

Modern Biology - (Open + Free)

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Unit 4:: Basis of Molecular Biology

This course is not led by an instructor

DNA and RNA

DNA Replication

DNA Transcription

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Basis of Molecular Biology

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Describe and list the sequence of events from DNA to protein in the central dogma of molecular biology.

Describe the role of DNA and RNA in the central dogma of molecular biology.

Modern molecular biology is built upon our understanding of the structure and function of DNA (deoxyribonucleic acid) and RNA (ribonucleic acid) and the enzymes and proteins that interact with these structures. In this section of the course the structures of RNA and DNA will be explored along with the processes by which they are used to transmit information.

The structure of DNA (shown on the left below) is the molecule upon which the Central Dogma of modern molecular biology is based. It contains the information necessary to code for the RNA and proteins used by a cell or virus to replicate and produce the next generation. While a virus does not satisfy one of the major tenets of the Cell Theory that the entity is able to self-replicate, it still uses information from either its own DNA (RNA) or its host DNA to replicate itself.

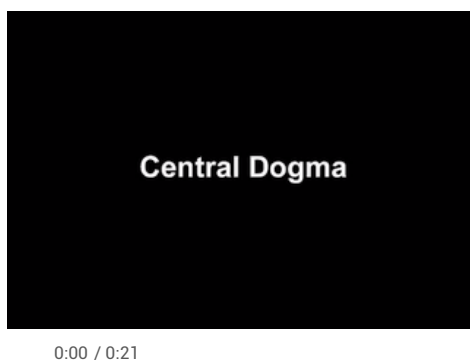
Although RNA has much of the same basic structural features of DNA, it takes on many more tertiary structures and has multiple functions in the cell. The forms of RNA include:

1. mRNA: messenger RNA is a copy of the DNA sequence that is read by the ribosome during protein synthesis. The mRNA contains the information on the order of the amino acids in protein that is being synthesized on the ribosome. Each base triplet corresponds to one amino acid.
2. tRNA: transfer RNA is responsible for translation of the nucleic acid code to an amino acid. tRNA carries an amino acid to the protein synthesis machinery (ribosome) and is responsible for decoding the mRNA information to insert the correct amino acid into the growing protein on the ribosome. tRNA folds into a distinct three dimensional structure, as shown in the 3D Jmol image on the right.
3. rRNA: ribosomal RNA is a significant structural component of the ribosome and plays a role in the catalyzing the formation of the peptide bond during protein synthesis. Since the rRNA catalyzes the reaction, it is referred to as catalytic RNA or a ribozyme.

Structure of B-DNA and tRNA.

Instructions: Drag the model with your mouse to rotate it in 3D space. Use your right mouse button or control click to select menu for exploring the model.

Combining all of these roles together, the Central Dogma of modern molecular biology follows the process outlined in this section and depicted below. DNA, with the aid of specific proteins and enzymes is replicated (DNA Replication) thus providing a copy to be passed to the next generation, the DNA is transcribed in sections (Transcription) into a RNA molecule that codes for a protein or that can itself be used in the form of RNA, and the RNA can be translated (Translation) into the primary sequence of a protein.



This short animation summarizes the processes central to Molecular Biology. The DNA double strand separates, the RNA Polymerase moves along the strand and transcribes the information from one strand of the DNA to a strand of RNA, and the RNA leaves the nucleus where its sequence is translated to a protein sequence on the ribosome.

The intensive efforts to understand the structure of the molecules involved as well as the details of the process have also yielded a set of tools that have led to the sequencing of whole genomes containing the inherited information passed from generation to generation. This immense amount of information has spawned the field of computational biology that is able to extract information from the sequences that can be applied to both our basic understanding of the functioning of organisms and to applications leading to potential cures for genetically inherited diseases.

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