CENTRAL DOGMA OF MOLECULAR BIOLOGY

Definitions

Amino acid : Small molecule that is a building block (monomer) of proteins.
Central dogma of molecular biology : DNA → RNA → Protein; the rule that states that the information in DNA is transcribed into RNA and translated into protein.
DNA (deoxyribonucleic acid) : Double-stranded nucleic acid that makes up genes and chromosomes; the hereditary material.
Protein : Organic compound made up of amino acids.
RNA (ribonucleic acid) : Single-stranded nucleic acid involved in protein synthesis.
Transcription : Process in which genetic instructions in DNA are copied to form a complementary strand of mRNA.
Translation : Process in which genetic instructions in mRNA are read to synthesize a protein.

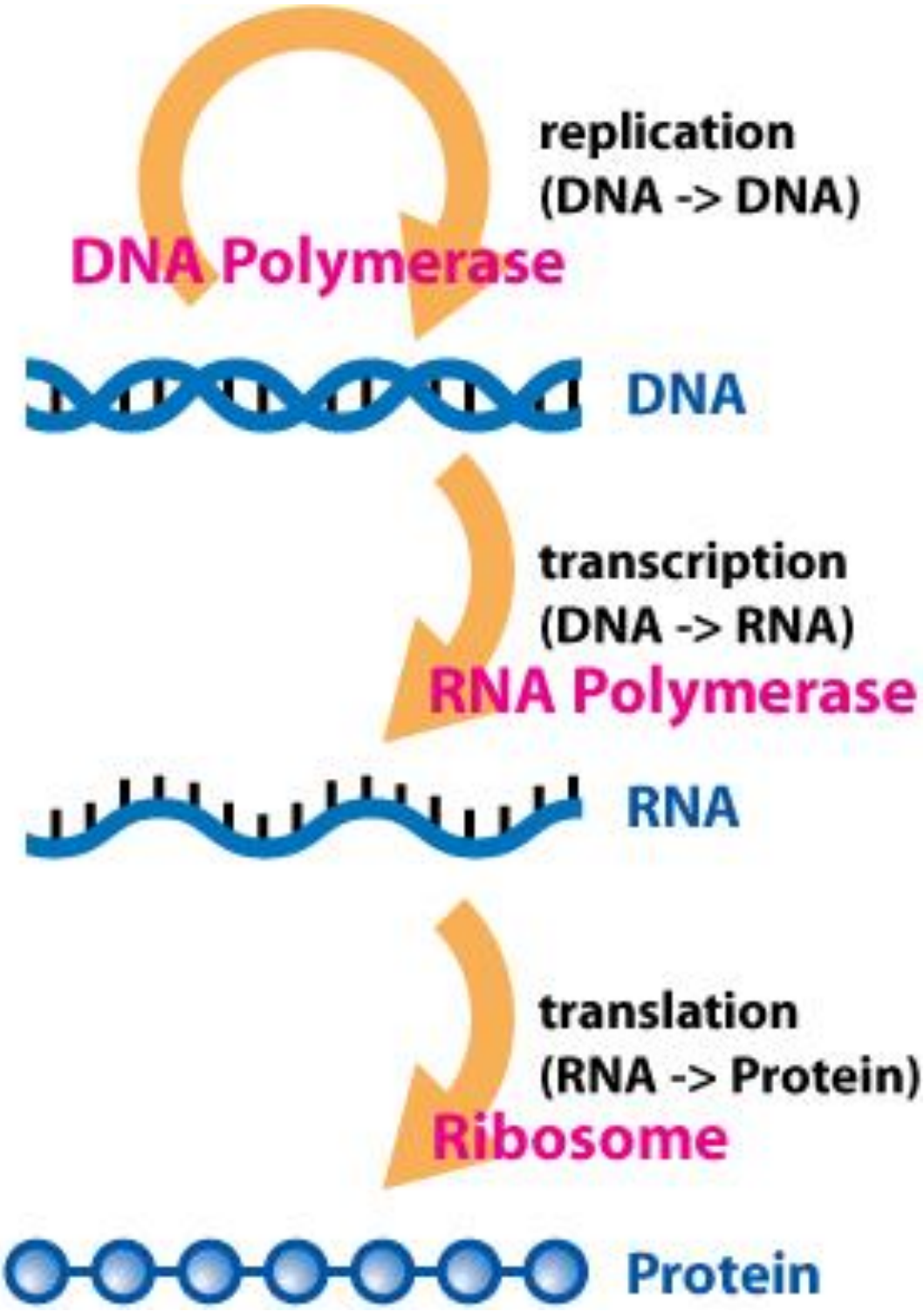
The sum total of all the **DNA** in an organism is called its **genome.** Genomic information is like a computer program for a cell. If DNA is the master copy of a cell's genetic program, its integrity must be preserved. One way the DNA is protected is because **RNA** acts as the working copy. Chemically, RNA is very similar to DNA. Biochemically, the major difference is that RNA either acts as a component of the metabolic machinery or is a copy of the information for protein synthesis. The relationship between DNA and RNA is called the **central dogma of molecular biology.**
The central dogma of molecular biology describes the flow of information from DNA through RNA into proteins. This flow of information is called **gene expression**. It occurs through two main processes: transcription and translation.

DNA → RNA → protein

DNA contains genes that code for proteins. RNA is the intermediate between DNA and proteins. It carries information in genes from the nucleus to the cytoplasm in eukaryotes. Proteins determine the structure and the function of a particular cell. A protein is composed of an amino acid sequence, which is the coding sequence of a gene. Gene expression is the process of synthesizing proteins based on the instructions in genes. The two steps of gene expression are transcription and translation. The ribosome translates the nucleotide sequence of the mRNA into an amino acid polymer using tRNAs to translate triplets of nucleotides into the amino acids specified by the genetic code.

Transcription is the synthesis of an RNA molecule that contains the coding sequence of a gene. The enzyme RNA polymerase recognizes template promoter sequences and initiates, elongates and terminates the synthesis of an unstable intermediate RNA molecule
In some cases this RNA is functional (i.e. rRNAs, tRNAs) but in most cases it is a transient message due to RNA's inherent instability. The primary transcript in prokarytoes is the mature mRNA. In eukaryotes several post-transcriptional modifications - including addition of the 5' CAP, the removal of introns and joining of exons to form a contiguous coding sequence, and cleavage and addition of the 3' poly-A tail are observed.

Translation follows transcription in which the amino acid sequence of a gene is synthesized based on the coding sequence in mRNA. As translation proceeds, the newly synthesized protein folds through a series of transient states to eventually achieve its mature 3D shape.
The protein represents the functional expression of the infomation stored in the heritable storehouse. The surfaces of the mature protein are responsible for molecular recognition and signaling, enzymatic and structural functions.



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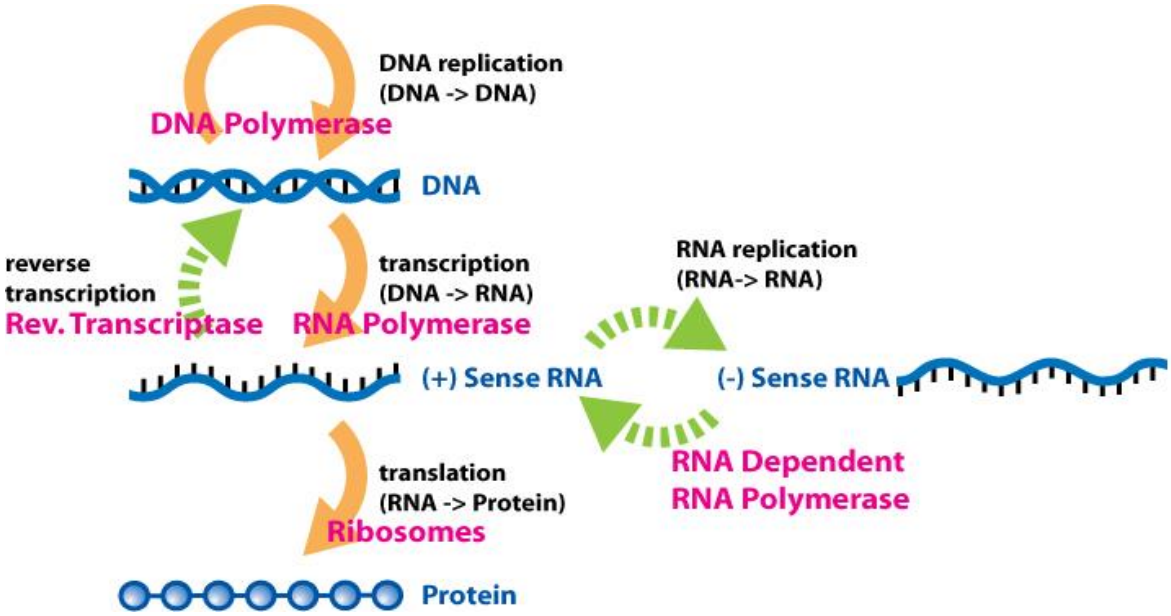

Exception to/Deviation from Central Dogma (Reverse Transcription)
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REVISION QUESTIONS

1. State the central dogma of molecular biology.
2. What are transcription and translation?
3. Explain the central dogma of molecular biology.

Further Reading:

Cell and Molecular Biology – P.K. Gupta
Cell Biology – C.B. Powar
Cell Biology, Genetics, Molecular Biology, Evolution and Ecology – P.S. Verma
Cell and Molecular Biology – Gerald Karp