

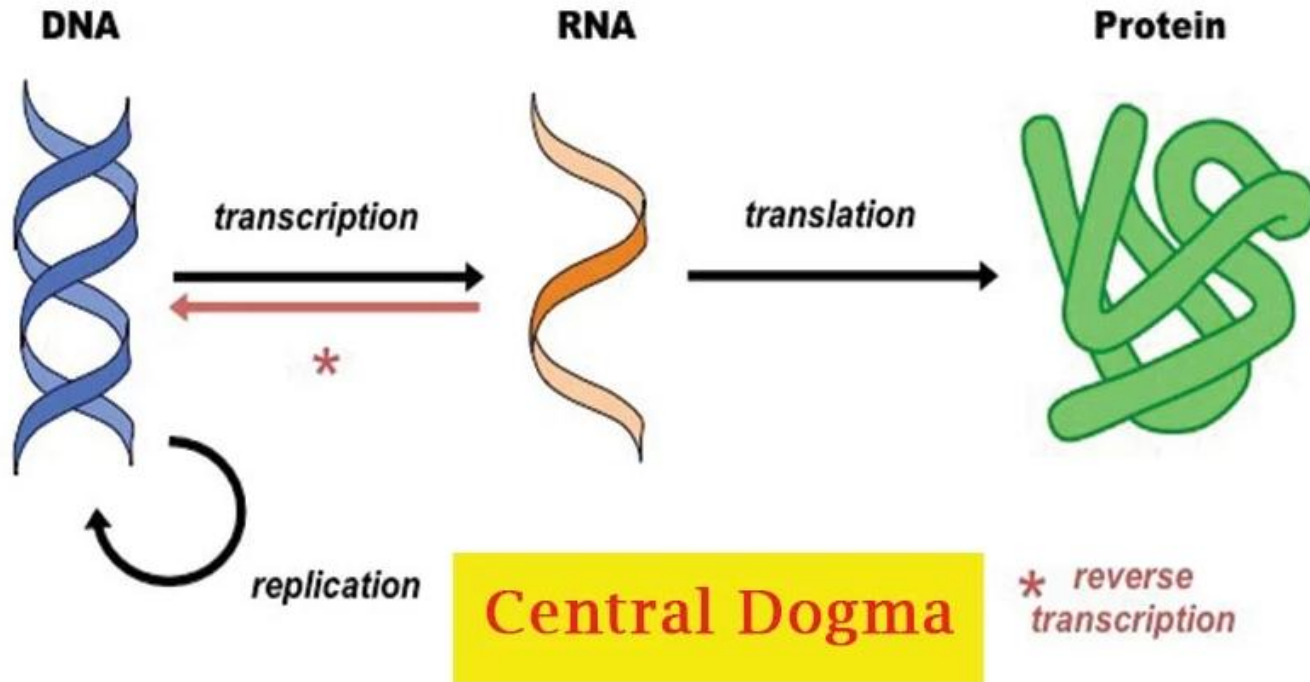
# **The Central Dogma**

Microbiology VI

# Central Dogma- Replication, Transcription, Translation

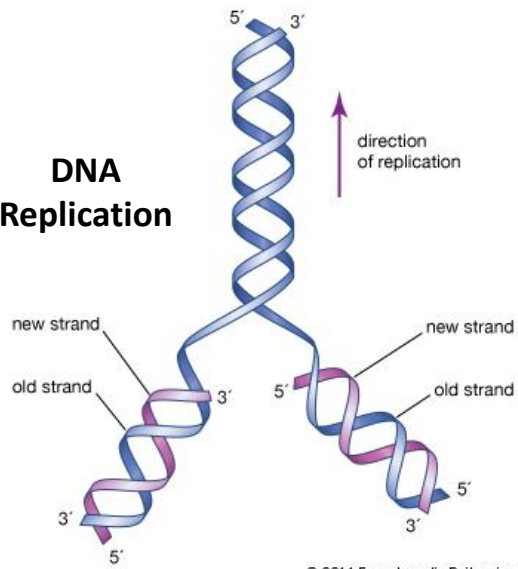
- **DNA** contains the complete **genetic information** that defines the structure and function of an organism.
- Proteins are formed using the **genetic code** of the DNA.
- Conversion of **DNA** encoded information to **RNA** is essential to form **proteins**.
- Thus, within most cells, the genetic information flows from – DNA to RNA to protein.

**Central Dogma - the flow of information is unidirectional and irreversible.**

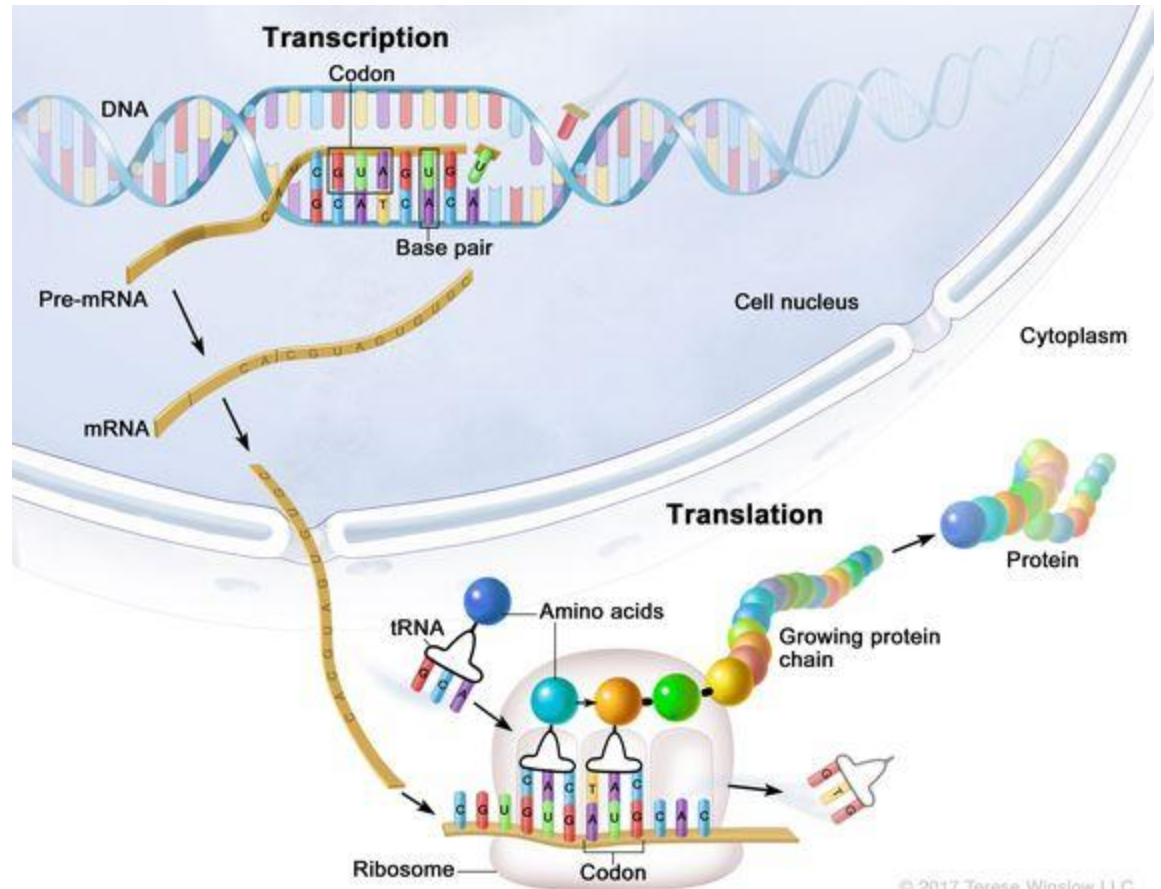


- The flow of information is followed through **three different processes** which are responsible for the **inheritance** of **genetic information** and for its **conversion** from one form to another:
  1. **Replication:** a double stranded nucleic acid is **duplicated** to give identical copies. This process perpetuates the genetic information.
  2. **Transcription:** a DNA segment that constitutes a **gene** is read and transcribed into a single stranded sequence of **RNA**. The RNA moves from the nucleus into the cytoplasm.
  3. **Translation:** the **RNA** sequence is translated into a sequence of **amino acids** as the **protein** is formed. During translation, the ribosome reads three bases (a codon) at a time from the RNA and translates them into one amino acid.

# DNA Replication



© 2014 Encyclopaedia Britannica, Inc.



© 2017 Terese Winslow LLC  
U.S. Govt. has certain rights

## Central Dogma of Molecular Biology :

- In the bigger picture, the central dogma of molecular biology is an explanation of the **flow of genetic information** within a biological system.
- It was first stated by **Francis Crick** in 1958, as:
- “Once ‘**information**’ has passed into protein it cannot get out again. In more detail, the transfer of information from nucleic acid to nucleic acid or from nucleic acid to protein may be possible, but transfer from protein to protein, or from protein to nucleic acid is impossible.”

DNA → DNA

Nucleic acid → protein

**Possible**

Protein → Protein

Protein → nucleic acid

**Impossible**

## The Dogmas

- The dogma is a framework for understanding the **transfer of sequence information** between information-carrying biopolymers, DNA and RNA (both nucleic acids), and protein.
- There are  $3 \times 3 = 9$  conceivable direct transfers of information that can occur between these.

The dogma classes these into 3 groups of 3:

- **A. Three general transfers**
- **B. Three special transfers**
- **C. Three unknown transfers**

## A. Three general transfers

- It describes the normal flow of biological information:
  - DNA can be copied to DNA (**DNA replication**),
  - DNA information can be copied into mRNA (**transcription**), and
  - proteins can be synthesized using the information in mRNA as a template (**translation**).
- It is believed to occur **normally** in most cells.



## B. Three special transfers

- The special transfers describe:
  - RNA being copied from RNA (RNA replication),
  - DNA being synthesized using an RNA template (**reverse transcription**), and
  - Proteins being synthesized directly from a DNA template without the use of mRNA.
- **Temin** (1970) reported the existence of an enzyme “RNA dependent DNA polymerase” (**reverse transcriptase**) which could synthesize **DNA** from a single stranded **RNA template**.
- **Baltimore** (1970) also reported the activity of this enzyme in certain **RNA tumour viruses**.

- This exciting finding in molecular biology gave rise to the concept of **central dogma reverse**” or teminism:
- It suggests that the sequence of information flow is not necessarily from DNA to RNA to protein but can also take place from **RNA to DNA**.
- It is known to occur, but only under **specific conditions** in case of some **viruses** or in a laboratory.

## C. Three unknown transfers

- The unknown transfers describe:
  - a protein being copied from a protein,
  - synthesis of RNA using the primary structure of a protein as a template,
  - DNA synthesis using the primary structure of a protein as a template.
- These do not occur naturally. (Not natural)

## Significance of the Central Dogma of Molecular Biology

- The central dogma provides the basic framework for how genetic information flows from a **DNA sequence** to a **protein** product inside cells and thus give an insight to the important **processes** going on inside the **cells**.