Protein Synthesis

RNA, Transcription, & Translation

RNA – Ribonucleic Acid

- 3 differences between RNA & DNA
  - 1) The sugar is ribose instead of deoxyribose
  - 2) The base uracil replaces thymine
  - 3) RNA = single-stranded instead of double

Three (3) Types of RNA

- There are three types of RNA
  - 1) Messenger RNA (mRNA)
  - 2) Transfer RNA (tRNA)
  - 3) Ribosomal RNA (rRNA)

mRNA

- Single uncoiled chain that carries the genetic information from the nucleus to the ribosome
**tRNA**
- Consists of a single chain folded into a cross/T shape
- Each binds to a specific amino acid

**rRNA**
- Nucleotides glob up along with proteins in order to make up ribosomes
- Ribosomes are where proteins are made

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**Transcription**
- The process of copying DNA into RNA
- *RNA polymerase* makes RNA by reading specific sequences of DNA called *genes*

1) Initiation  
2) Elongation  
3) Termination

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**Transcription – 3 step process**
1) *Initiation*
   - Begins by RNA *polymerase* binding to the *promoter*
**Initiation**

1) Initiation
- Begins by RNA polymerase binding to the promoter

2) Elongation
- RNA polymerase reads the template strand of DNA

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**Transcription – 3 step process**

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**Transcription (cont...)**

2) Elongation (cont.)
- RNA polymerase adds complementary RNA nucleotides to form the mRNA
- Base pairs are the same except that A now pairs with U

DO: Practice DNA → RNA pairing on right side

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**Elongation**

RNA polymerase travels along the DNA template strand (blue), catalyzing the addition of ribose nucleotides into an RNA molecule (pink). The nucleotides in the RNA are complementary to the template strand of the DNA.
Transcription (cont...)

2) Elongation (cont.)
- RNA polymerase adds complementary RNA nucleotides to form the mRNA
  * Base pairs are the same except that A now pairs with U

3) Termination
- Transcription occurs until a termination signal is reached

Quick Review
- Function of mRNA?
- Location of Transcription?

Termination

At the end of a gene, RNA polymerase encounters a DNA sequence called a termination signal. RNA polymerase detaches from the DNA and releases the RNA molecule.

Amino Acid Role

- The amino acid sequence determines the structure of the protein and therefore determines the protein’s function

- There are 20 amino acids found in proteins
  - 9 essential ones; must be consumed (Can’t be made)
**Codons/Triplets**

- The mRNA sequence will be read in groups of 3 nucleotides = codons
  - Codons determine which **amino** acid will get delivered to ribosome
  - Codon chart will be used to identify amino acids

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**mRNA Codon Chart #1 - color**

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**mRNA Codon Chart #2 - color**

**Translation: Step 1: Initiation**

A. **mRNA** leaves the nucleus and migrates to a ribosome in the cytoplasm
B. The mRNA enters the ribosome between the large and small subunits
C. The **mRNA** is then read by the ribosome in groups of 3 called **codons**
D. **AUG** is always the first codon “**Start**” codon
Translation: Step 2: Elongation

E. One codon is read by the ribosome, while a tRNA brings in the correct amino acid for that codon (1st amino acid will always be Methionine (Met.))

F. The tRNA has an anticodon (complementary) so that it can match up to the codon

G. The next codon is read, and another tRNA carrying the correct amino acid comes to the ribosome

Step 2: Elongation (cont.)

H. The two amino acids are bonded together with a peptide bond

I. The first tRNA can now leave the ribosome to go get another amino acid

J. The process continues the entire length of the mRNA that codes for the gene
Translation: Step 3: Termination

K. Once a “STOP” codon enters the ribosome, termination begins.

L. These do NOT code for an amino acid; instead they release the newly formed polypeptide.

In Summary..

- **Transcription** = reading a single strand of DNA in order to make RNA, occurs in the nucleus.
- **Translation** = using an mRNA to code for the linking of amino acids, occurs in the ribosome.
- Product is a *polypeptide chain* that can fold itself into a protein.
Central Dogma

1. DNA
   - complementary DNA strand
2. Template DNA strand
3. mRNA
4. tRNA
5. Protein
   - amino acids
   - phosphate
   - sugar