PROTEIN SYNTHESIS

INTRODUCTION

- Protein Synthesis = manufacture of proteins
- Occurs in the nucleus & cytoplasm
- Codes for specific proteins are located on DNA
- Triplet codes (made up of 3 DNA nucleotides) are called codons
- Protein synthesis occurs on the ribosomes

Protein Synthesis has 2 Parts

- Transcription: copying the codons for a protein from a segment of DNA to make messenger RNA (mRNA)

- Translation: using the sequence of codons on the mRNA to build a protein at the ribosome. Transfer RNA (tRNA) assists in this process

ROLE OF DNA

- Contains the information (triplet codes or codons) for the synthesis of proteins

- Provides a template for mRNA to be produced

ROLE OF mRNA (messenger RNA)

- Carries the coded message from the DNA in the nucleus to the ribosomes in the cytoplasm

- Sets the order of amino acids for protein synthesis by the sequence of codons

RIBOSOMES

- Site of protein synthesis where the mRNA code is translated and amino acids are bonded together (with peptide bonds) in a specific order.

tRNA (transfer RNA)

- Carries the specific amino acid to the ribosome where its anticodon complementary base pairs with the mRNA codon

Amino Acids

- These are the monomers that make up proteins

- Amino acids are picked up by the tRNA in the cytoplasm and are carried to the ribosomes

TRANSCRIPTION

STEPS OF PROTEIN SYNTHESIS

TRANSCRIPTION (in the nucleus)

- 1. DNA contains the triplet code for a protein
- 2. DNA unwinds, unzips, breaking hydrogen bonds and provides a template for the formation of mRNA
- 3. Complementary base-pairing of RNA nucleotides with DNA codons
- 4. RNA polymerase joins the adjacent nucleotides to form mRNA
- 5. mRNA exits the nucleus & travels to the cytoplasm

TRANSLATION

STEPS OF PROTEIN SYNTHESIS

TRANSLATION (at ribosomes)

- 1. mRNA binds to the ribosome
- 2. tRNA carrying a specific amino acid binds to mRNA where the anticodon of tRNA complementary pairs with the mRNA codon
- 3. Adjacent amino acid undergoes dehydration synthesis forming a peptide bond with the next amino acid
- 4. The ‘empty’ tRNA will bond with another specific amino acid in the cytoplasm.

TRANSLATION cont.

- 5. Ribosome moves along the mRNA from one codon to the next recieving incoming tRNA's carrying amino acids
- 6. The polypeptide (protein) is produced until a 'STOP' codon on the mRNA is reached.
- 7. Protein synthesis terminates and the polypeptide is released.

ENVIRONMENTAL MUTAGENS

Environmental mutagens that cause mutations include:

- UV radiation, X-rays, gamma rays
- Industrial chemicals, pollutants, pesticides, food additives
- Viruses
- Heavy metals (Pb, Hg)

MUTATIONS AFFECT PROTEIN SYNTHESIS

- All gene mutations involve altering the sequence of amino acids or the number of nitrogenous bases within a DNA molecule
- This dramatically alters the code for the synthesis of proteins which could cause disorders or genetic diseases (eg. Sickle-cell anemia)
- There are 3 types of mutations (deletion, addition, and substitution)

DELETION MUTATION

- One or more nucleotides is deleted from the DNA sequence

- This alters all of the following codes and therefore alters the polypeptide and its function

ADDITION MUTATION

- One or more nucleotides is added to the DNA
- This pushes all bases back one code and therefore alters the polypeptide and its function

SUBSTITUTION MUTATION

- Involves a change in a single nucleotide and a change in one specific codon

- When substituting a base the results are variable