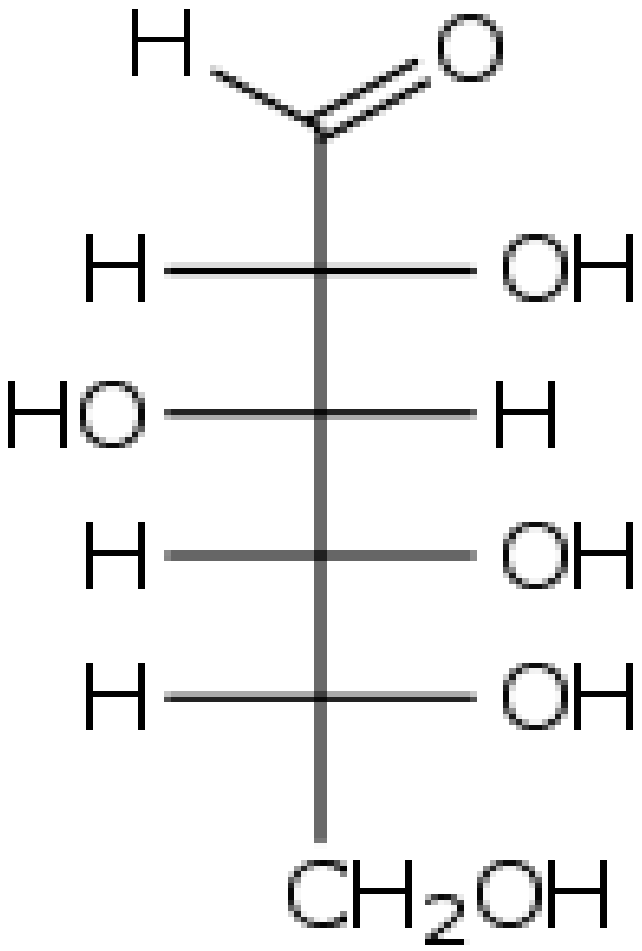
Polysacharidy, nukleové kyseliny

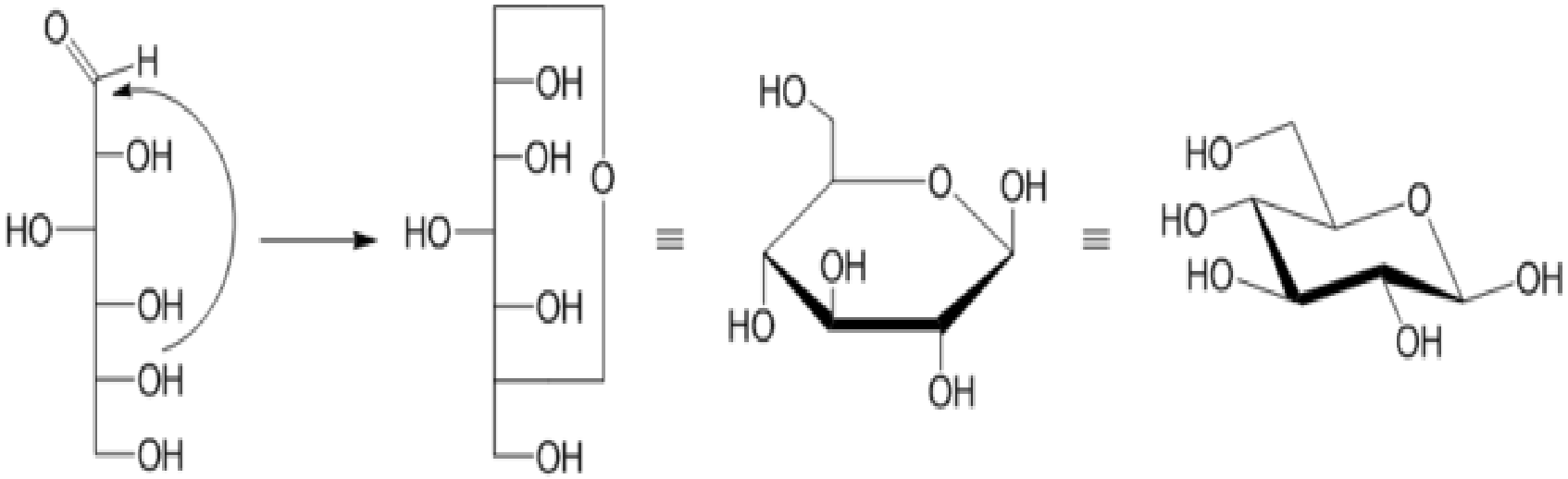
Július Cirák

Polysacharidy

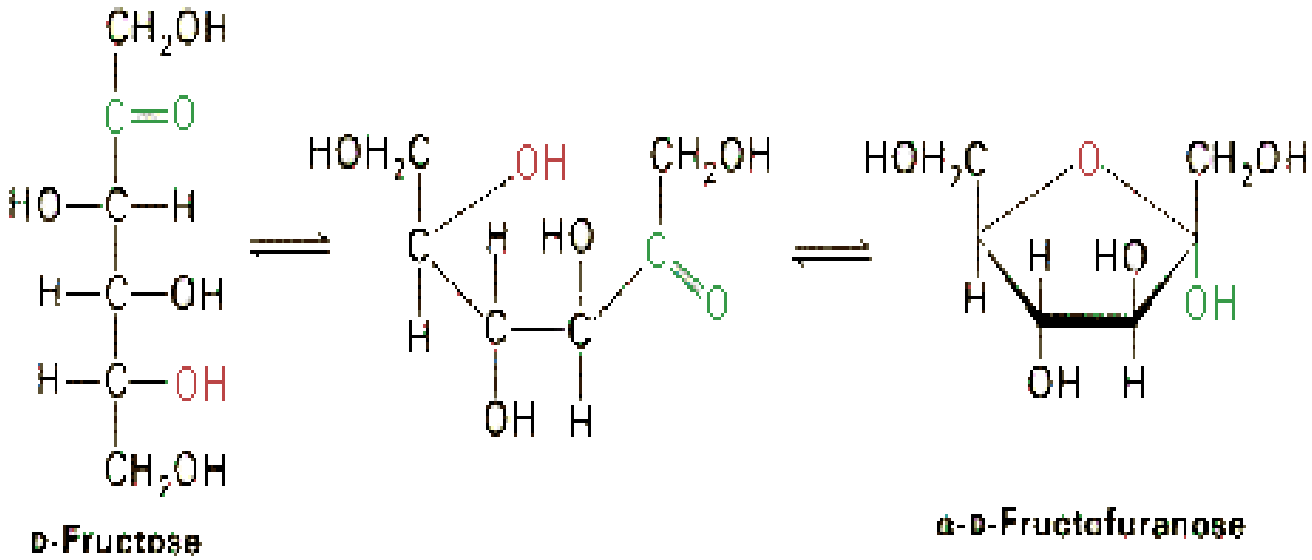
Glukóza



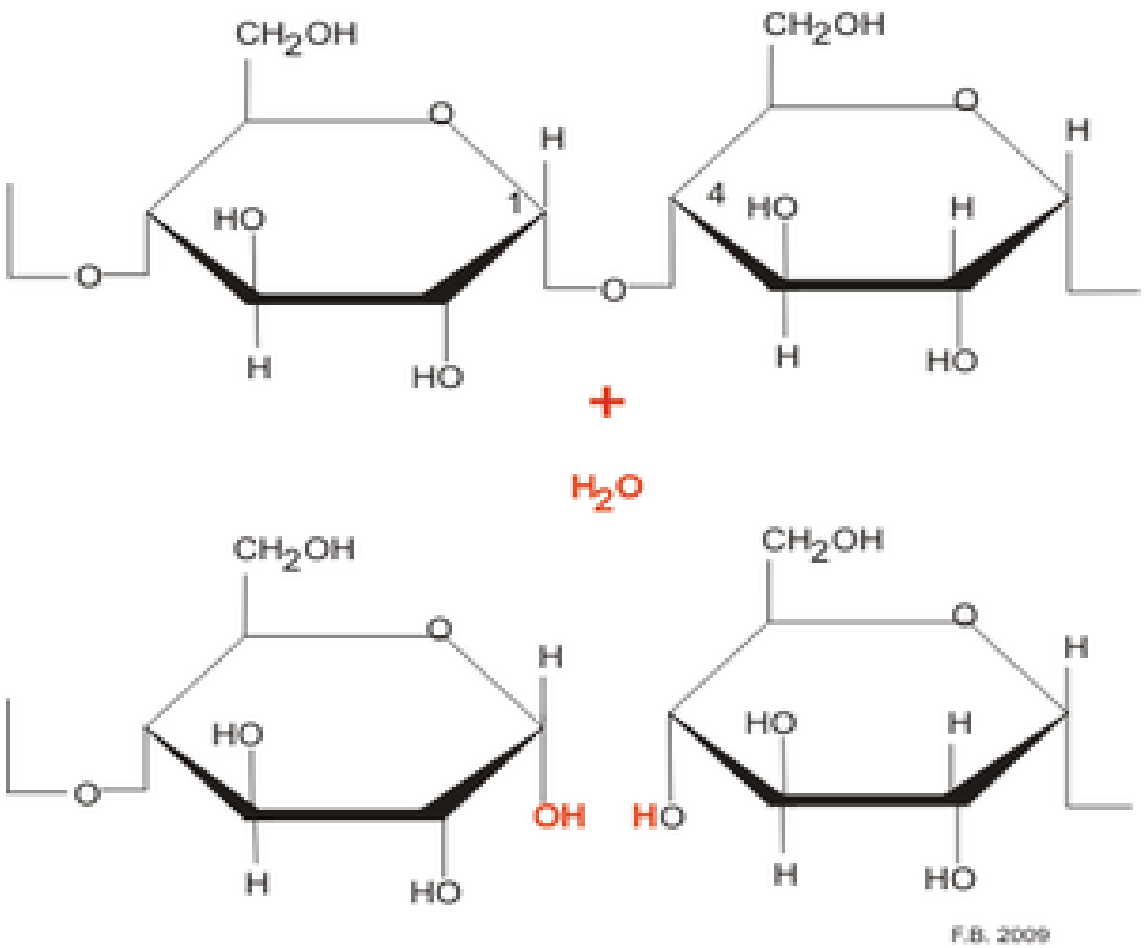
Vytvorenie pyranozového cyklu



Vytvorenie furanozového cyklu

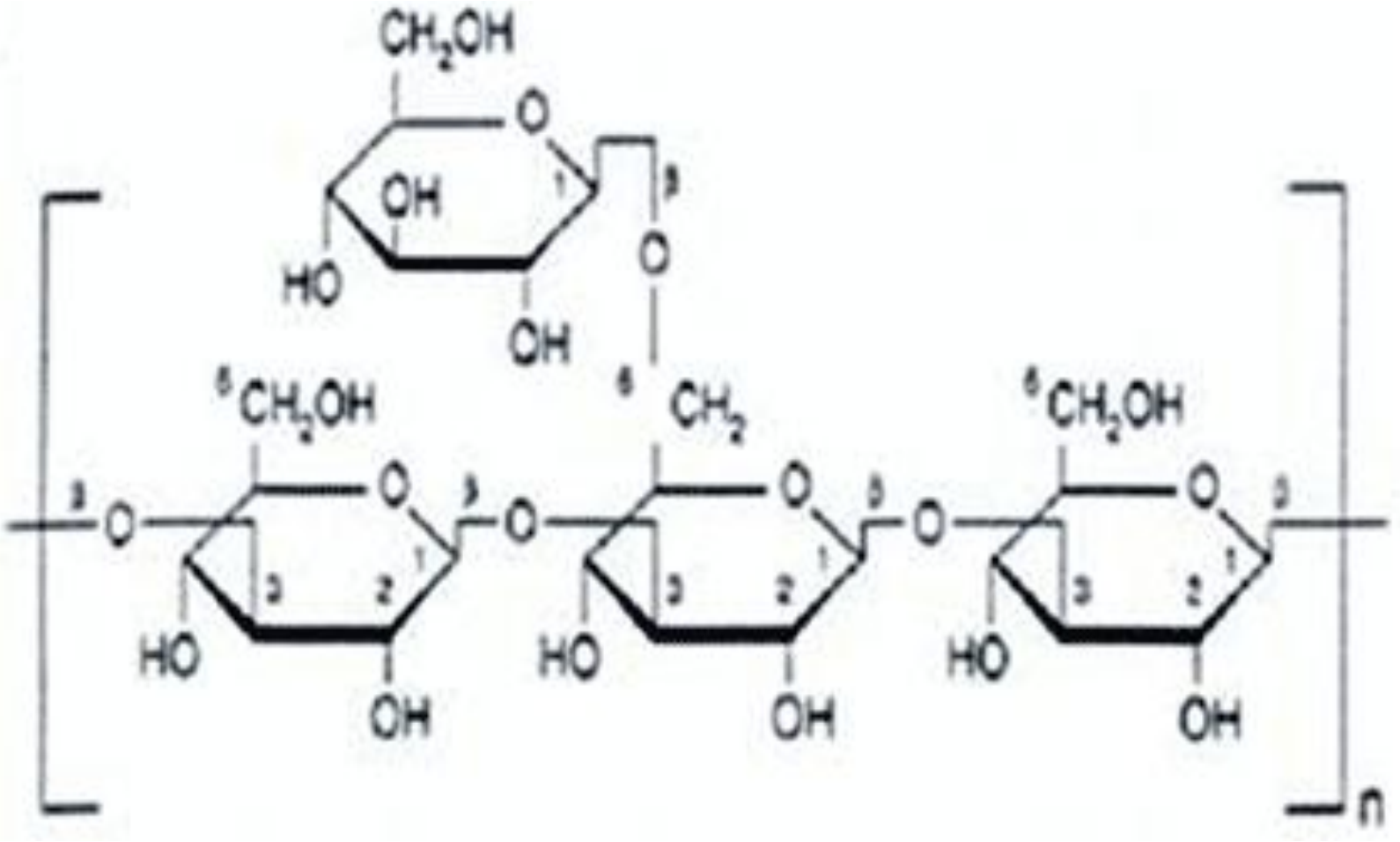


Vytvorenie glykozidickej α väzby

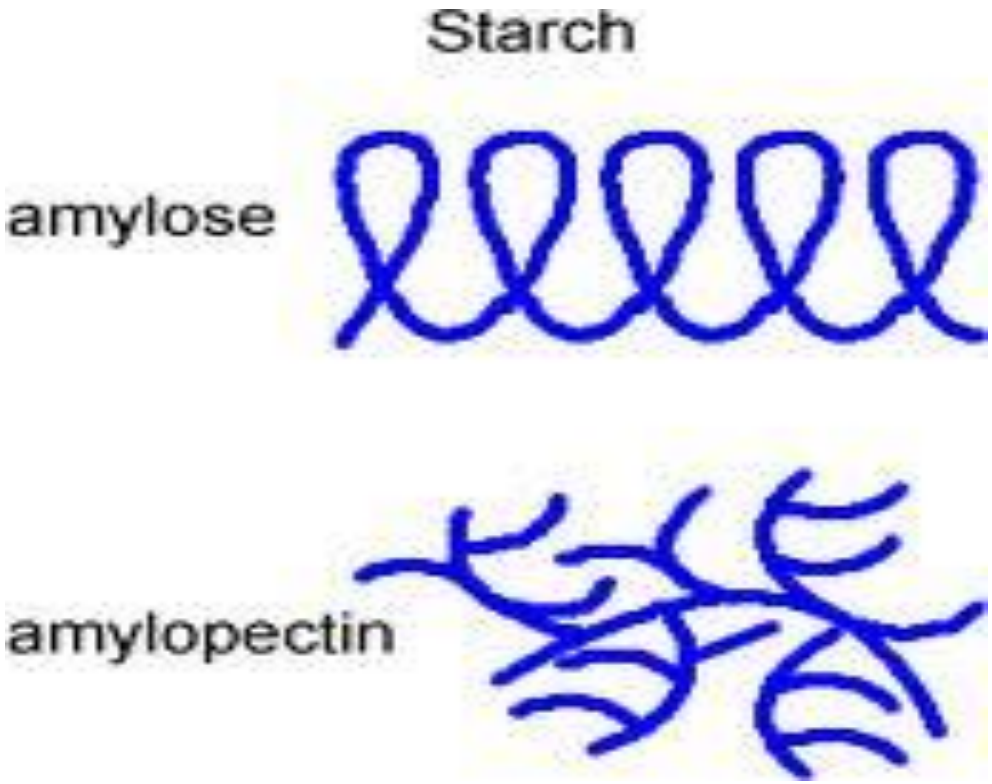


Hydrolysis of 1:4α Linkage

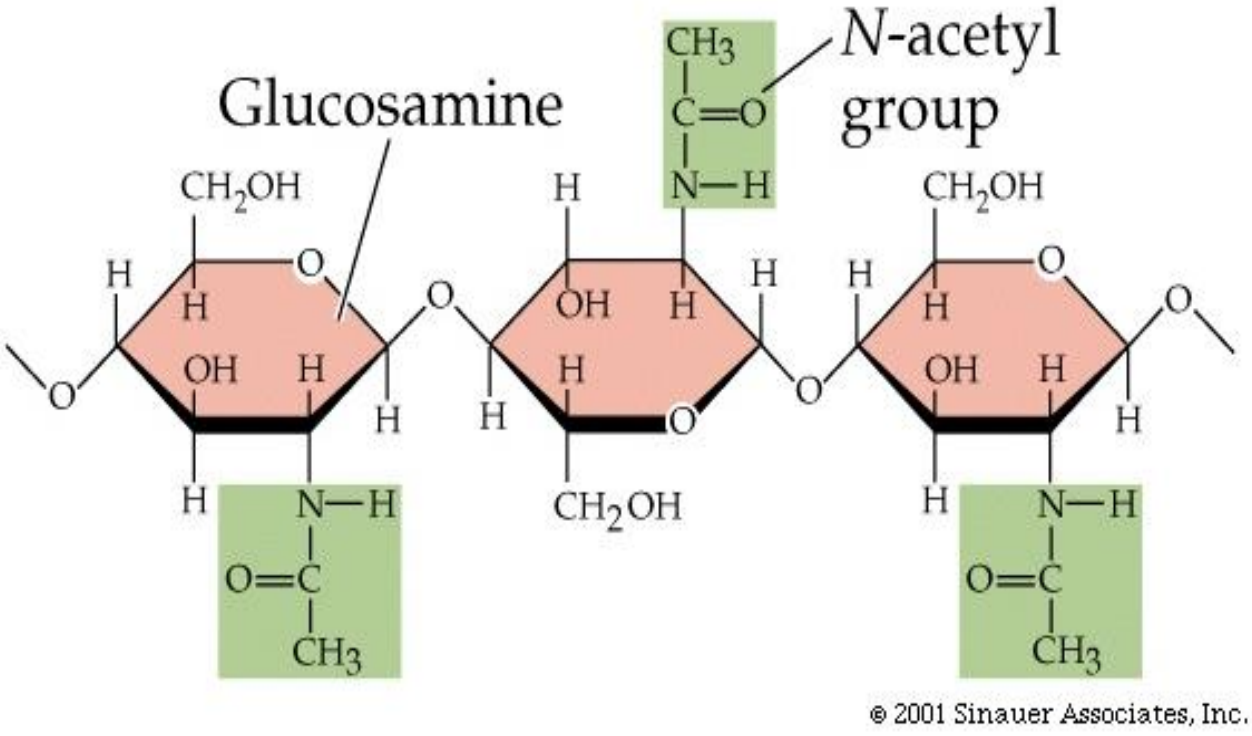
Vetvenie polysacharidového reťazca



Škrob = amylóza + amylopektín



Chitín


Glucosamine
N-acetyl group
CH3
C=O
N—H
CH2OH
H
O
OH
H
O=C
CH3
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Nukleotidy

Nukleové kyseliny

Definitions

Nucleic acids are polymers of nucleotides

Nucleotides are carbon ring structures containing nitrogen linked to a 5-carbon sugar (a ribose)

5-carbon sugar is either a ribose or a deoxy-ribose making the nucleotide either a ribonucleotide or a deoxyribonucleotide

In eukaryotic cells nucleic acids are either:

- Deoxyribose nucleic acids (DNA)
- Ribose nucleic acids (RNA)
  - Messenger RNA (mRNA)
  - Transfer RNA (tRNA)

Nucleic Acid Function

DNA

Genetic material - sequence of nucleotides encodes different amino acids

RNA

Involved in the transcription/translation of genetic material (DNA)

Genetic material of some viruses

Nucleotide Structure

Despite the complexity and diversity of life the structure of DNA is dependent on only 4 different nucleotides

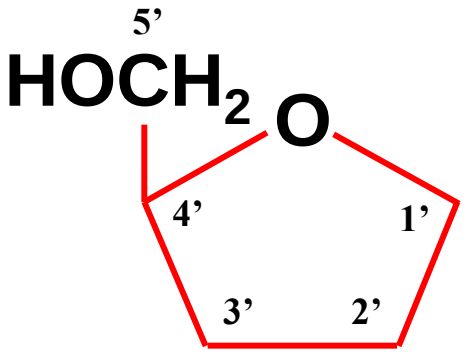
Diversity is dependent on the nucleotide sequence

All nucleotides are 2 ring structures composed of:

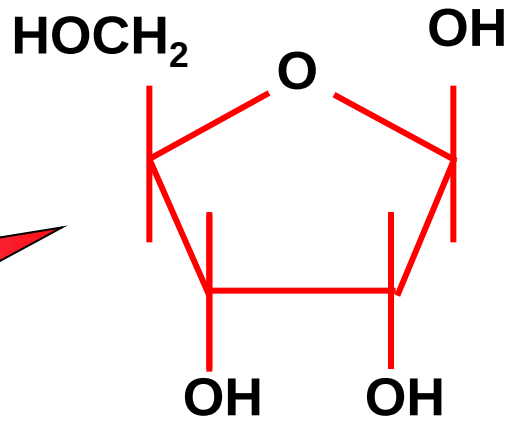
5-carbon sugar :	β-D-ribose (RNA) β-D-deoxyribose (DNA)
Base	Purine Pyrimidine
Phosphate group	A nucleotide **WITHOUT** a phosphate group is a **NUCLEOSIDE**

Nucleotide Structure - 1
Sugars

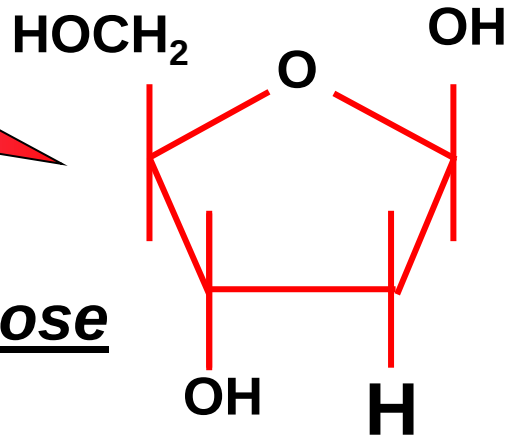
Generic Ribose Structure



Ribose



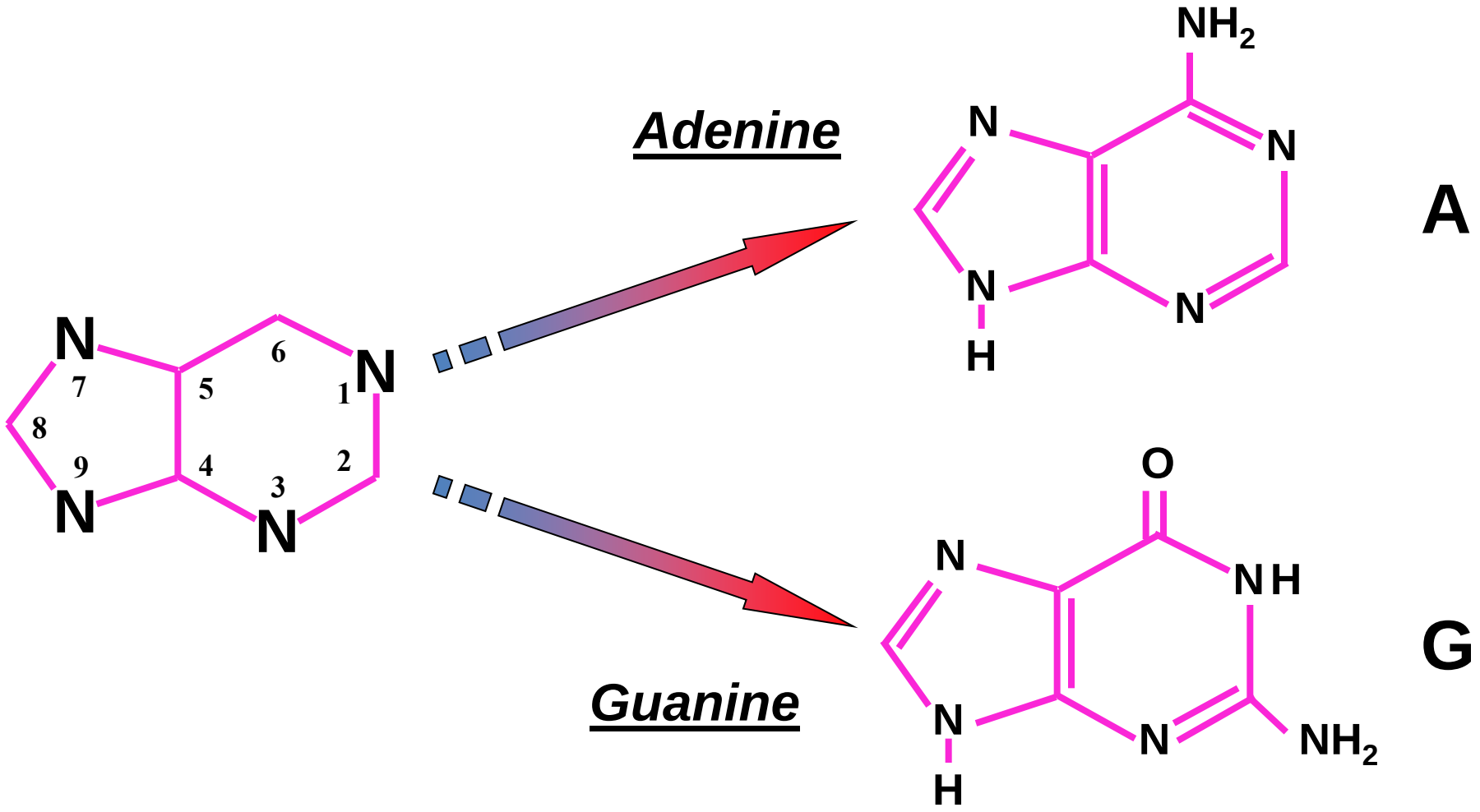
Deoxyribose



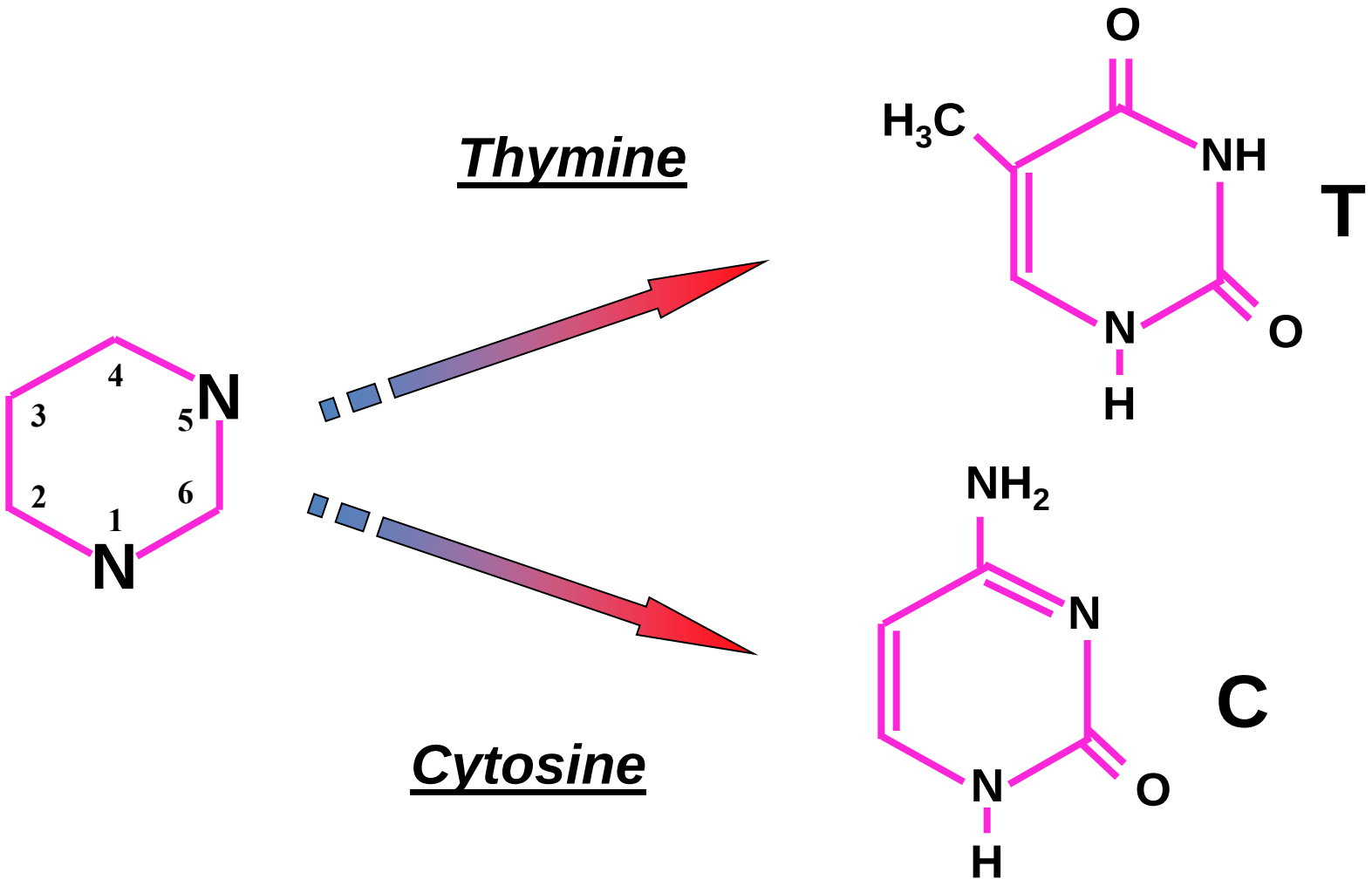
N.B. Carbons are given numberings as a prime

Nucleotide Structure - 2

Bases - Purines



Nucleotide Structure - 3
Bases - Pyrimidines

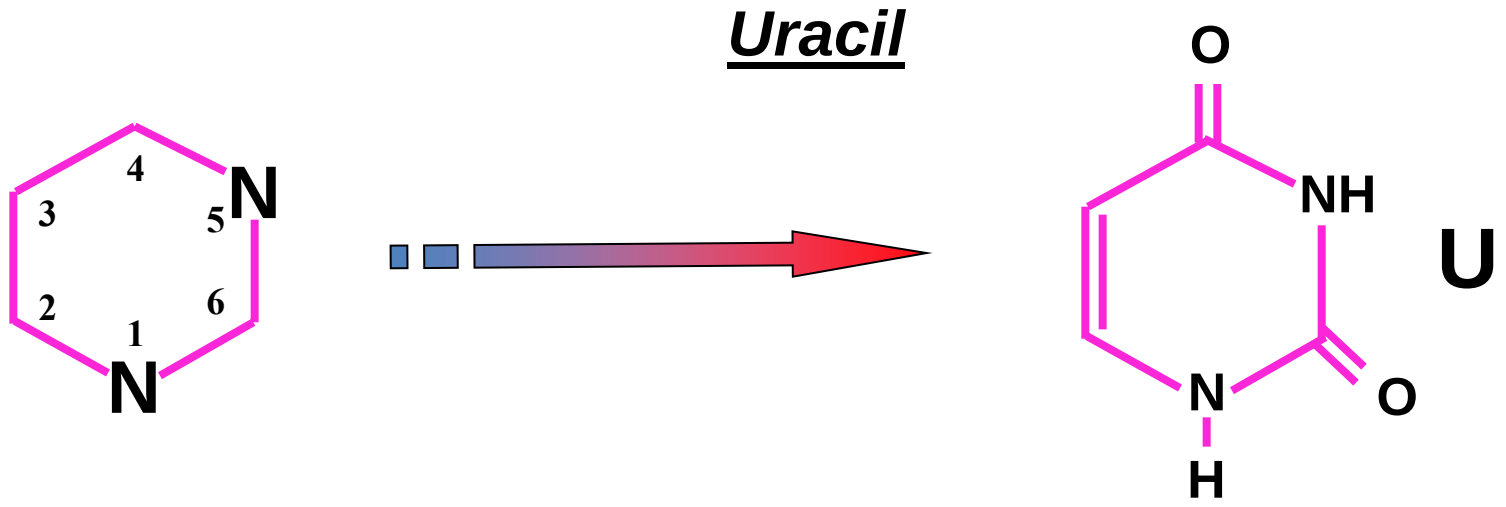


Nucleotide Structure - 4
Bases - Pyrimidines

Thymine is found ONLY in DNA.

In RNA, thymine is replaced by uracil

Uracil and Thymine are structurally similar

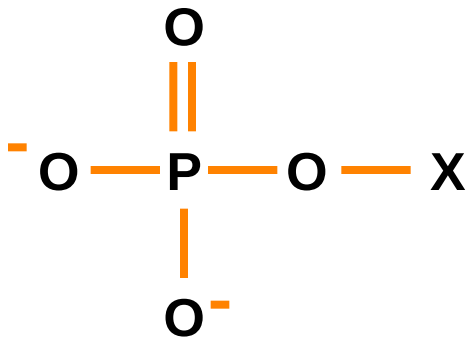


Nucleotide Structure - 4
Phosphate Groups

Phosphate groups are what makes a nucleoside a nucleotide

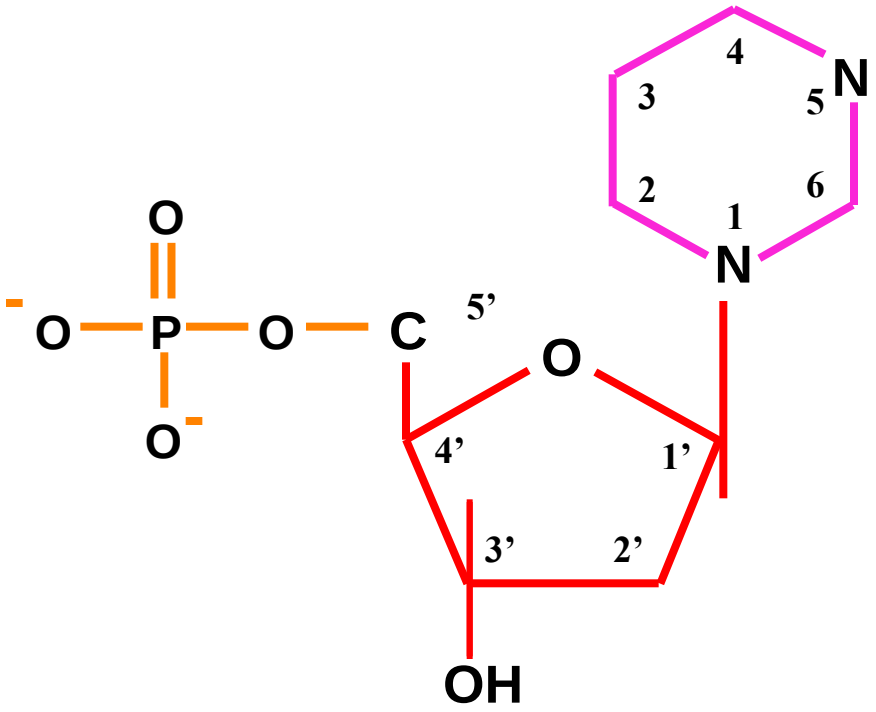
Phosphate groups are **essential** for nucleotide polymerization

Basic structure:



Nucleotide Structure - 4

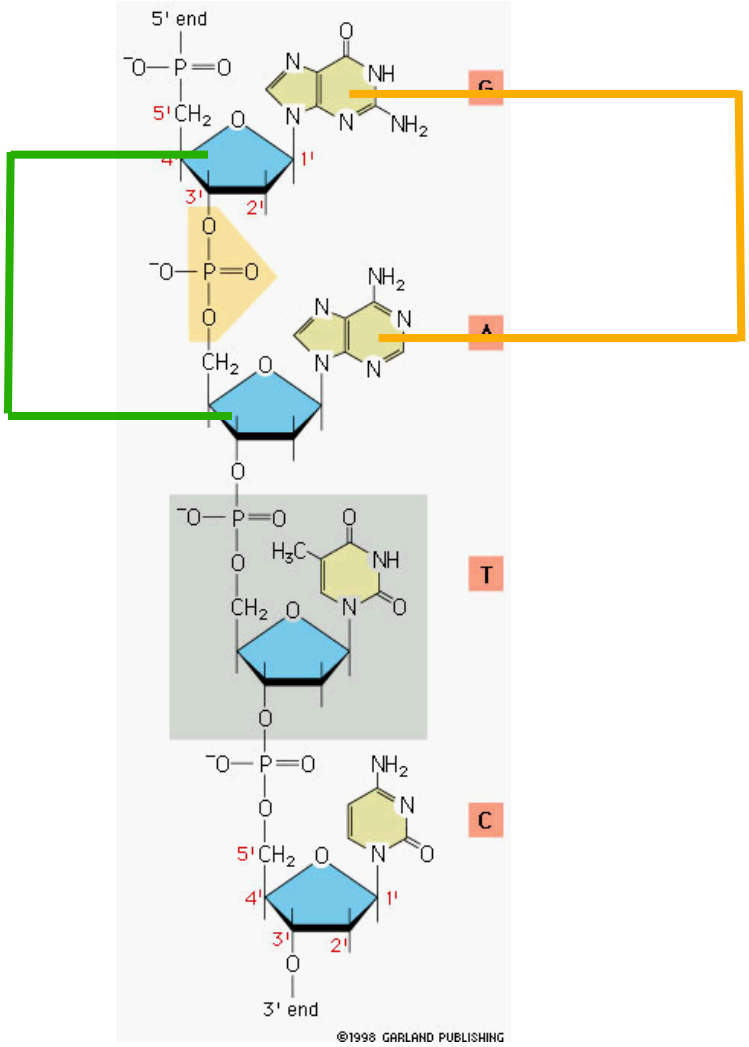
Base-Sugar-PO_4^{2-}



Monophosphate

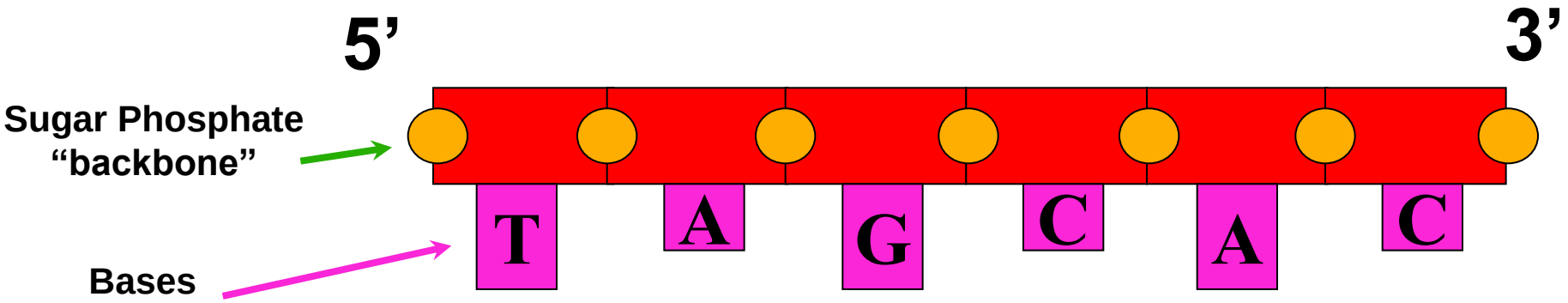
Nucleic Acid Structure
Polymerization

Sugar Phosphate "backbone"



Nucleotide

Nucleic Acid Structure
Polymerization



5’ TAGCAC 3’

Nucleic Acid Structure
“Base Pairing”

RNA [normally] exists as a single stranded polymer

DNA exists as a double stranded polymer

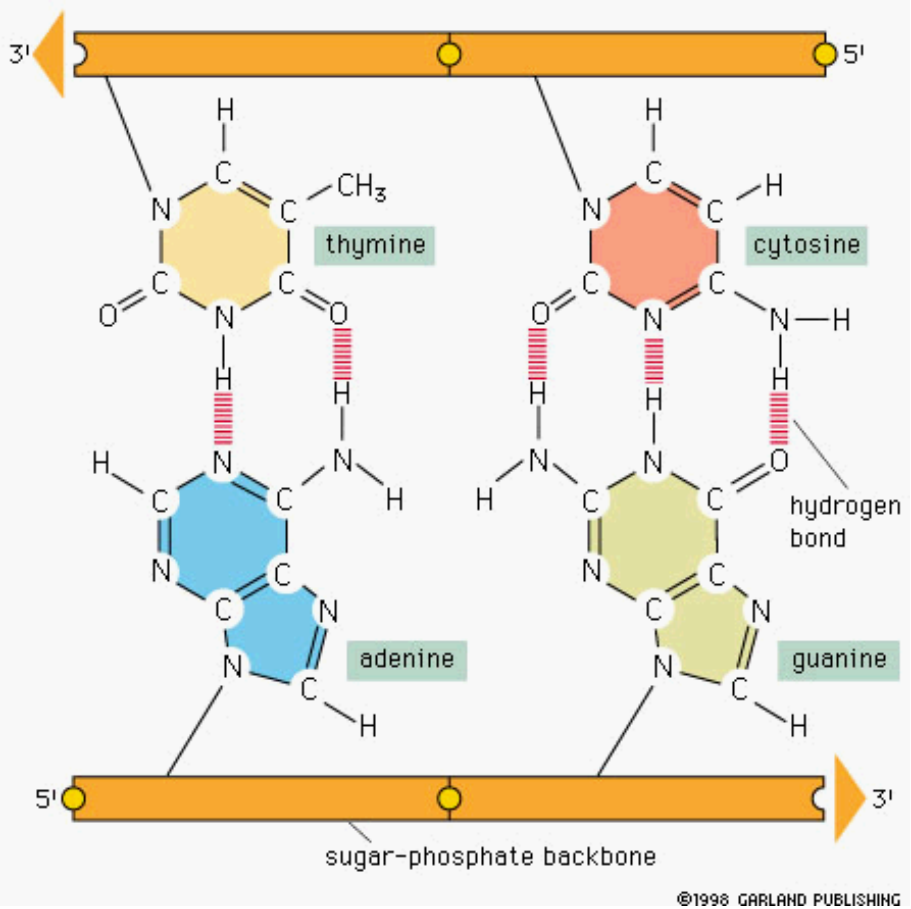
DNA double strand is created by hydrogen bonds between nucleotides

Nucleotides always bind to complementary nucleotides

A ⟷ **T** **(2 H-bonds)**

G ⟷ **C** **(3 H-bonds)**

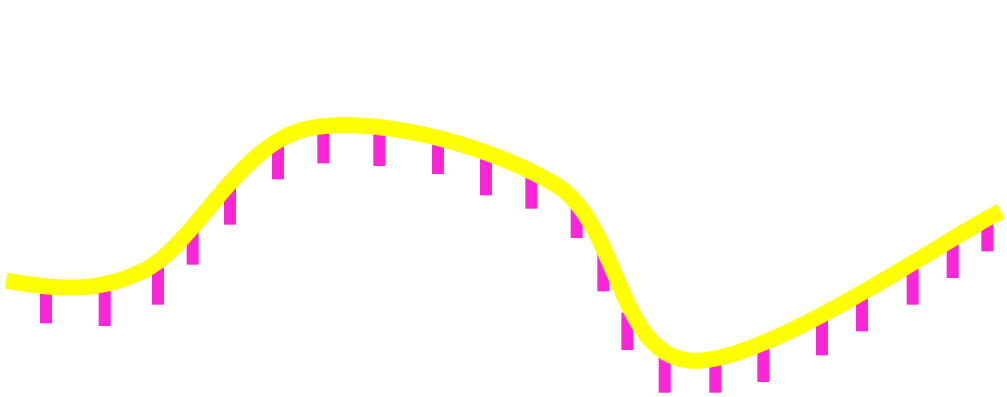
Nucleic Acid Structure
"Base Pairing"

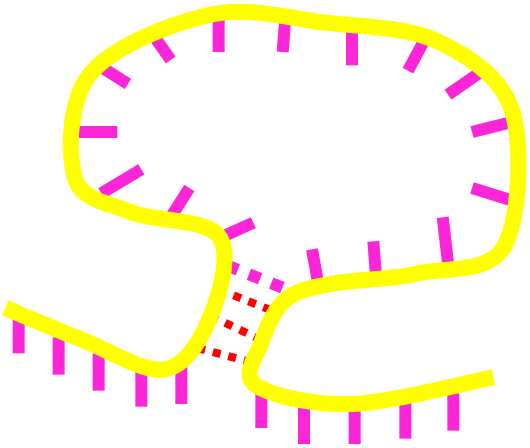


Nucleic Acid Structure
“Base Pairing”

RNA is [usually] single stranded

Base pairing can occur in RNA but is usually within the same strand

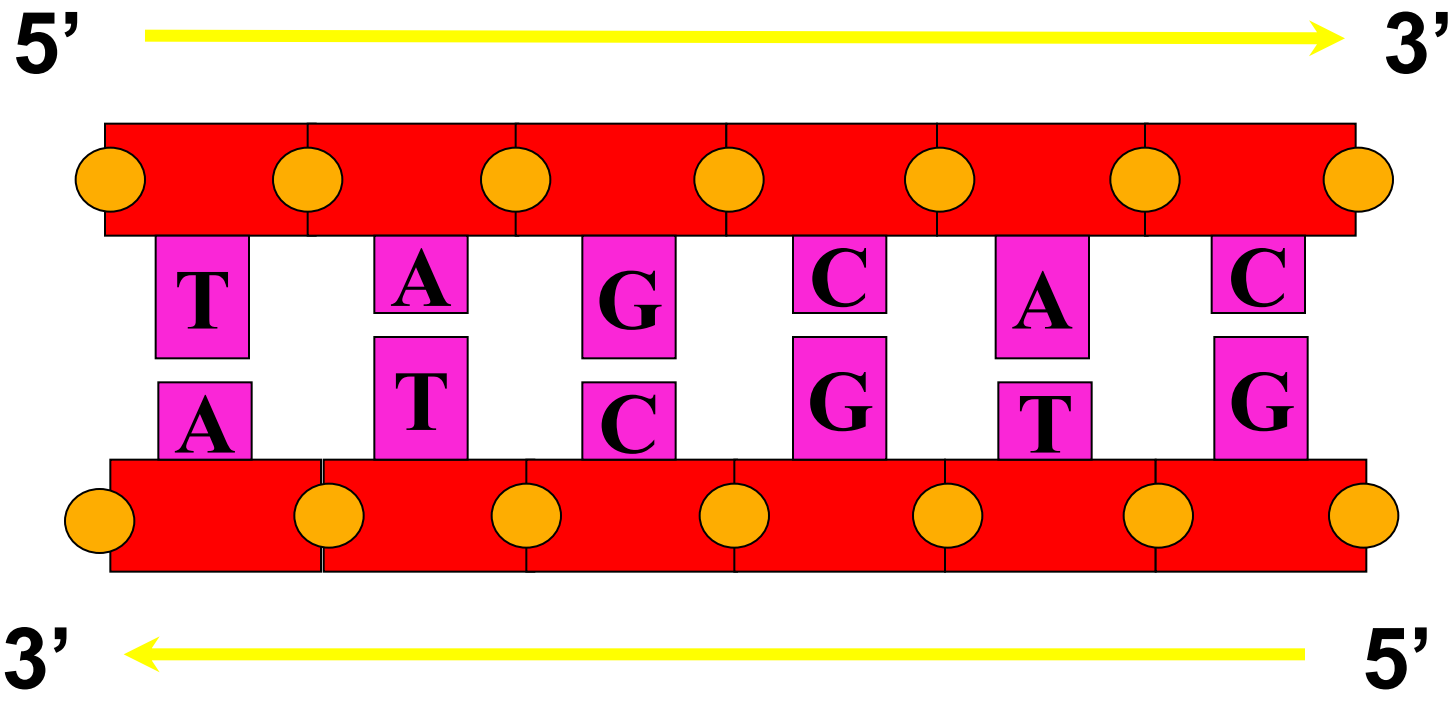




Nucleic Acid Structure
"Base Pairing"

DNA base-pairing is **antiparallel**

i.e. 5' - 3' (l-r) on top : 5' - 3' (r-l) on



Nucleic Acid Structure
Antiparallel Base Pairing

Why antiparallel DNA base-pairing?

- Need to shield the genetic information
- Is the **only** conformational structure to allow **double helix** formation

Nucleic Acid Structure
The double helix

First determined by Watson & Crick in 1953

Most energy favorable conformation for double stranded DNA to form

Shape and size is uniform for all life (i.e. DNA is identical)

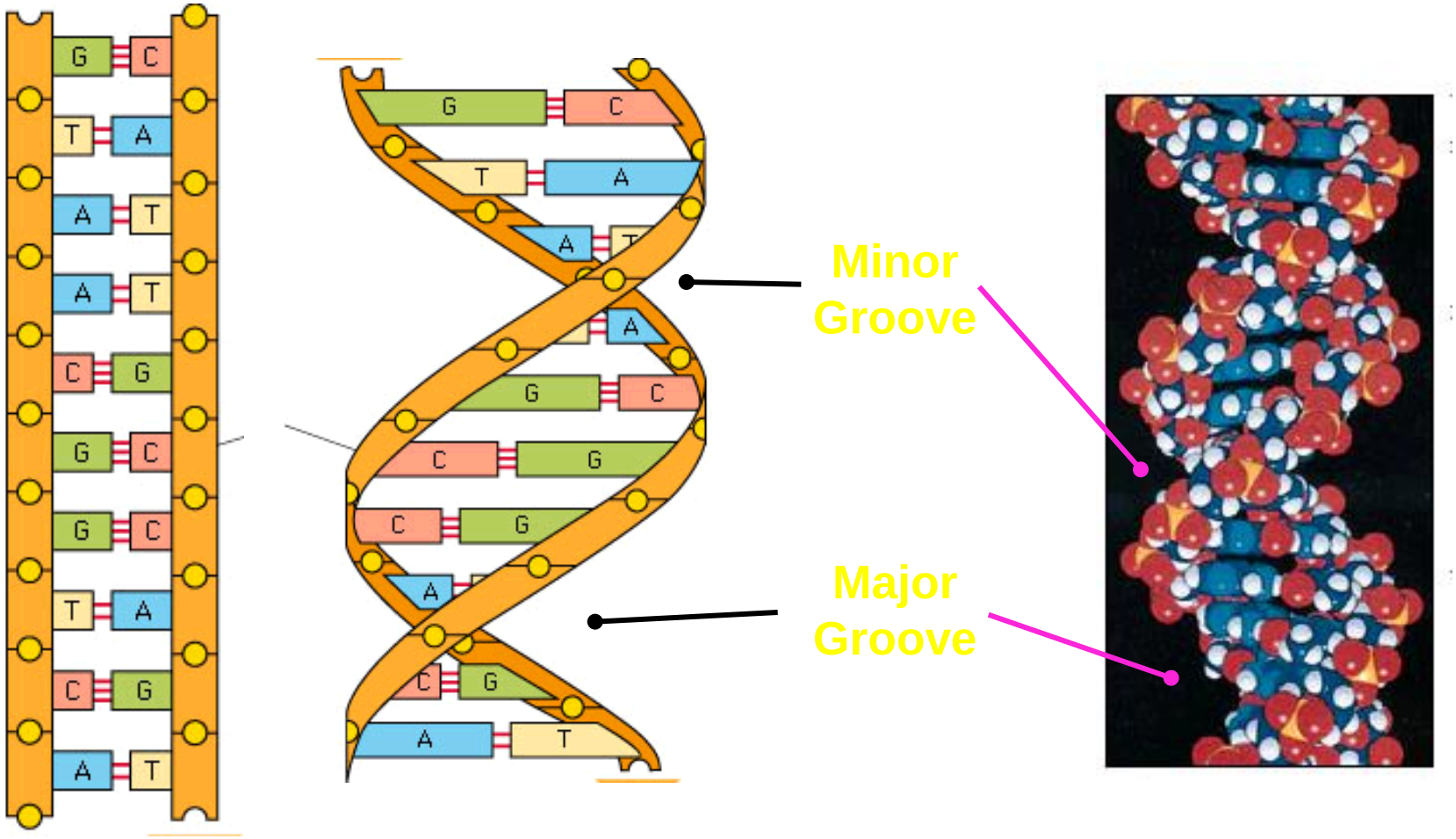
Without anti-parallel base pairing this conformation could not exist

Structure consists of “major” grooves and “minor” grooves

Major grooves are critical for binding proteins that regulate DNA function

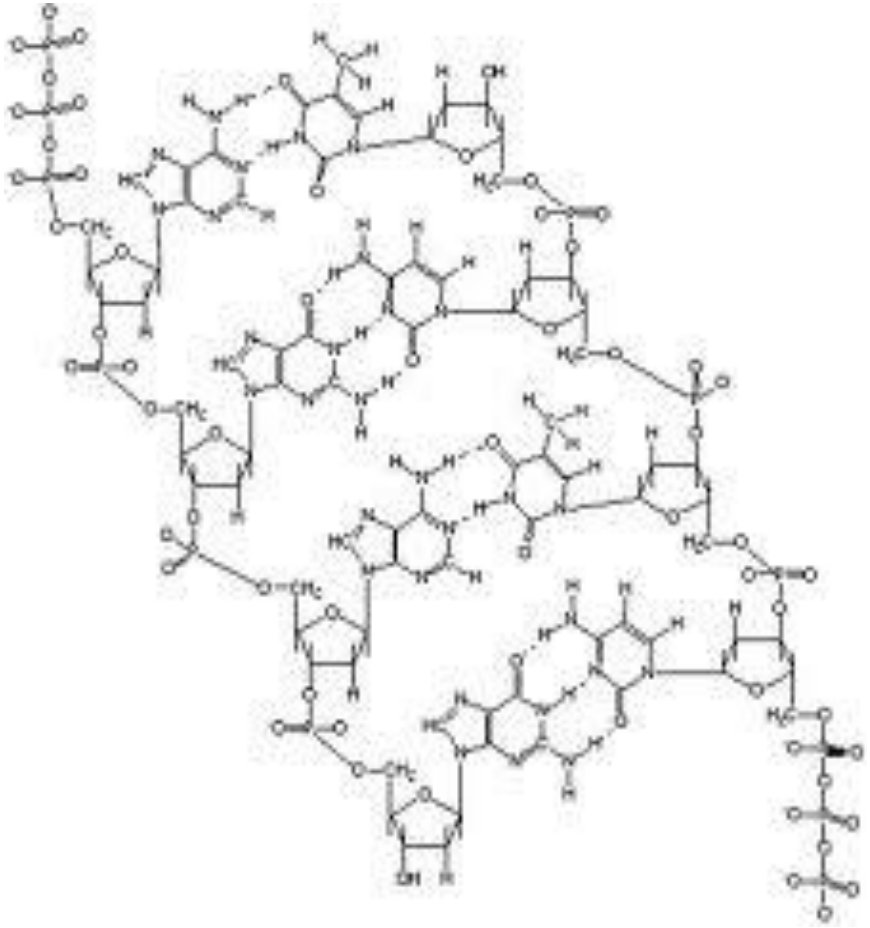
Nucleic Acid Structure

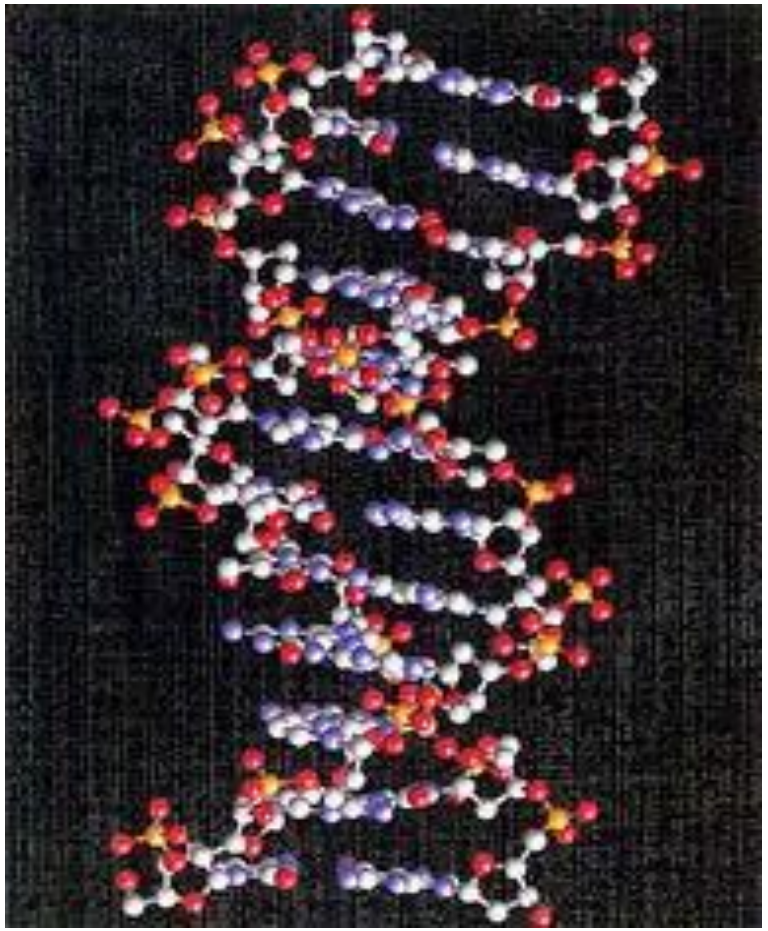
The double helix



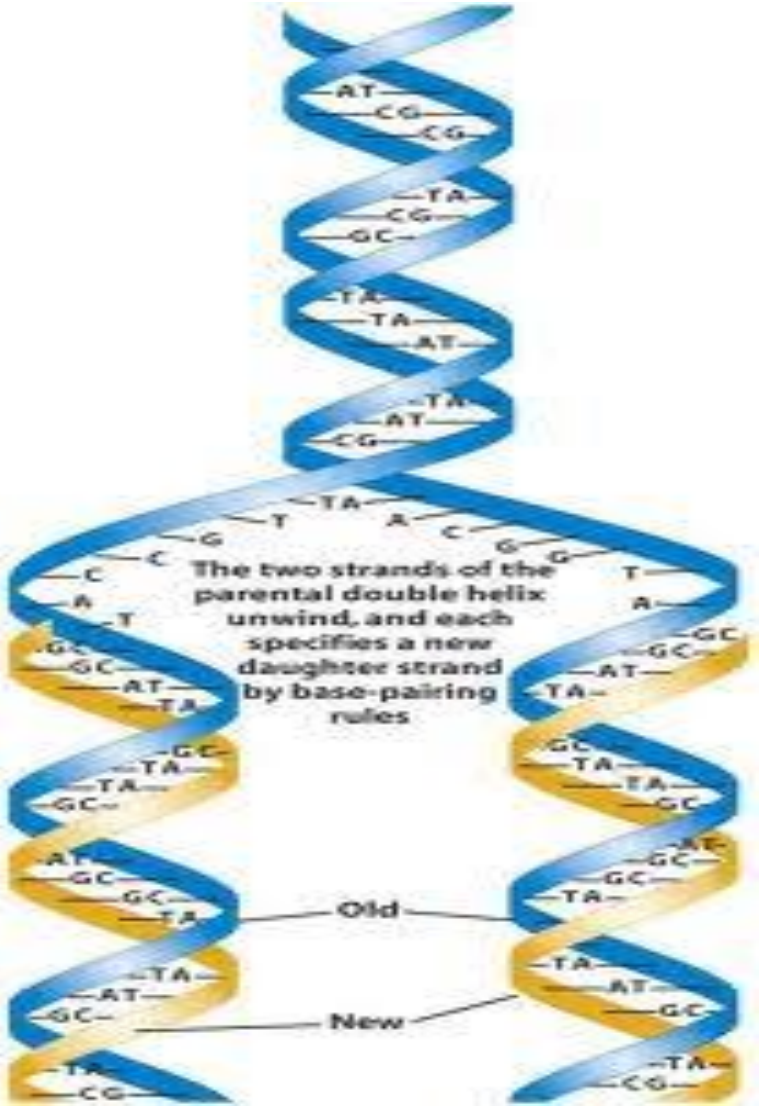
Nucleic Acid Structure

The double helix

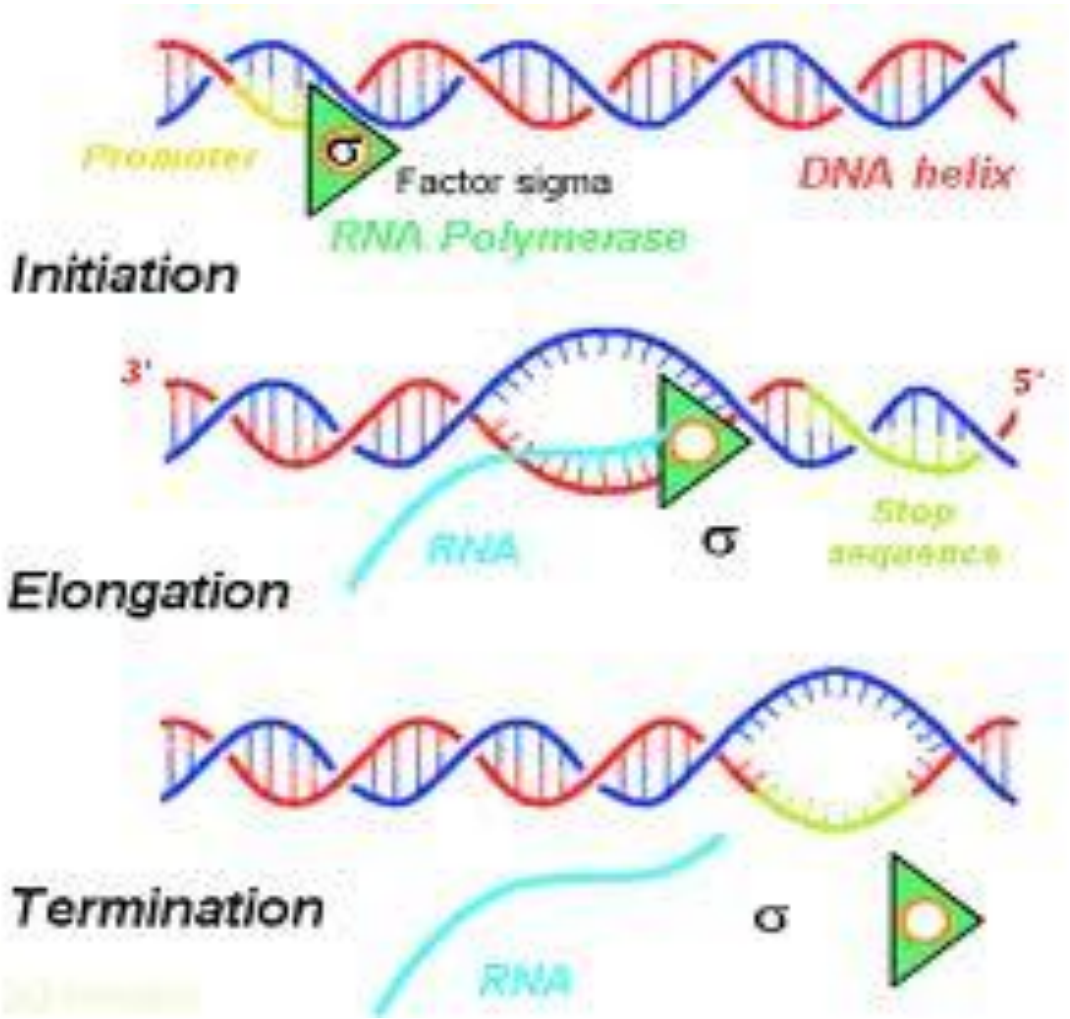




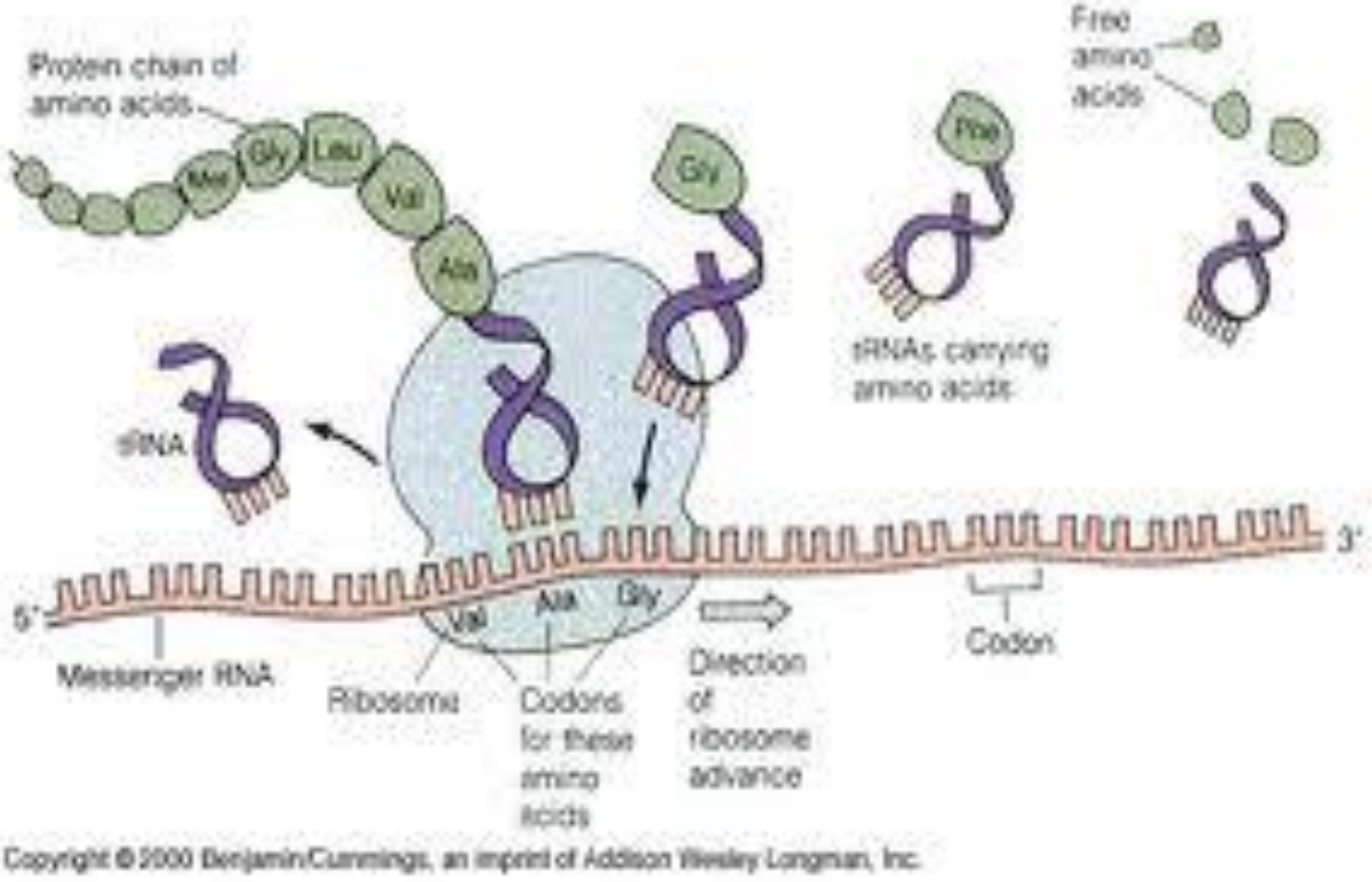
DNA replikácia



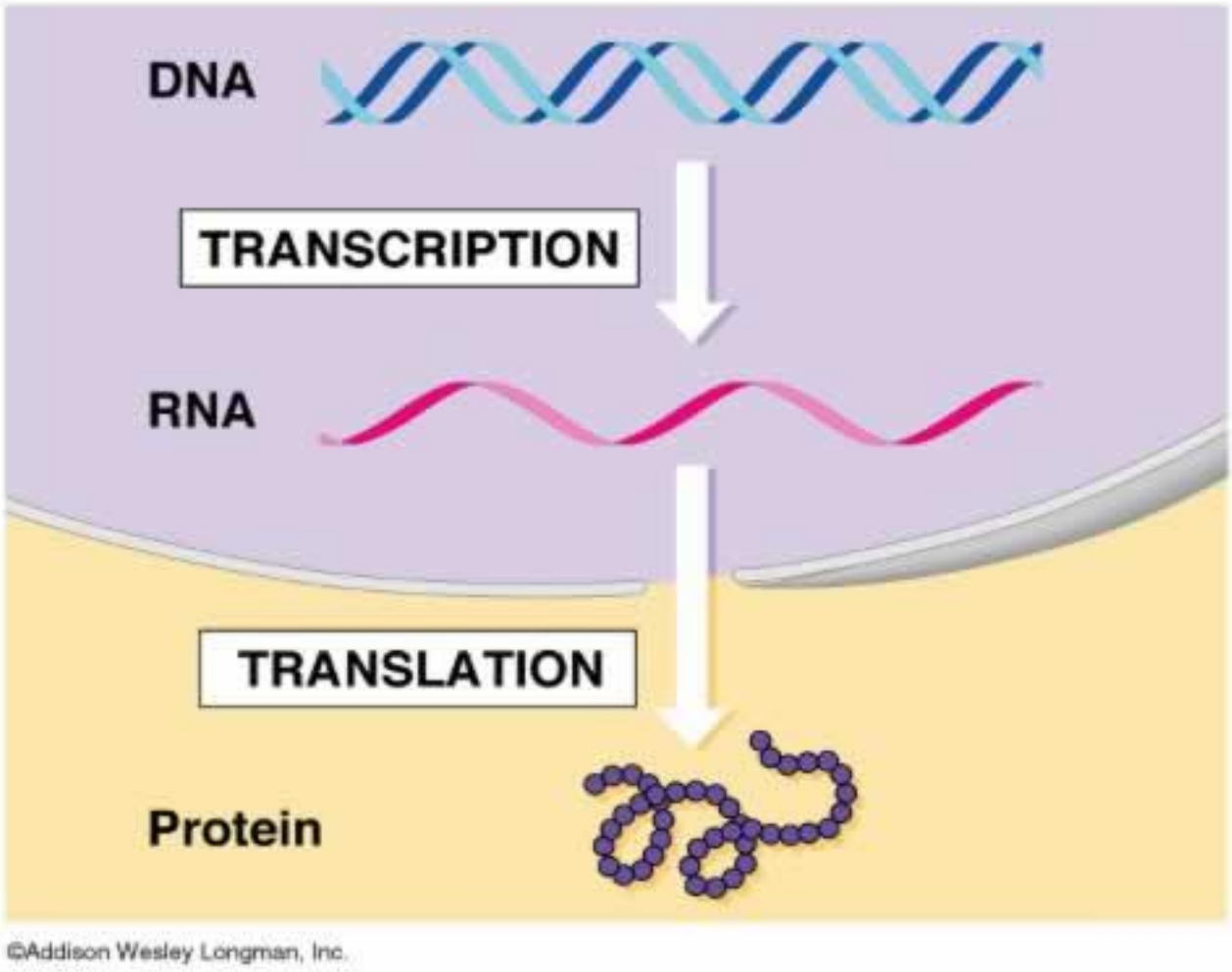
Transkripcia DNA → mRNA



Translácia mRNA → tRNA - bielkovina



Crick – centrálna dogma molekulárnej genetiky:
DNA → RNA → bielkovina



Typy mutácií