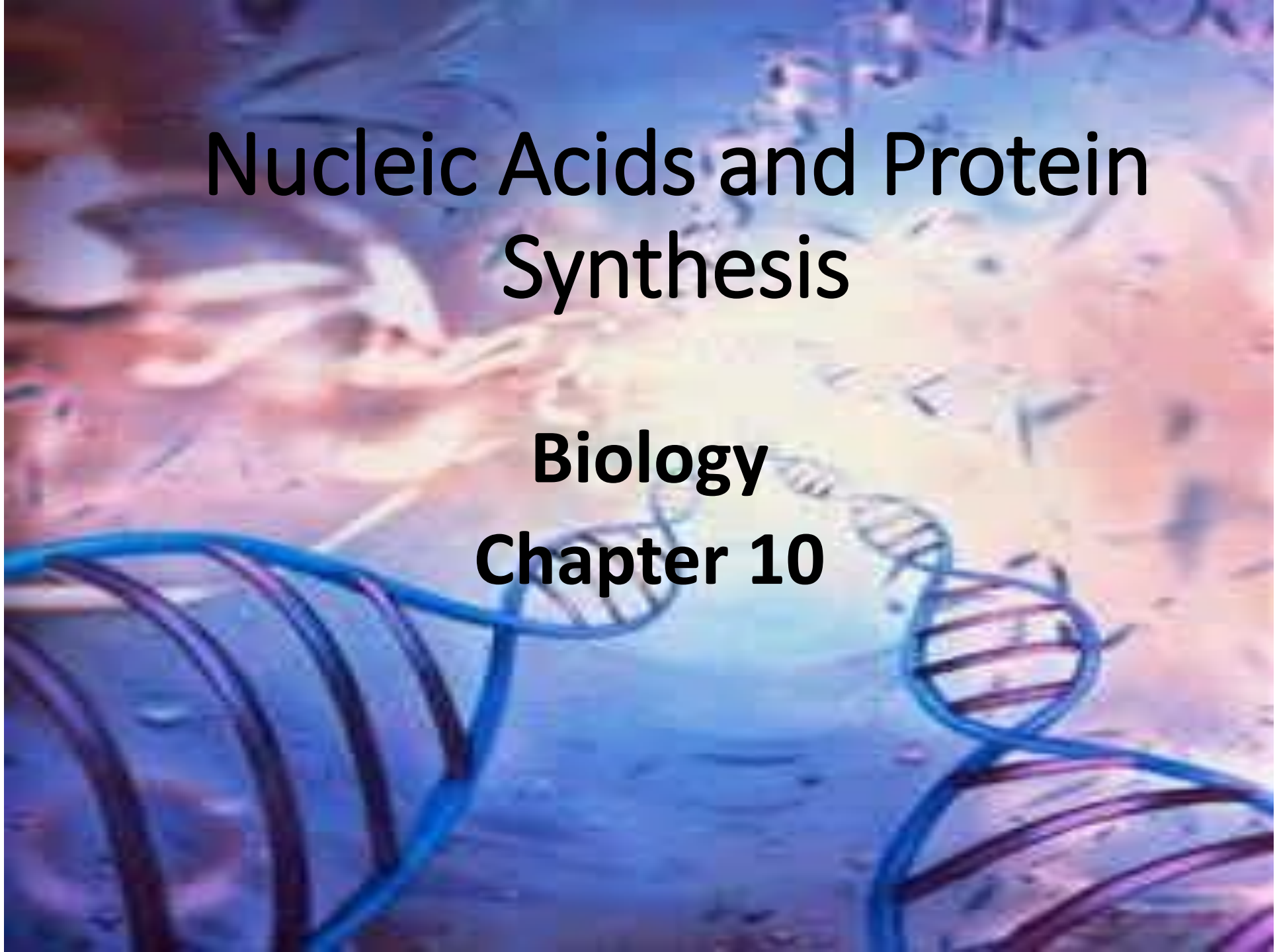


Nucleic Acids and Protein Synthesis

Biology

Chapter 10

I. DNA –Deoxyribonucleic acid

Composed of repeating units called "nucleotides" it is the storage place for genetic information.

A. Structure of DNA

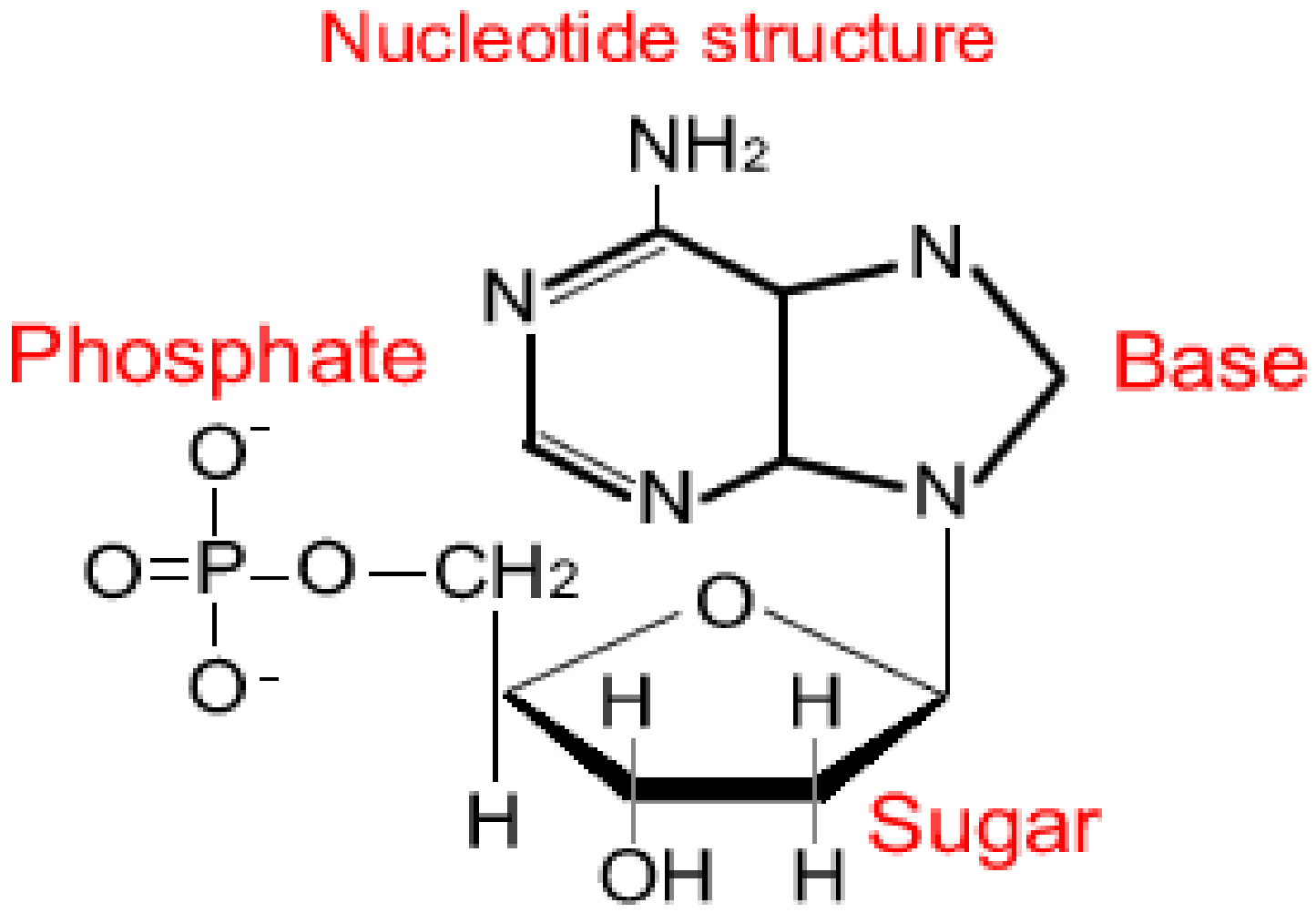
1. Nucleotide structure

a. Deoxyribose – 5 carbon sugar

b. Phosphate group

c. Nitrogen containing base

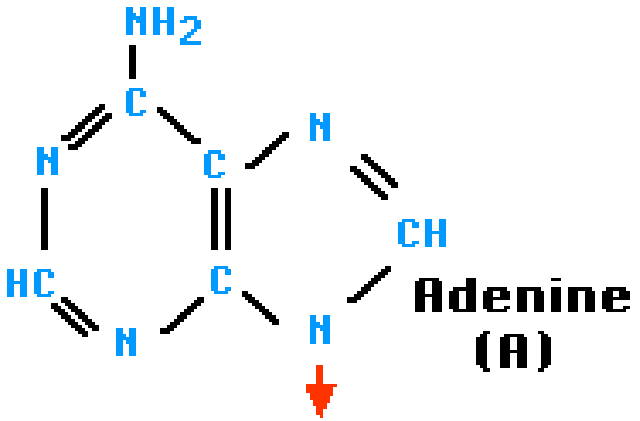
NUCLEOT


Nucleotide structure
Phosphate
Base
Sugar
NH2
N
N
N
N
O⁻
O=P–O–CH2
O⁻
O
H
H
H
OH
H

2. Nitrogenous Bases

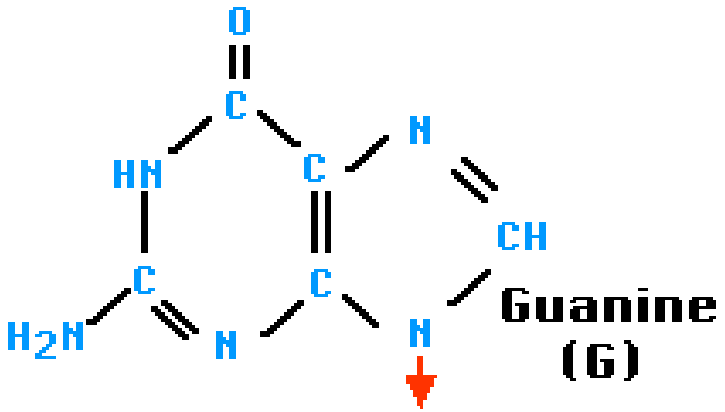
There are four different bases classified into two groups.

- **a. Purines**
  1. **Adenine (A)**
  2. **Guanine (G)**
- **b. Pyrimidines**
  1. **Thymine (T)**
  2. **Cytosine (C)**



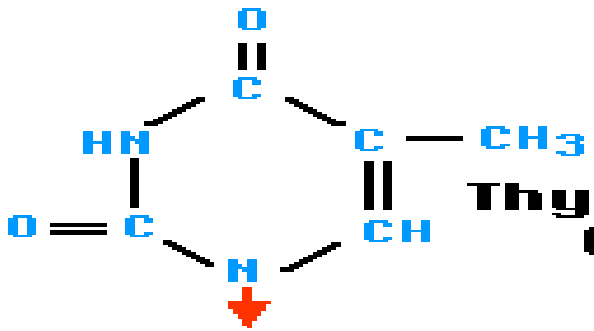
Adenine
(A)

to 1′ carbon of
either pentose



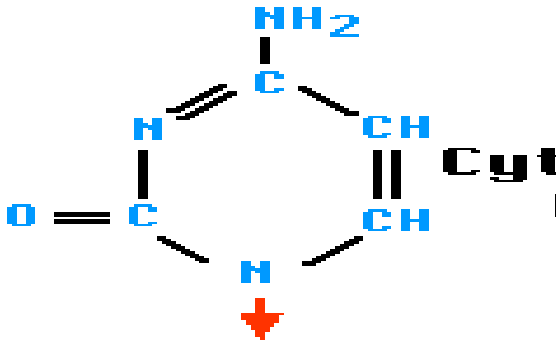
Guanine
(G)

to 1′ carbon of
either pentose



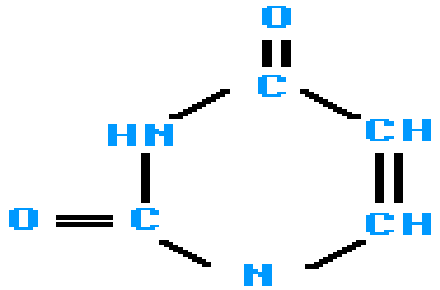
Thymine
(T)

to 1′ carbon of
deoxyribose



Cytosine
(C)

to 1′ carbon of
either pentose



Uracil
(U)

to 1′ carbon
of ribose

3. The Double Helix

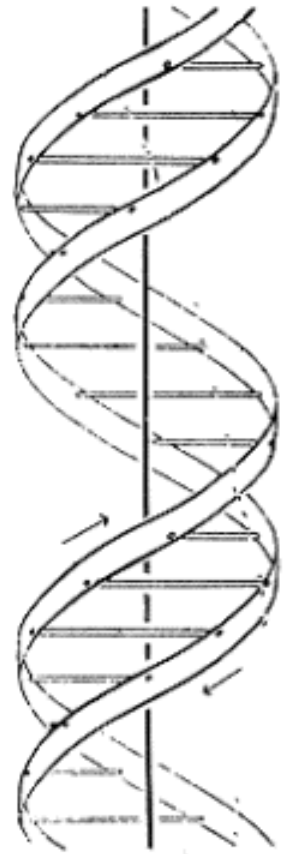
In 1953 Watson and Crick announced the shape of the DNA molecule was a double helix.

The sugar and phosphate group make up the sides of the molecule.

Two bases, hydrogen bonded together, make up the cross pieces of the molecule like rungs in a ladder.

The most common form of DNA has a right hand twist with each full turn consisting of ten base pairs.

WATSO



This figure is purely diagrammatic. The two ribbons symbolize the two phosphate—sugar chains, and the horizontal rods the pairs of bases holding the chains together. The vertical line marks the fibre axis

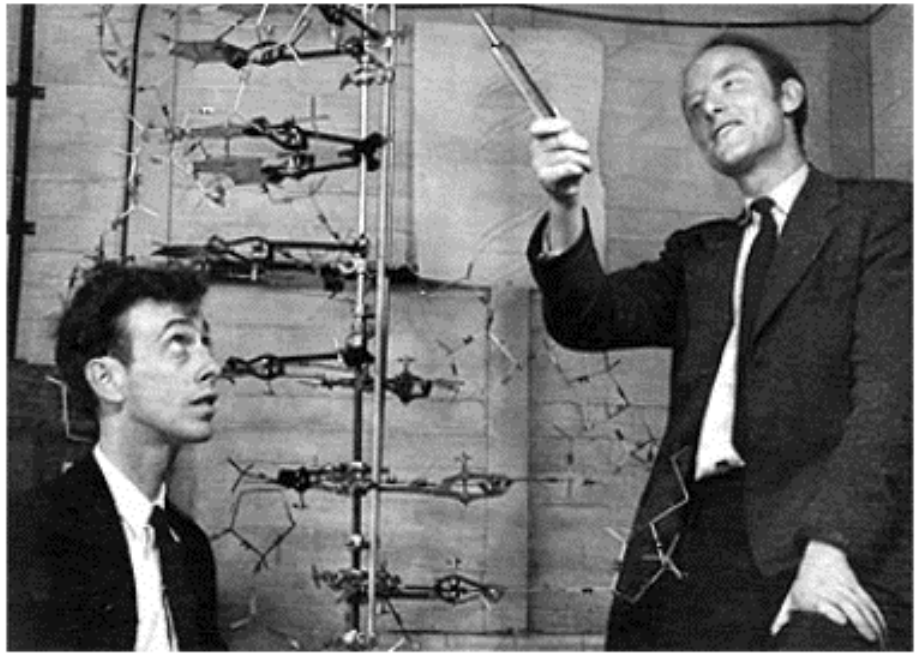
2 April 1953 *NATURE,* VOL 171, page 737

MOLECULAR STRUCTURE OF NUCLEIC ACIDS

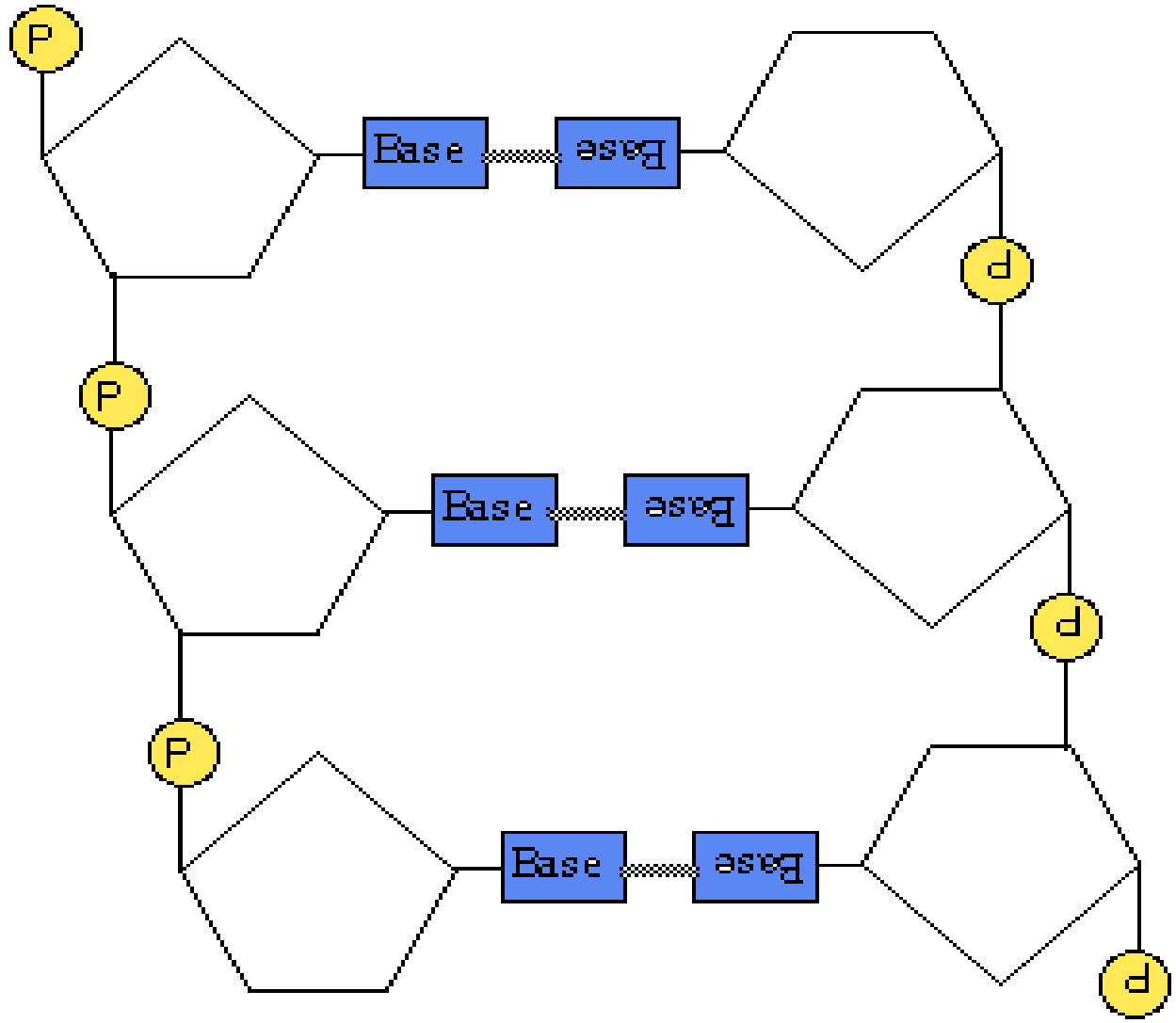
James D. WATSON & Francis H.C. CRICK

1962 Nobelprice in Medicine

Molecular structure of nuclear acids and significance for information transfer in living material



DNA



4. Complementary Base Pairing

Because of molecular compatibility, purines and pyrimidines pair up in a specific manner.

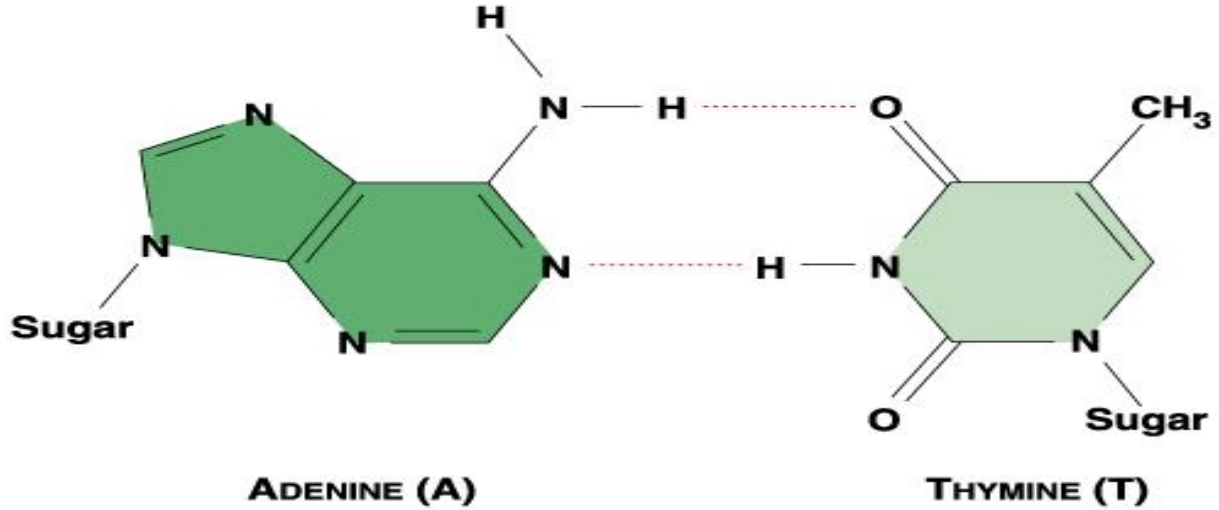
a. **Adenine only with Thymine A –T**

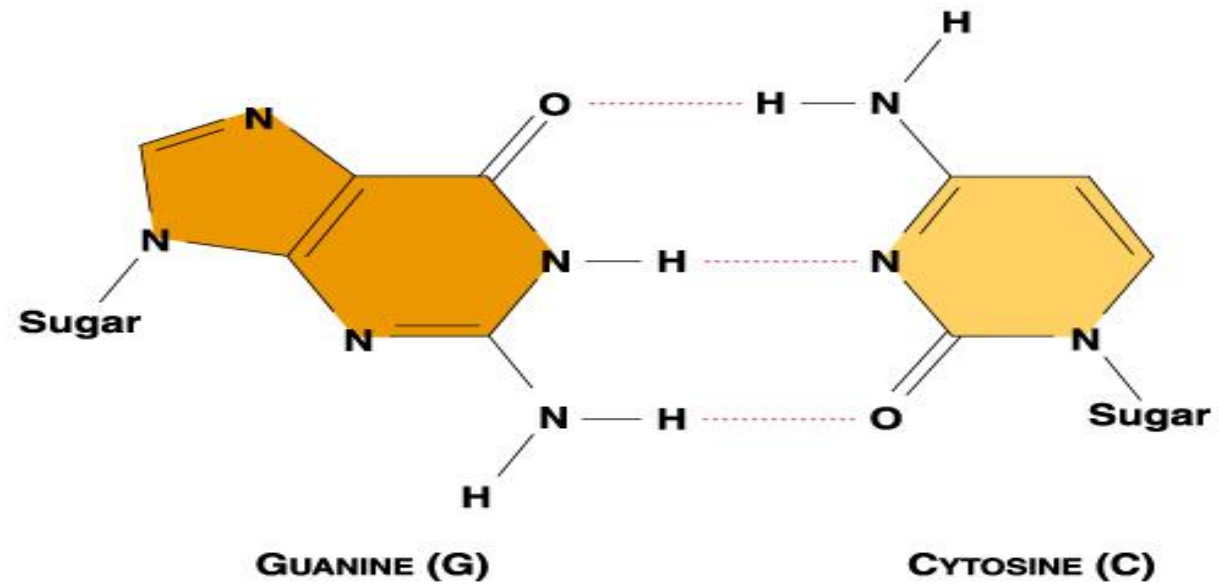
b. **Guanine only with Cytosine G – C**

The sequence of the bases comprises the genetic code of living things.

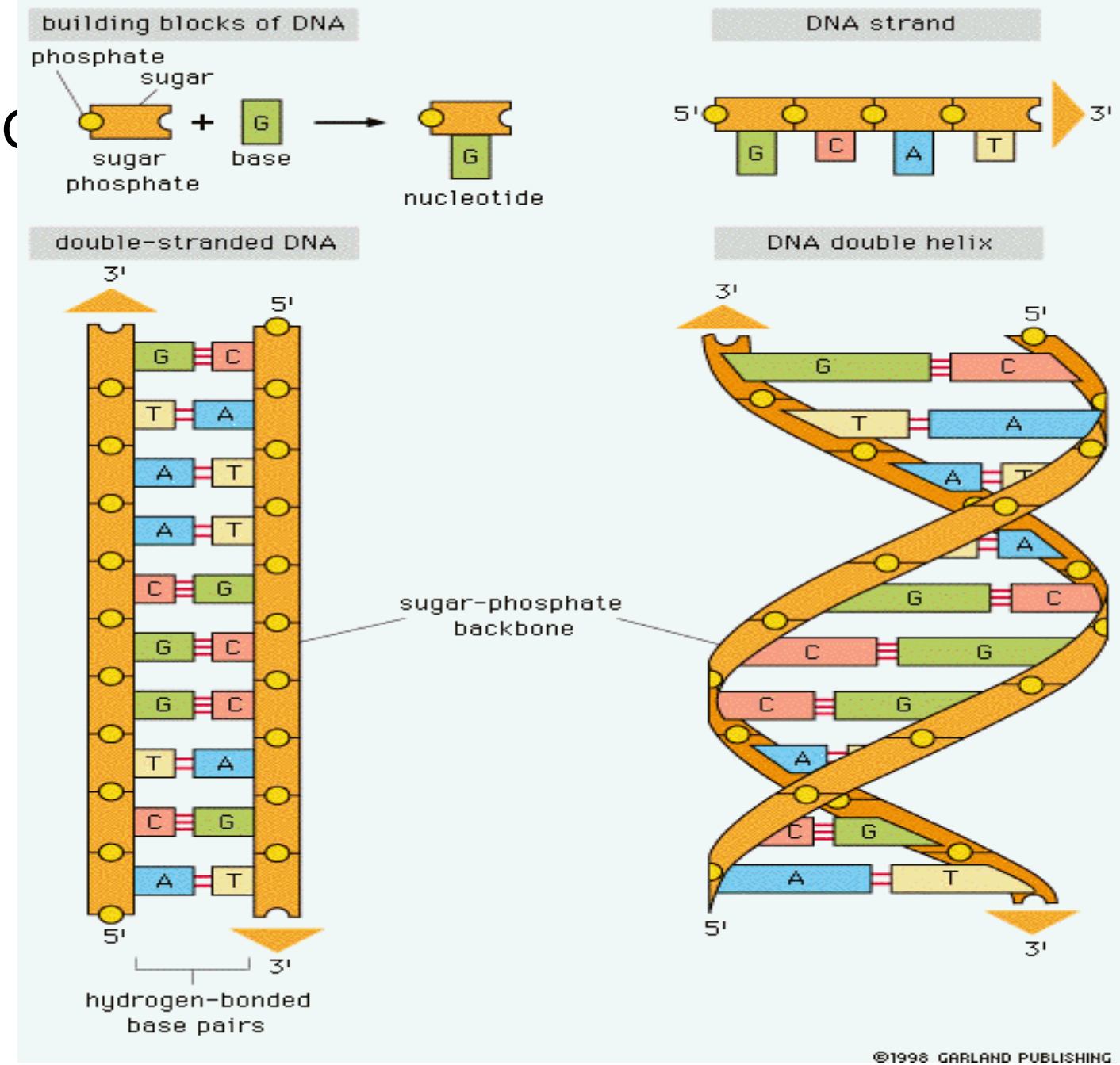
The complementary base pairing allows the DNA molecule to be replicated.

BASE PAIRING





BASE PAIRING



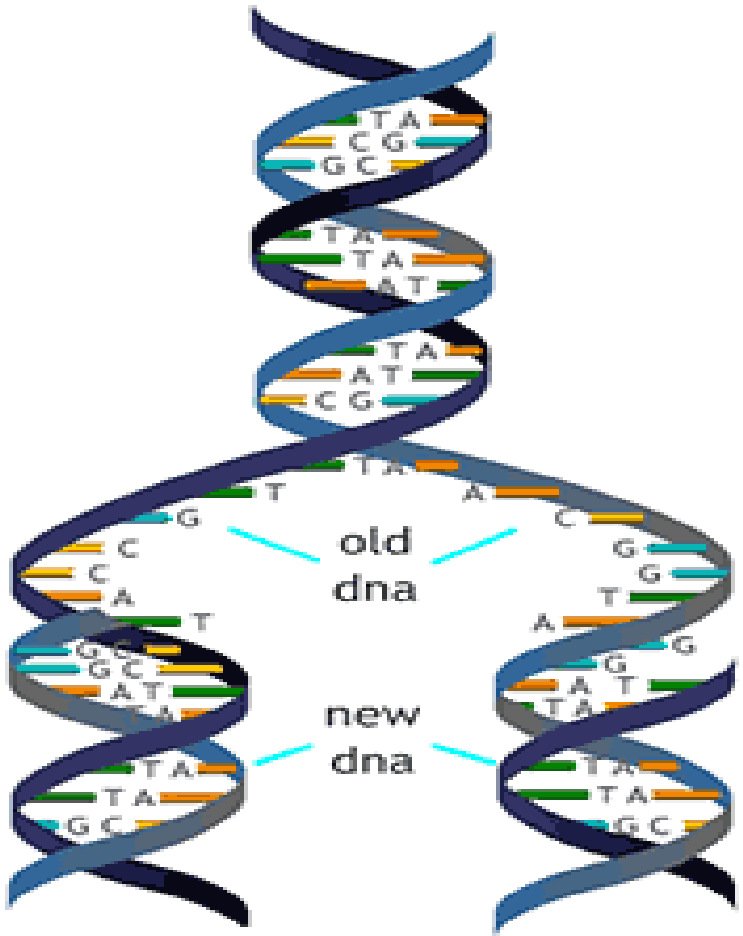
B. Replication of DNA

1. **DNA separates into two strands.**
   a. **Replication Fork**

      Point at which the two strands unzip.

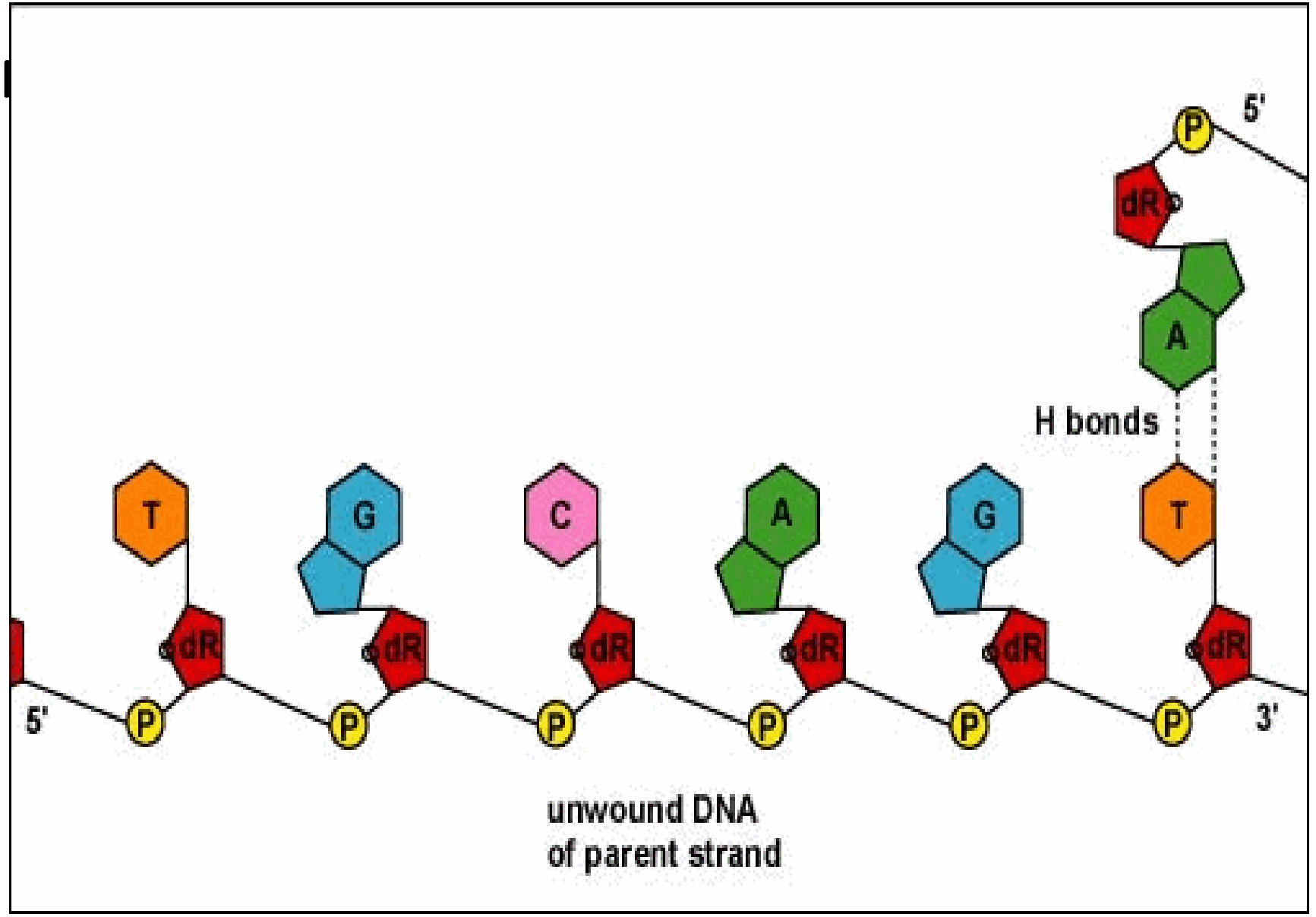
   b. **Helicases**

      Enzyme that breaks the hydrogen bonds, allowing the strands to separate.
2. **Nucleotide molecules present in the nucleus are attached to the unzipped strands of DNA by "DNA Polymerase"**
3. **Two identical strands of DNA are formed.**



DNA unzipping

DNA REI



4. Accuracy and Repair

When copying a DNA strand the error rate is about one in ten thousand.

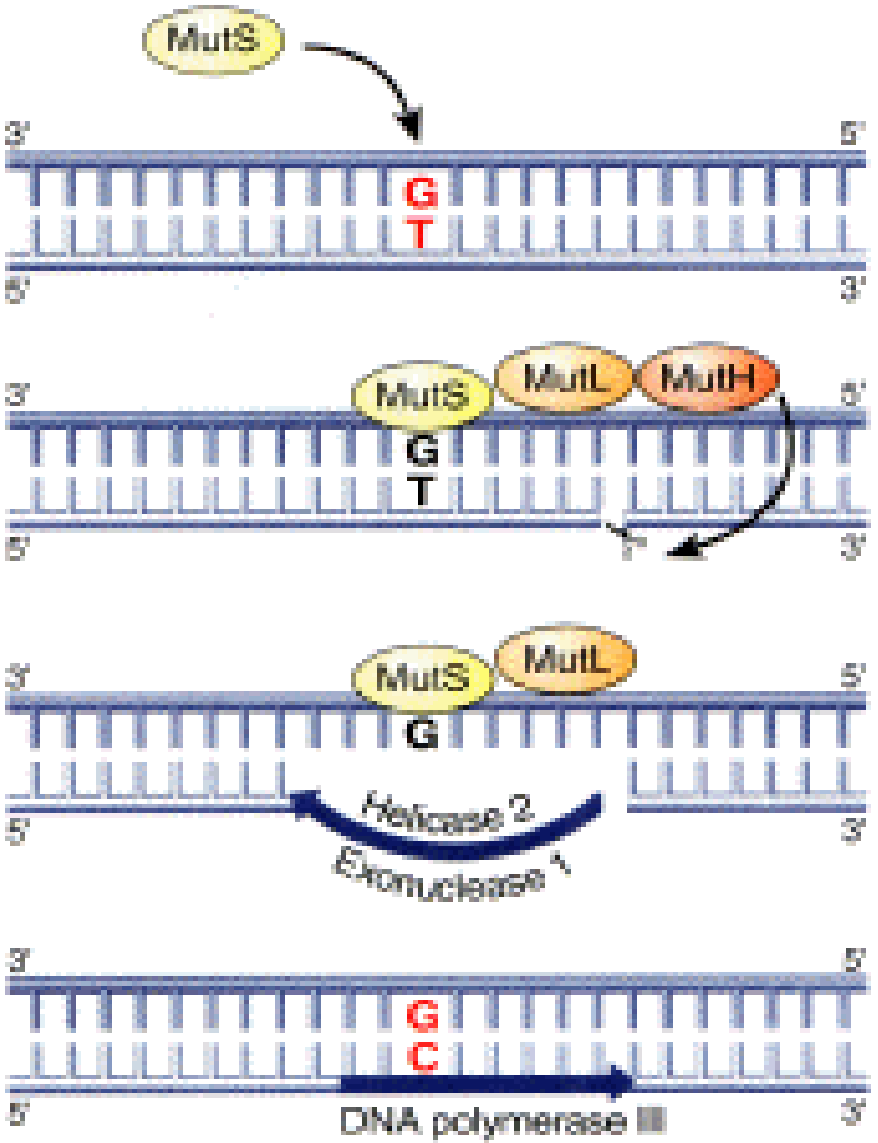
Chemical proofreading and repair by special enzymes reduces this rate to about one in a billion.

Damage to DNA by ultraviolet light, chemicals, etc. are also repaired by the repair enzymes.

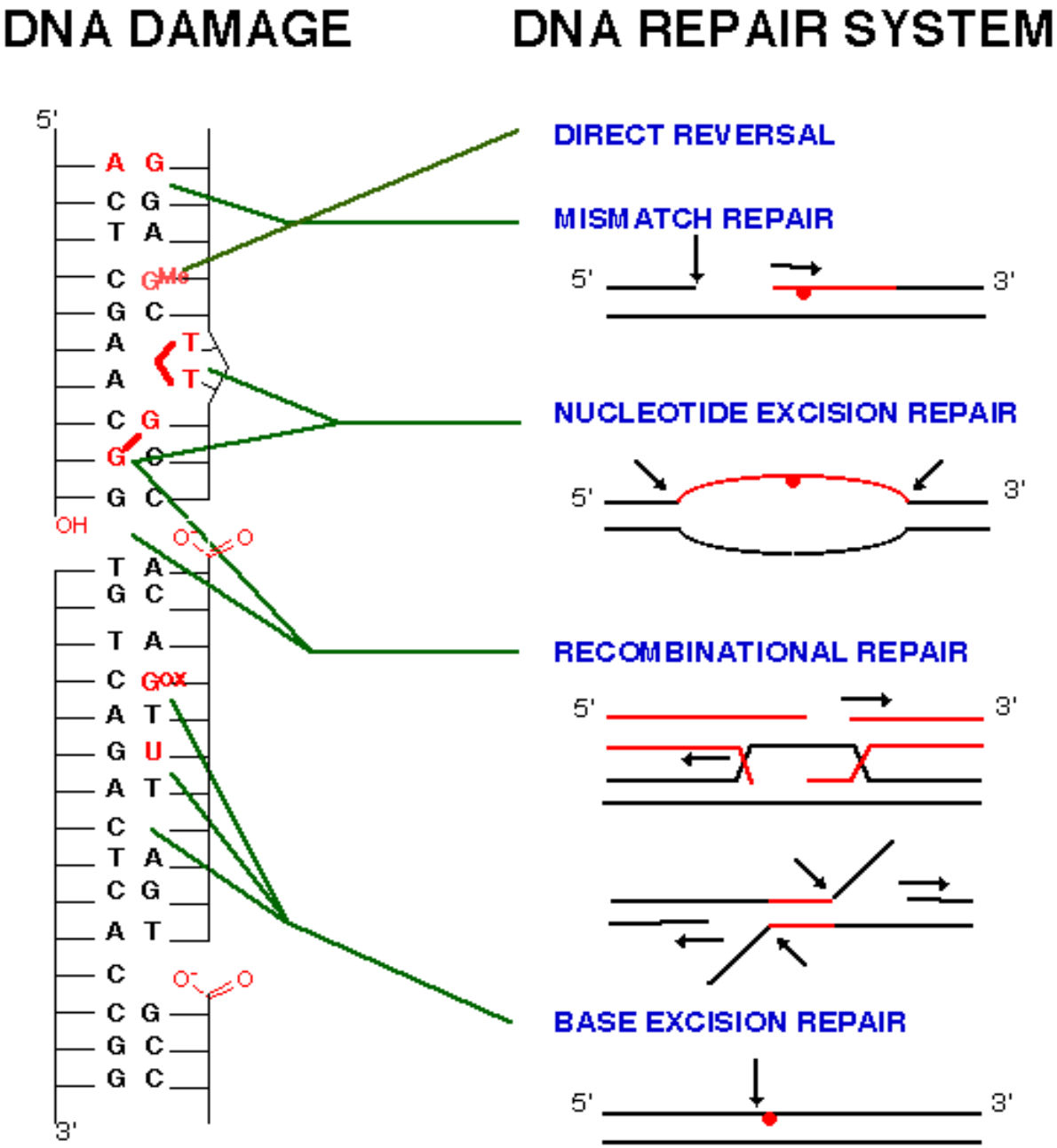
Those errors that are not corrected cause changes in the nucleotide sequence and are called.

“Mutations”

MUTATIONS


MutS
3'
5'
G
T
5'
3'
MutS
MutL
MutH
3'
5'
G
T
5'
3'
MutS
MutL
3'
5'
G
5'
3'
Helicase 2
Exonuclease I
3'
5'
G
C
5'
3'
DNA polymerase III

DNA REPAIR


DNA DAMAGE
DNA REPAIR SYSTEM
5'
A G
C G
T A
C GMe
G C
A T
A T
C G
G O
G C
OH
T A
G C
T A
C Gox
A T
G U
A T
C
T A
C G
A T
C
C G
G C
G C
3'
DIRECT REVERSAL
MISMATCH REPAIR
5'
3'
NUCLEOTIDE EXCISION REPAIR
5'
3'
RECOMBINATIONAL REPAIR
5'
3'
BASE EXCISION REPAIR
5'
3'

II. RNA

Moves information from the DNA in the nucleus to the ribosomes in the cytosol and controls protein synthesis.

A. RNA Structure

1. Single Stranded Molecule composed of nucleotides.

a. Ribose is the Sugar

b. Uracil replaces Thymine as one of the bases.