12.4.1 Types of RNA

- There are three main types of RNA, all involved in protein synthesis.
- Messenger RNA (**mRNA**) serves as the intermediary between DNA and the synthesis of protein products during translation.
- Ribosomal RNA (**rRNA**) is a type of stable RNA that is a major constituent of ribosomes. It ensures the proper alignment of the mRNA and the ribosomes during protein synthesis and catalyzes the formation of the peptide bonds between two aligned amino acids during protein synthesis.
- Transfer RNA (**tRNA**) is a small type of stable RNA that carries an amino acid to the corresponding site of protein synthesis in the ribosome. It is the base pairing between the tRNA and mRNA that allows for the correct amino acid to be inserted in the polypeptide chain being synthesized.
- Although RNA is not used for long-term genetic information in cells, many viruses do use RNA as their genetic material.

Messenger RNA

Messenger RNA (mRNA) is synthesized from a gene segment of DNA which ultimately contains the information on the primary sequence of amino acids in a protein to be synthesized. The genetic code as translated is for m-RNA not DNA. The **messenger RNA carries the code** into the cytoplasm where protein synthesis occurs.

Ribosomal RNA

In the cytoplasm, **ribsomal RNA (rRNA)** and protein combine to form a nucleoprotein called a ribosome. **The ribosome serves as the site and carries the enzymes necessary for protein synthesis.** The ribosome is made from two sub units, 50S and 30S. There are about equal parts rRNA and protein. The far left graphic shows the complete ribosome with three tRNA attached.

The ribosome attaches itself to m-RNA and provides the stabilizing structure to hold all substances in position as the protein is synthesized. Several ribosomes may be attached to a single RNA at any time. In upper right corner is the 30S sub unit with mRNA and tRNA attached.

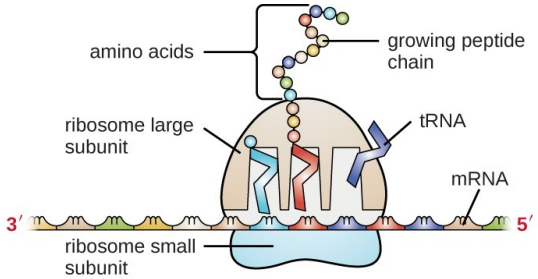

Figure 12.4.1.1: A generalized illustration of how mRNA and tRNA are used in protein synthesis within a cell.

Transfer RNA

Transfer RNA (tRNA) contains about 75 nucleotides, three of which are called anticodons, and one amino acid. **The tRNA reads the code and carries the amino acid to be incorporated into the developing protein.**

There are at least 20 different tRNA's - one for each amino acid. The basic structure of a tRNA is shown in the left graphic. Part of the tRNA doubles back upon itself to form several double helical sections. On one end, the amino acid, phenylalanine, is attached. On the opposite end, a specific base triplet, called the **anticodon**, is used to actually "read" the codons on the mRNA.

The tRNA "reads" the mRNA codon by using its own anticodon. The actual "reading" is done by matching the base pairs through hydrogen bonding following the base pairing principle. Each codon is "read" by various tRNA's until the appropriate match of the anticodon with the codon occurs. In this example, the tRNA anticodon (AAG) reads the codon (UUC) on the mRNA. The UUC

codon codes for phenylalanine which is attached to the tRNA. Remember that the codons read from the mRNA make up the genetic code as read by humans.

References

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2. Sussman, J.L. et al. (1978) "Crystal Structure of Yeast Phenylalanine Transfer RNA I. Crystallographic Refinement" J. Mol. Biol. 123 607.

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