RNA and Gene Expression Section 3

RNA and Gene Expression

Key Idea: Gene expression produces proteins by **transcription** and **translation**. This process takes place in **two** stages, both of which involve **RNA**.

- RNA is a second type of nucleic acid which takes the information from DNA and makes protein.
- Gene expression is the manifestation of genes into specific traits.
- Transcription is the process of making RNA from the information in DNA.
- Translation is the use of information in RNA to make specific protein.

Transcription: DNA to RNA

- Transcription is similar to copying (transcribing) notes from the board (DNA) to a notebook (RNA).

Translation: RNA to Proteins

- Translation is similar to translating a sentence in one language (RNA, the nucleic acid "language") to another language (protein, the amino acid "language").

RNA: A Major Player

Key Idea: In cells, three types of RNA complement DNA and translate the genetic code into proteins.

RNA Versus DNA

- RNA is composed of ***one strand*** of nucleotides rather than two strands.
- RNA nucleotides contain the five-carbon sugar ***ribose*** rather than the sugar deoxyribose.
- RNA nucleotides have a nitrogenous base called ***uracil*** (U) instead of the base thymine (T).

Types of RNA

- **Messenger RNA:** (mRNA) is produced when DNA is transcribed into RNA.
- **Transfer RNA:** (tRNA) "reads" the instructions carried by the mRNA, then translates the mRNA sequence into protein subunits called amino acids.
- **Ribosomal RNA:** (rRNA) is an RNA molecule that is part of the structure of ribosomes.

Types of RNA

- Ribosomes are the cellular structure where protein production occurs using the three main types of RNA.

Transcription: Reading the Gene

Key Idea: During transcription, the information in a specific region of DNA (a gene) is transcribed, or copied, into mRNA.

Transcription Versus Replication

- In transcription, a new molecule of RNA is made from the DNA. In DNA replication, a new molecule of DNA is made from the DNA.

The Genetic Code: Three-Letter "Words"

Key Idea: The genetic code is based on codons that each represents a specific amino acid.

- A codon is a three-nucleotide sequence that corresponds to 1 of 20 amino acids.

Codons of mRNA

- There are 64 mRNA codons. Each codon specifies only one amino acid, but several amino acids have more than one codon.

Translation: RNA to Proteins

Key Idea: Translation occurs in a sequence of steps, involves three kinds of RNA, and results in a complete polypeptide.

Steps of Translation

Step 1: The mRNA joins with a ribosome and tRNA.

Step 2: A tRNA molecule that has the correct anticodon and amino acid binds to the second codon on the mRNA.

Step 3: A peptide bond forms between the two amino acids, and the first tRNA is released from the ribosome.

Step 4: The ribosome then moves one codon down the mRNA.

Step 5: This process is repeated until one of three stop codons is reached. Then the amino acid chain is released.

Translation: RNA to Proteins

- Translation takes place in the cytoplasm, where tRNA, rRNA, and mRNA interact to assemble proteins.

Repeating Translation

- Many copies of the same protein can be made rapidly from a single mRNA molecule because several ribosomes can translate the same mRNA at the same time.

Complexities of Gene Expression

Key Idea: The relationship between genes and their effects is complex. Despite the neatness of the genetic code, every gene cannot be simply linked to a single outcome.

Complexities of Gene Expression

- Gene expression produces proteins by transcription and translation. this process takes place in two stages, both of which involve RNA.