Translation of RNA to Protein

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Translation of RNA to Protein

- Define translation.
- Explain how the RNAs interact during translation.
- Summarize the process of translation.



RNA to proteins. How?

You must translate. To go from one language to another. Spanish to English, French to German, or nucleotides to amino acids. Which type is the translation of molecular biology? Obviously, the type of translating discussed here translates from the language of nucleotides to the language of amino acids.

Translation

Translation is the second part of the central dogma of molecular biology: $RNA \rightarrow Protein$. It is the process in which the genetic code in **mRNA** is read, one **codon** at a time, to make a protein. **Figure** 1.1 shows how this happens. After mRNA leaves the nucleus, it moves to a **ribosome**, which consists of **rRNA** and proteins. The ribosome reads the sequence of codons in mRNA. Molecules of **tRNA** bring amino acids to the ribosome in the correct sequence.

To understand the role of tRNA, you need to know more about its structure. Each tRNA molecule has an **anticodon** for the amino acid it carries. An anticodon is a sequence of 3 bases, and is complementary to the codon for an amino acid. For example, the amino acid lysine has the codon AAG, so the anticodon is UUC. Therefore, lysine would be carried by a tRNA molecule with the anticodon UUC. Wherever the codon AAG appears in mRNA, a UUC anticodon on a tRNA temporarily binds to the codon. While bound to the mRNA, the tRNA gives up its amino acid. Bonds form between adjacent amino acids as they are brought one by one to the ribosome, forming a **polypeptide**

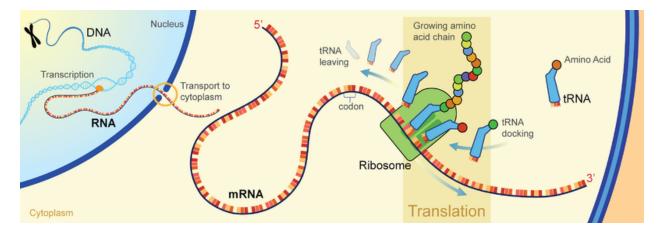


FIGURE 1.1

Translation of the codons in mRNA to a chain of amino acids occurs at a ribosome. Notice the growing amino acid chain attached to the tRNAs and ribosome. Find the different types of RNA in the diagram. What are their roles in translation?

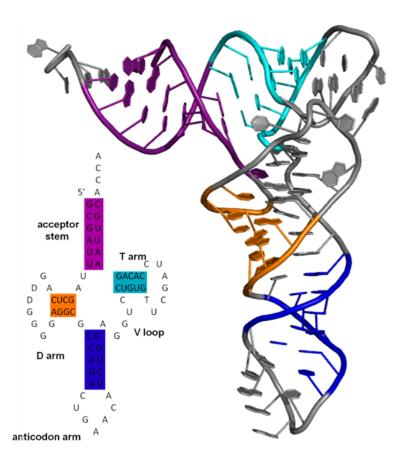


FIGURE 1.2

The tRNA structure is a very important aspect in its role. Though the molecule folds into a *3-leaf clover* structure, notice the anticodon arm in the lower segment of the molecule, with the amino acid attached at the opposite end of the molecule (acceptor stem). It is the anticodon that determines which codon in the mRNA the tRNA will bind to.

chain. The chain of amino acids keeps growing until a stop codon is reached. To see how this happens, go the link below. http://www.youtube.com/watch?v=B6O6uRb1D38 (1:29)

After a polypeptide chain is synthesized, it may undergo additional processes. For example, it may assume a folded shape due to interactions among its amino acids. It may also bind with other polypeptides or with different types of molecules, such as lipids or carbohydrates. Many proteins travel to the Golgi apparatus to be modified for the specific job they will do. You can see how this occurs by watching the animation at this link: http://vcell.ndsu.ed u/animations/proteinmodification/movie-flash.htm .

Summary

- Translation is the $RNA \rightarrow Protein$ part of the central dogma.
- Translation occurs at a ribosome.
- During translation, a protein is synthesized using the codons in mRNA as a guide.
- All three types of RNA play a role in translation.

Making Connections



MEDIA Click image to the left or use the URL below. URL: http://www.ck12.org/flx/render/embeddedobject/115602

Explore More

Explore More I

Use this resource to answer the questions that follow.

- http://www.hippocampus.org/Biology → Non-Majors Biology → Search: Translation
- 1. In addition to the mRNA, translation needs what three components?
- 2. Describe the structure of a ribosome.
- 3. Describe the structure and role of a tRNA molecule.
- 4. Define codon and anticodon.
- 5. How does termination occur?

Explore More II

- Protein Synthesis at http://www.wisc-online.com/Objects/ViewObject.aspx?ID=AP1302 .
- RNA Translation at http://johnkyrk.com/DNAtranslation.html .
- How Do Cells Make Proteins? at http://ca.pbslearningmedia.org/content/lsps07.sci.life.stru.lpbiosystems /#content/4dd2fb6badd2c73bce006585 .
- Transcribe and Translate a Gene at http://learn.genetics.utah.edu/content/begin/dna/transcribe/ .

Review

- 1. Outline the steps of translation.
- 2. Discuss the structure of a tRNA molecule, and its role in translation.
- 3. How are transcription and translation related to the central dogma of molecular biology?

References

- 1. Original image by the National Human Genome Research Institute, redrawn by Mariana Ruiz Villarreal (LadyofHats) for CK-12 Foundation. DNA transcription to mRNA, which translates to a chain of amino acids at a ribosome . CC BY-NC 3.0
- 2. Kyle Schneider. Structure of tRNA . Public Domain