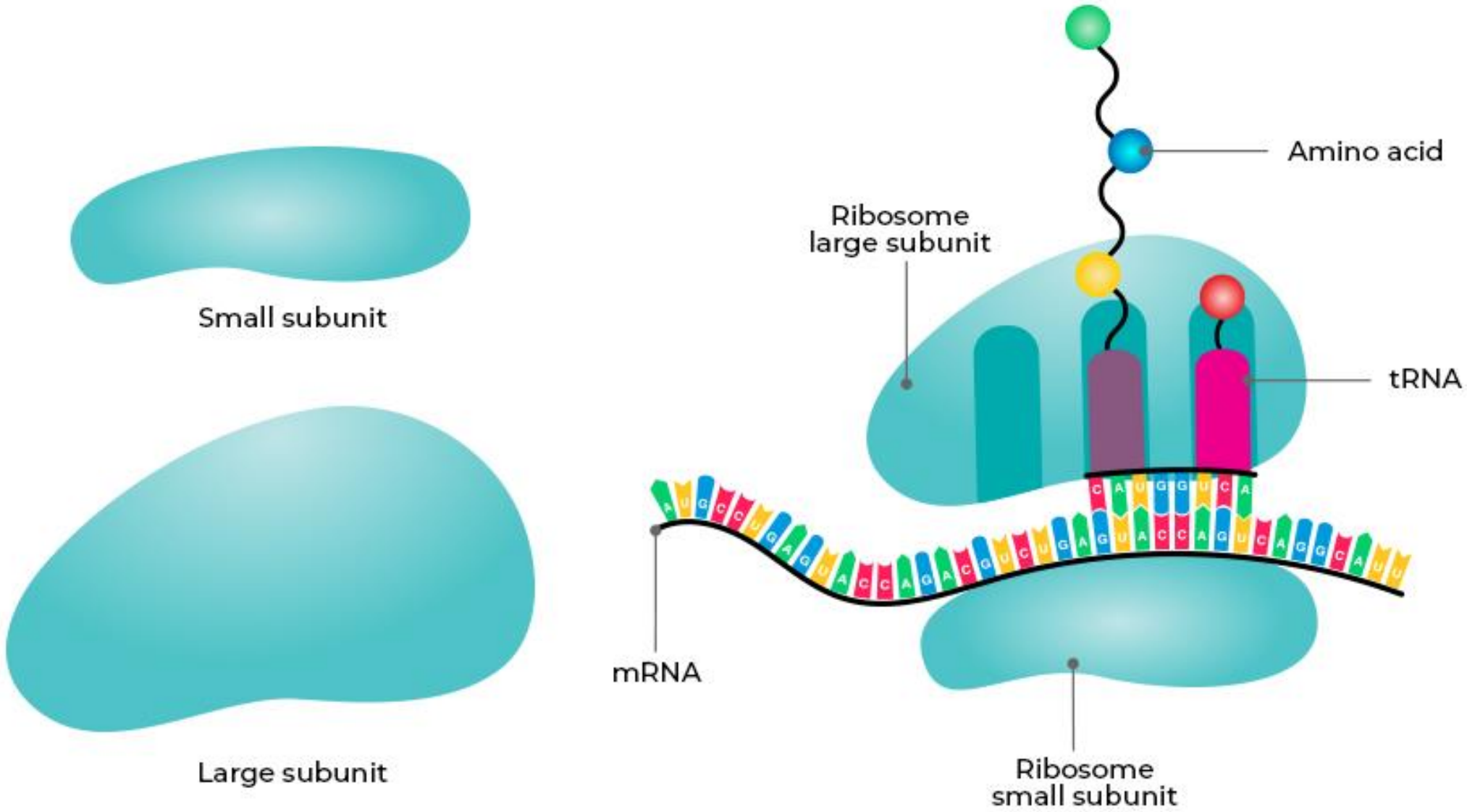
Ribosomes

- Cell contains many tiny granular structures known as ribosomes. Palade (1955) was the first person to study them.
- Ribosomes are essential cellular structures responsible for synthesizing proteins. Found in all living cells, they translate genetic information encoded in mRNA into polypeptides, which then fold into functional proteins. Ribosomes are composed of ribosomal RNA (rRNA) and proteins, and they exist as two subunits that come together during protein synthesis.

Structure

- Ribosomes are made up of two subunits, large and small, each composed of rRNA and ribosomal proteins. The size and composition of these subunits can vary between prokaryotes and eukaryotes:
- Prokaryotic Ribosomes: Prokaryotic ribosomes, also known as 70S ribosomes, consist of a small 30S subunit and a large 50S subunit. The 'S' stands for Svedberg units, a measure of sedimentation rate during ultracentrifugation, which reflects both size and shape.
- Eukaryotic Ribosomes: Eukaryotic ribosomes, or 80S ribosomes, are larger and consist of a 40S small subunit and a 60S large subunit. Eukaryotic ribosomes are more complex, containing more rRNA and proteins than their prokaryotic counterparts.

Structure


Small subunit
Large subunit
Amino acid
Ribosome
large subunit
tRNA
mRNA
Ribosome
small subunit

Functions

- The primary function of ribosomes is to translate mRNA into a specific polypeptide. The process of translation involves several steps:
- **Initiation:** The small ribosomal subunit binds to the mRNA and locates the start codon (AUG). The initiator tRNA, carrying the amino acid methionine, pairs with the start codon.
- **Elongation:** The large subunit joins the small subunit, forming a complete ribosome. As the ribosome moves along the mRNA, each codon is read, and the corresponding tRNA delivers the appropriate amino acid. The ribosome facilitates the formation of peptide bonds between amino acids, elongating the polypeptide chain.
- **Termination:** When a stop codon (UAA, UAG, or UGA) is reached, translation stops. Release factors bind to the ribosome, prompting the release of the newly synthesized polypeptide and dissociation of the ribosomal subunits from the mRNA.

Types

- **1. Free Ribosomes**: Located in the cytoplasm, these ribosomes synthesize proteins that typically function within the cytosol or organelles not associated with membranes.
- **2. Membrane-bound Ribosomes**: Attached to the rough endoplasmic reticulum (RER) in eukaryotic cells, these ribosomes synthesize proteins destined for secretion, incorporation into the cell membrane, or lysosomes.

Ribosomes in Prokaryotes and Eukaryotes

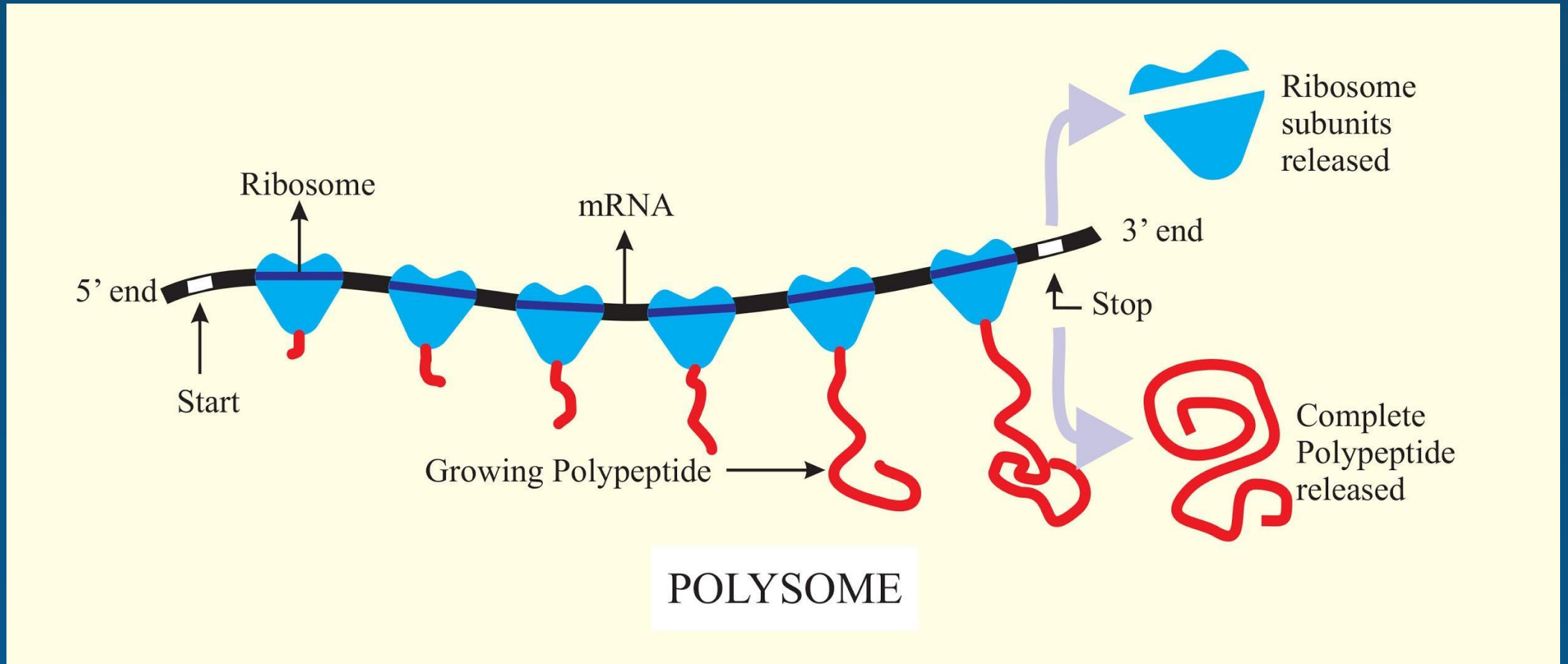
- Prokaryotic and eukaryotic ribosomes differ in structure and size.
- These differences are significant enough to be exploited in antibiotic development.
- Many antibiotics selectively target bacterial ribosomes without affecting eukaryotic ribosomes, thus inhibiting bacterial protein synthesis without harming the host.

Ribosome Biogenesis

- Ribosome assembly is a complex process that occurs in the nucleolus (in eukaryotes).
- Ribosomal proteins and rRNA are synthesized separately and then assembled into subunits.
- The subunits are exported to the cytoplasm, where they combine to form functional ribosomes.

Polysomes

- Polysomes, also known as polyribosomes, are complexes formed by multiple ribosomes simultaneously translating a single mRNA molecule. This structure allows for the efficient production of multiple copies of a protein from a single mRNA transcript.



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