

Study Guide for Understanding the Concept of Protein Synthesis

PURPOSE:

To help the first-semester ANATOMY & PHYSIOLOGY and/or MICROBIOLOGY student understand, with simplicity and visualization, the concept of the PROTEIN SYNTHESIS process. Many first-semester A&P and/or Microbiology students are not acquainted with the "language" of biology, and for various reasons, seem to be overwhelmed with the course --particularly the process by which proteins (enzymes) are made for the cell. (By following the PROTEIN SYNTHESIS drawing, the student can visualize this process).

OBJECTIVES:

1. To understand the definition of protein synthesis.
2. To understand the composition of each process in protein synthesis.
3. To know the location in the cell where each process occurs.
4. To be able to understand the function of each process.

Definition:

Protein Synthesis is the process by which proteins are made for the cell.

Composition:

The major "building blocks" for protein synthesis are:

- A). Deoxyribose nucleic acid (DNA)
- B). Ribose nucleic acid (RNA)
 - 1) Messenger RNA (mRNA)
 - 2) Transfer RNA (tRNA)
 - 3) Ribosomal RNA (rRNA)
- C). Ribosomes - organelles (little organs) located in the cell cytoplasm where the manufacturing of proteins (enzymes) are made for the cell to use.

Location:

Various theorists differ in the DNA/RNA location in the cell. There is no question that DNA and RNA originate in the nucleus of the cell. One theory is that DNA is in the nucleolus of the cell, and RNA is outside the nucleolus of the cell. This seems to be the reason URACIL in RNA must be substituted for THYAMINE in DNA -- because there is no THYAMINE where RNA is located. (Your professor will designate which theory he/she wants you to use). Nevertheless, mRNA transcription occurs in the nucleus, and mRNA translation occurs in the cytoplasm of the cell.

Function:**Step #1:**

DNA contains the genetic material and serves as the blueprint for protein synthesis. The double-stranded DNA "unzips" -- leaving the second strand as a pattern (template) of instruction for RNA. [Think of a "zipper". Zipped, the zipper has the appearance of one (1) strand. When unzipped, it is obvious that the zipper has two (2) strands. The "teeth" of the zipper must complement and "fit" exactly, or the zipper will not function as intended.] Likewise, the rieleotides must complement each other exactly (A-T, C-G, T-A, G-C). If a mispairing occurs in the nucleus, a genetic "malfunction" occurs, i.e. sickle cell anemia.

Step #2:

RNA carries out DNA's instruction. Messenger RNA(mRNA):

1st -- codes, or copies, the instructions. This is called *transcription* and acts as the codon. This occurs in the nucleus.

2nd-- decodes, or translates, the message. This is called *translation* and acts as the anti-codon. This occurs in the cytoplasm. At this point, each triplet code has coded an amino acid. The name of the amino acid depends on the arrangement of the triplet code (Appendix C, Genetic Code: Codon Sheet).

Step #3:

Individual "escort" ribosomes from the cytoplasm appear to the amino acids. At the presence of these ribosomes, the amino acids release.

Step #4:

Transfer RNA (tRNA) acts as a "taxi" by which the "escort" ribosomes take the amino acids and position them into place as Ribosomal RNA (rRNA).

Step #5:

Ribosomes: From the rRNA, the amino acids continue their journey within the cytoplasm, resting on "floating" ribosomes or on the Rough ER. These ribosomes are "factories" for making the proteins. [It takes eleven amino acids to make one protein.]

Protein is a complex nitrogenous (with a nitrogen base) substance. It is the main building of cells. Since all enzymes (catalysts) are proteins, this covers the synthesis of all biological molecules. Many proteins play active and vital roles in ensuring normal cell function.

DNA	RNA			
		mRNA	tRNA	rRNA
	<i>(transcription)</i>	<i>(translation)</i>	<i>(transports)</i>	<i>(takes amino acids to the protein factories-ribosomes)</i>
	T -- A	-----	U	----- A
	T -- A	-----	U	----- A
	A -- T	-----	A	----- U
	C -- G	-----	C	----- G
	G -- C	-----	G	----- C
	G -- C	-----	G	----- C
	A -- T	-----	A	----- U
	A -- T	-----	A	----- U
	T -- A	-----	U	----- A

*Remember: *It takes eleven (11) amino acids to make one (1) protein.*

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