Genetic Material

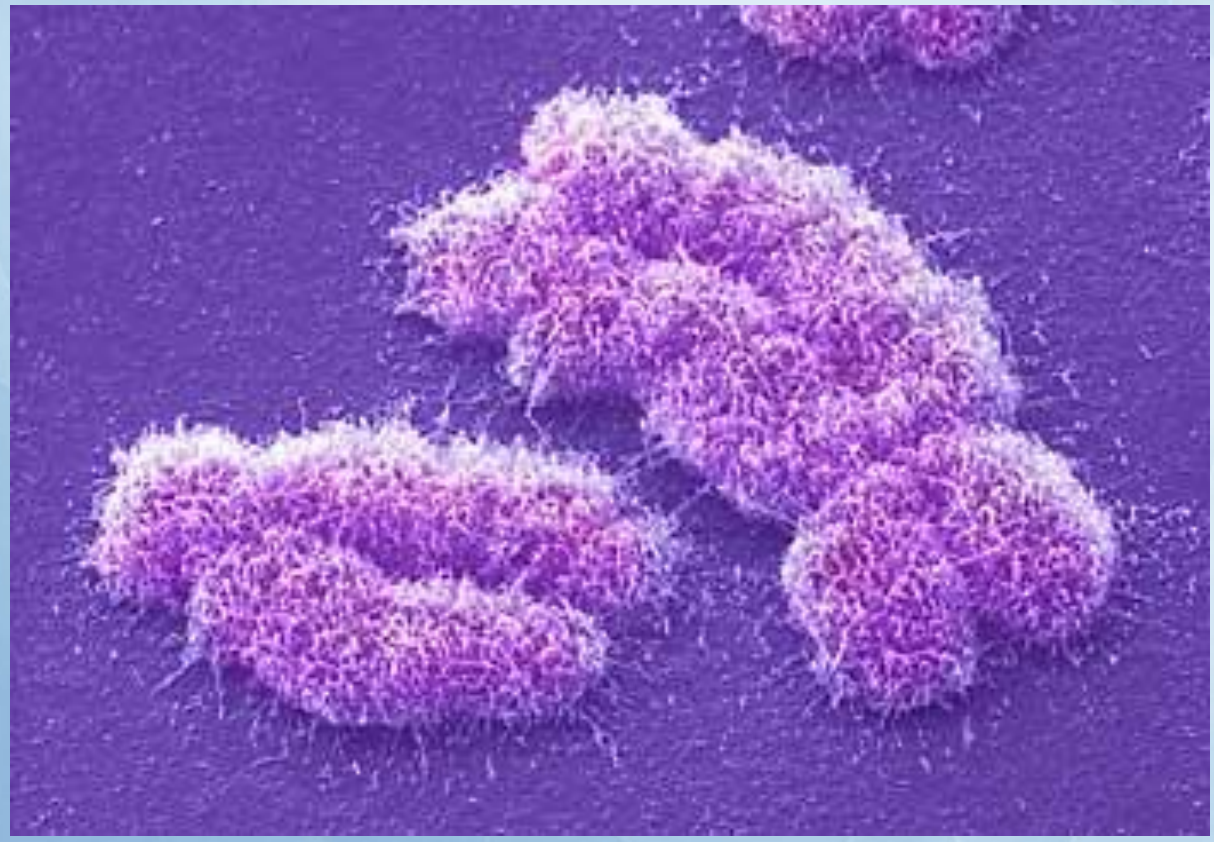
Genetics Department, Faculty of Agriculture,
Beni-Suef University

Properties Of Genetic Material

1. Repository of genetic information
2. Info must be accessible, allow cell to respond
3. Info must be in form transmissible to progeny
4. Physical and chemical stability
5. Potential for heritable change

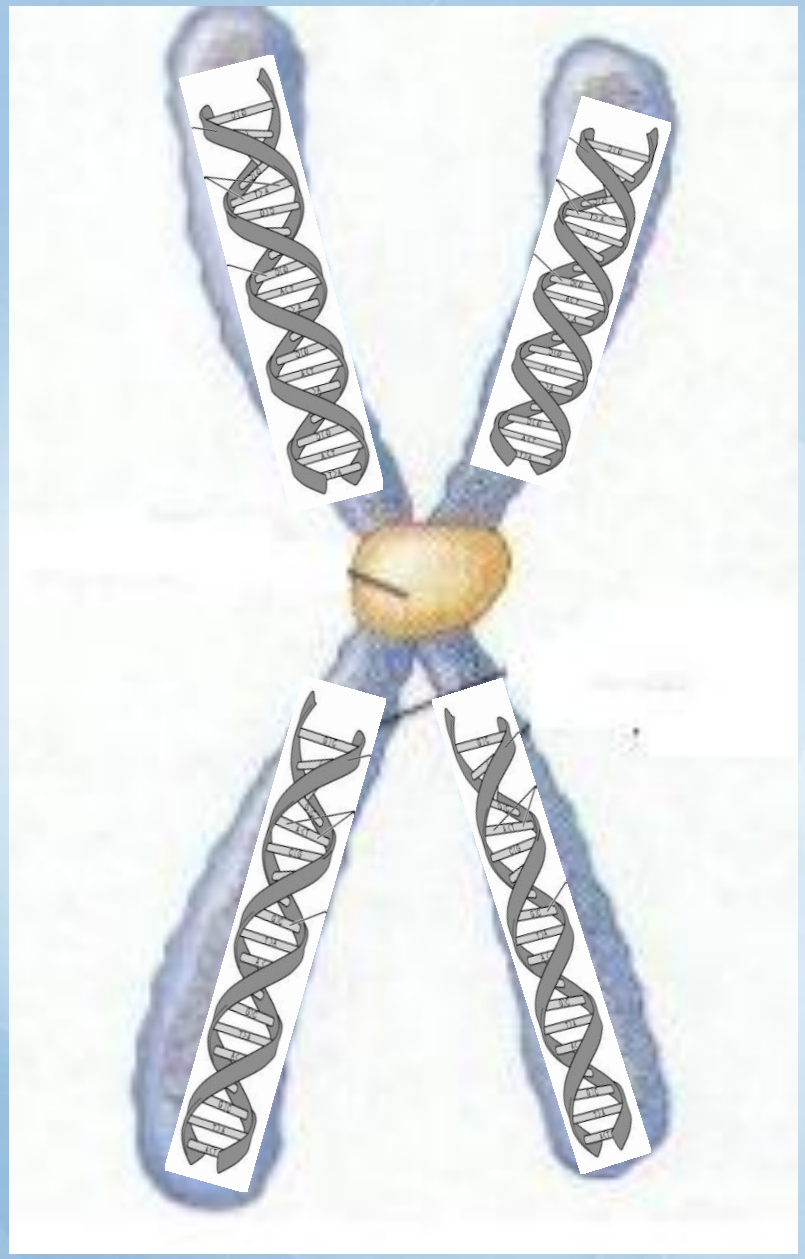
DNA

DNA stands for deoxyribonucleic acid.



Where is DNA found?

James Watson and **Francis Crick** discovered that chromosomes are made up of DNA and called it a **double helix.** These chromosomes are located in the **nucleus**!!



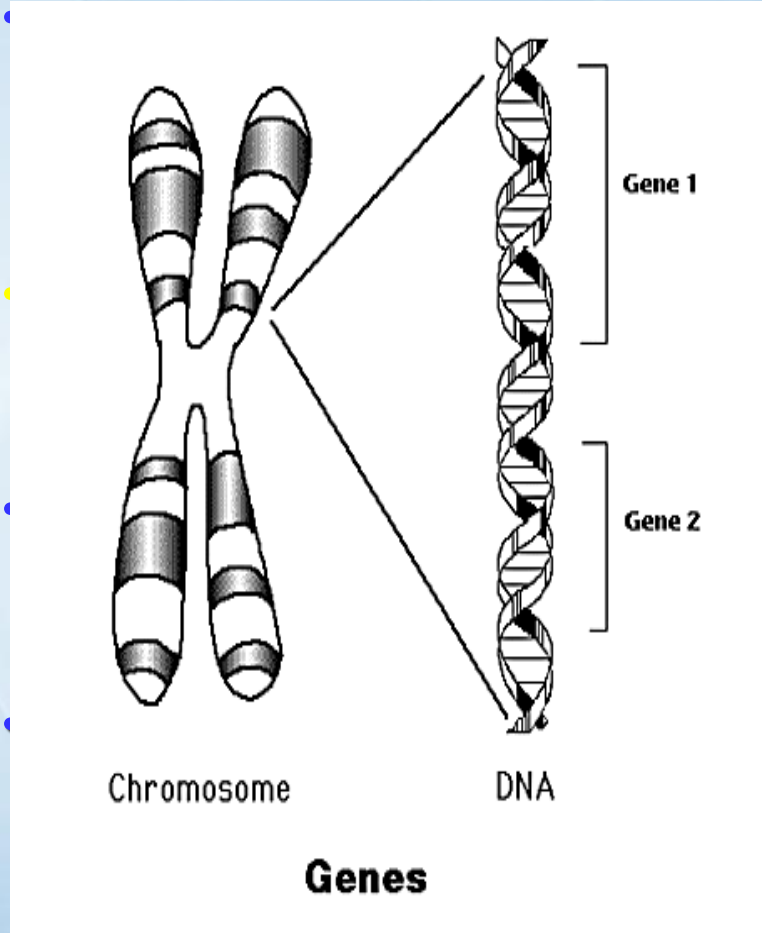
Genetic Information

Gene – basic unit of genetic information. Genes determine the inherited characters.

Genome – the collection of genetic information.

Chromosomes – storage units of *genes*.

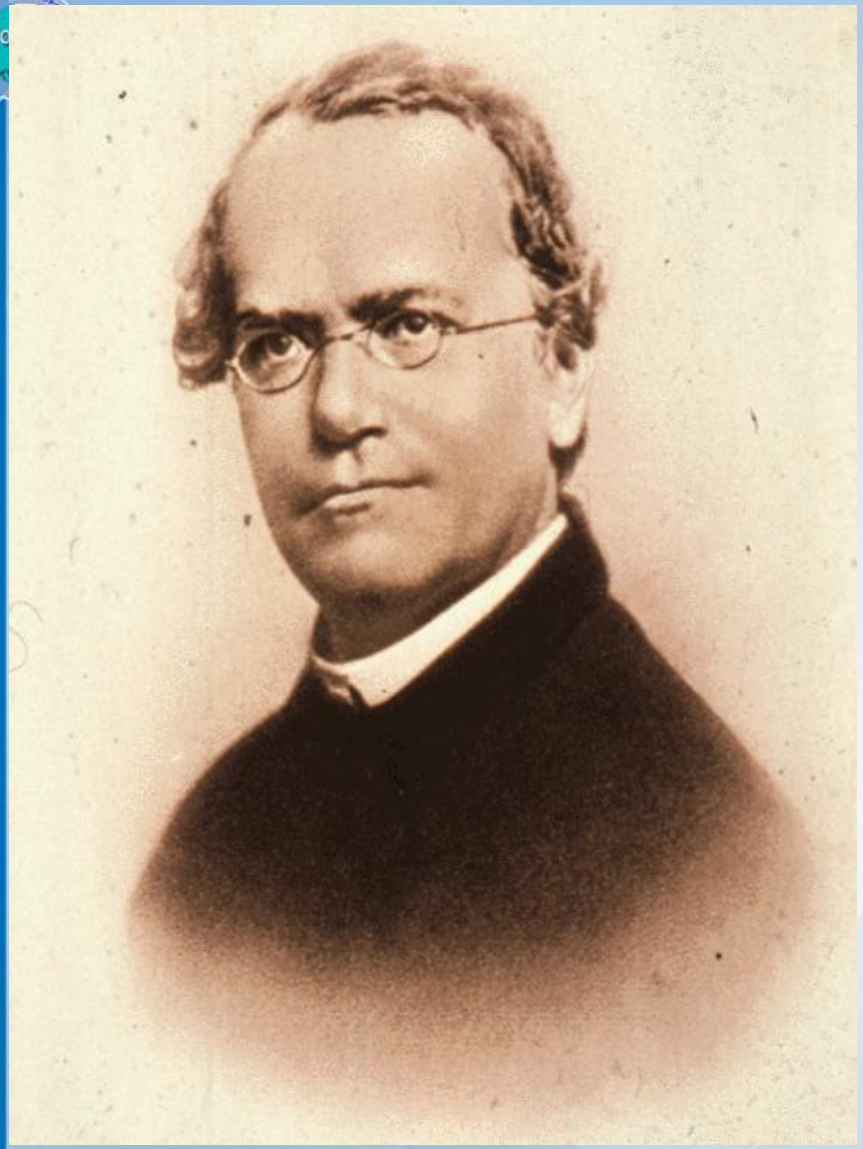
DNA - is a nucleic acid that contains the genetic instructions specifying the biological development of all cellular forms of life



Genotypes ⟺ Phenotypes

- At each locus (except for sex chromosomes) there are 2 genes. These constitute the individual's ***genotype*** at the locus.

- The expression of a genotype is termed a ***phenotype***. For example, hair color, weight, or the presence or absence of a disease.



1866

Gregor Mendel published the results of his investigations of the inheritance of "factors" in pea plants.

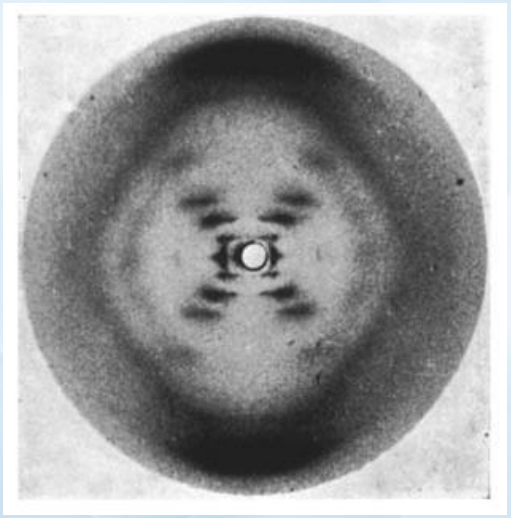
A HISTORY OF DNA

- **Discovery of the DNA double helix**

A. **Frederick Griffith** – Discovers that a factor in diseased bacteria can transform harmless bacteria into deadly **(1928)** bacteria

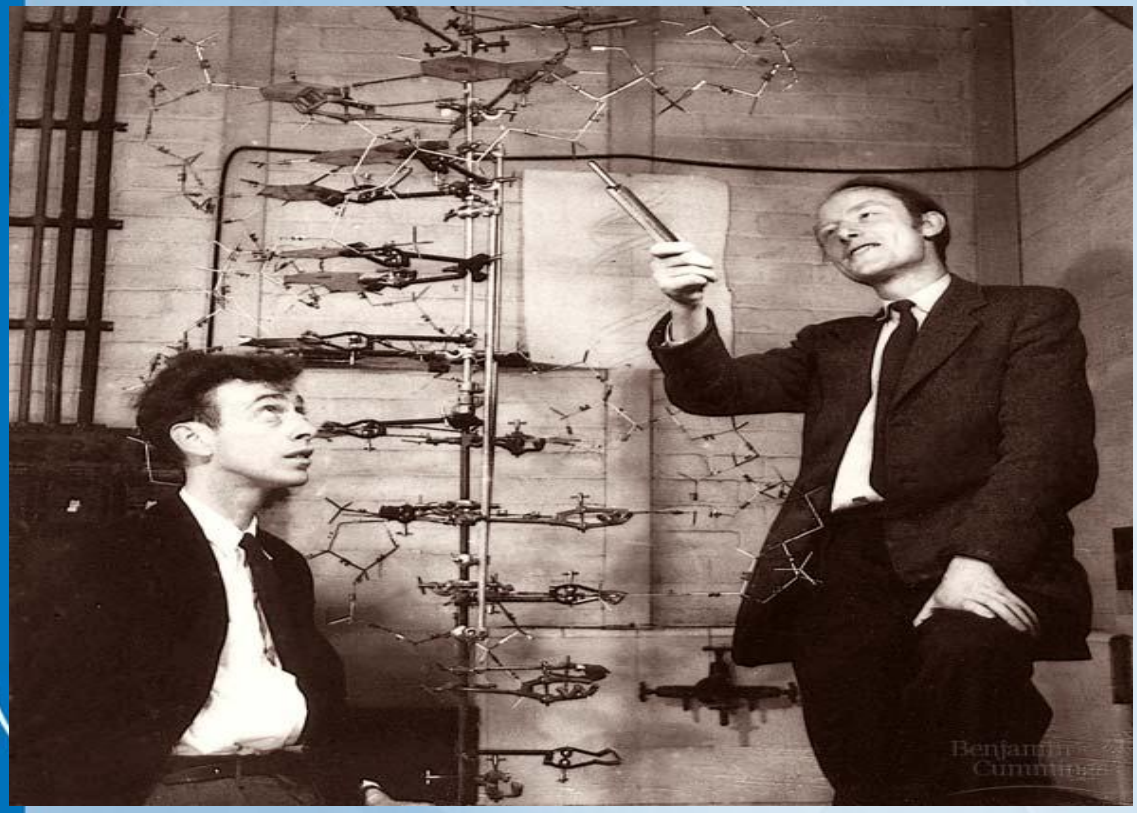
Rosalind B. Franklin - X-ray photo of DNA.

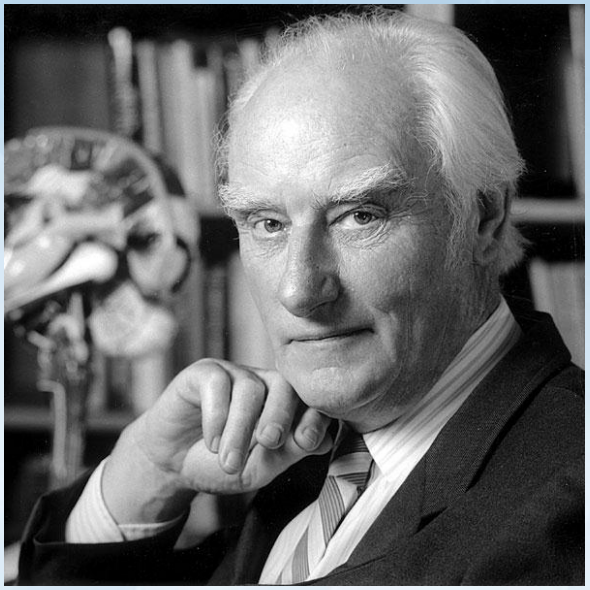
(1952)

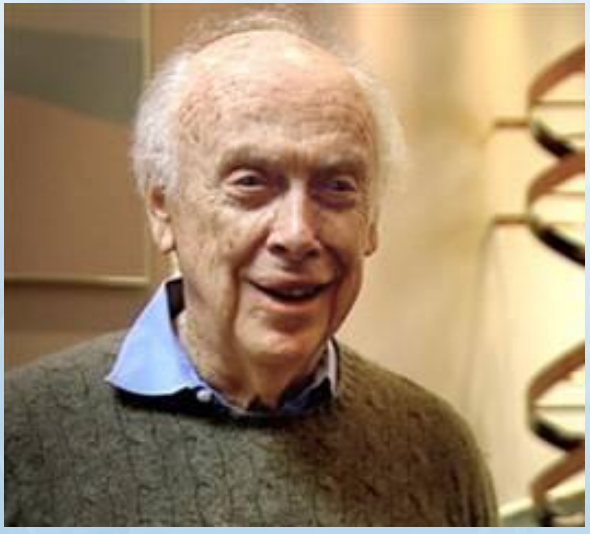


Watson (U.S.A) and Crick (Britain)

1953 article in Nature







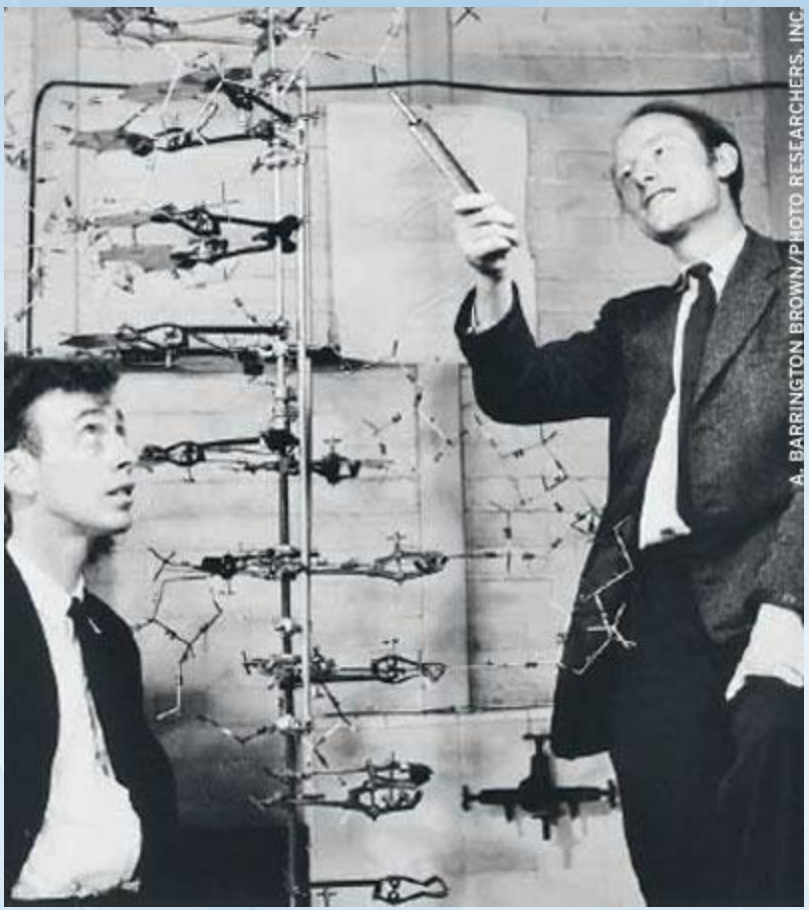
Watson and Crick - described the DNA molecule from Franklin's X-ray. **(1953)**

C.

C. Structure of DNA

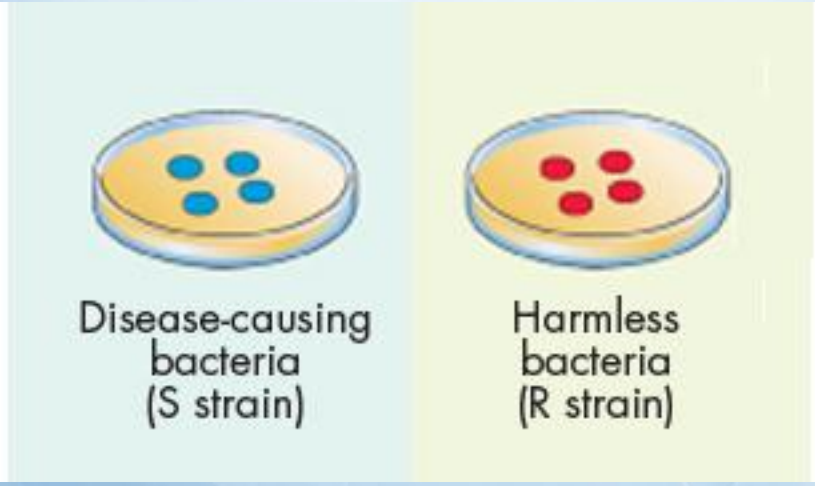
James Watson & Francis Crick – American biologist & British physicist who built the first accurate structural model of DNA (Nobel Prize in 1962).

-Watson & Crick's model of DNA was a double helix (twisted ladder), in which 2 strands were wound around each other.



Griffith's Experiments

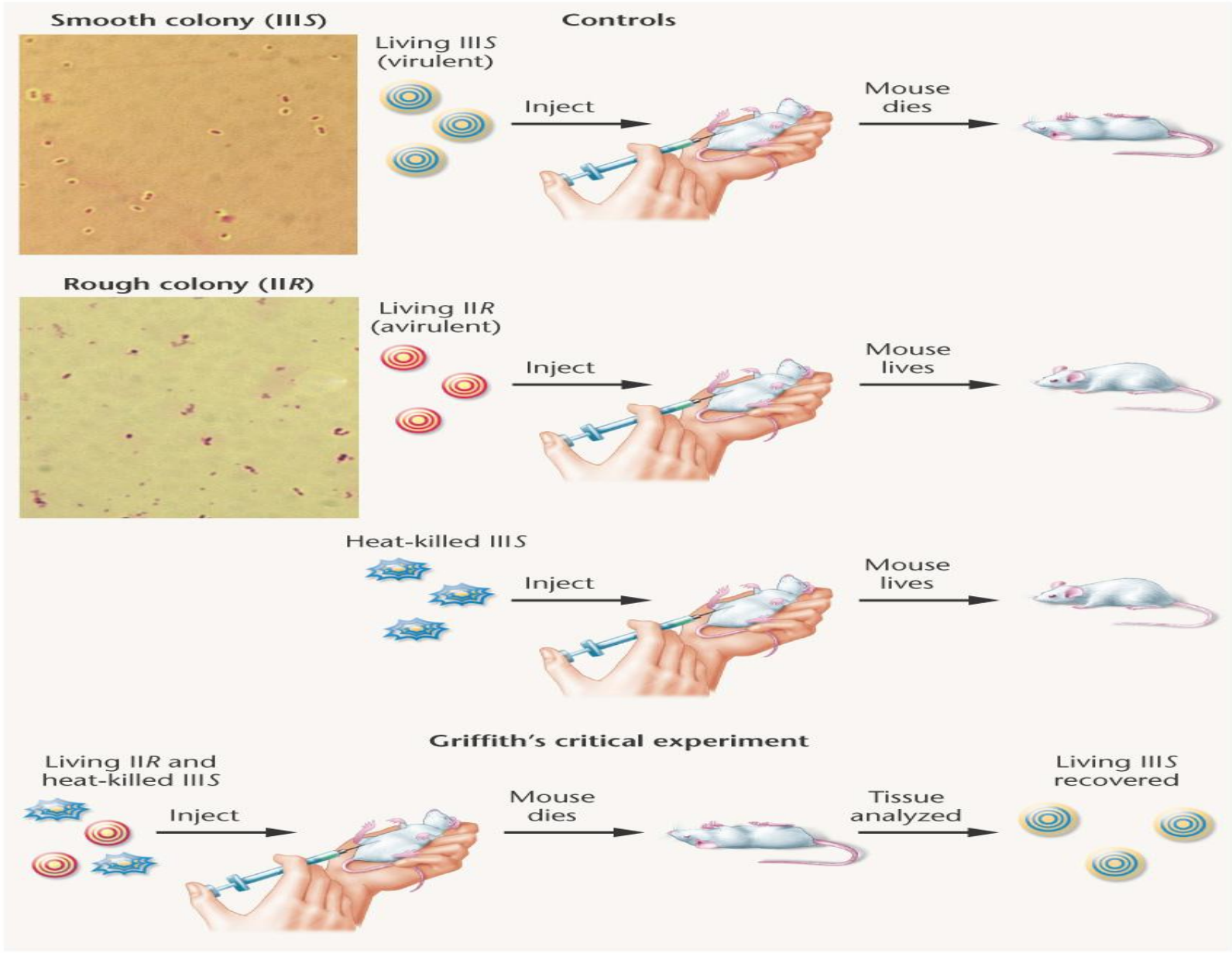
- The disease-causing bacteria (S strain) grew into smooth colonies on culture plates, whereas the harmless bacteria (R strain) produced colonies with rough



Griffith's Experiments

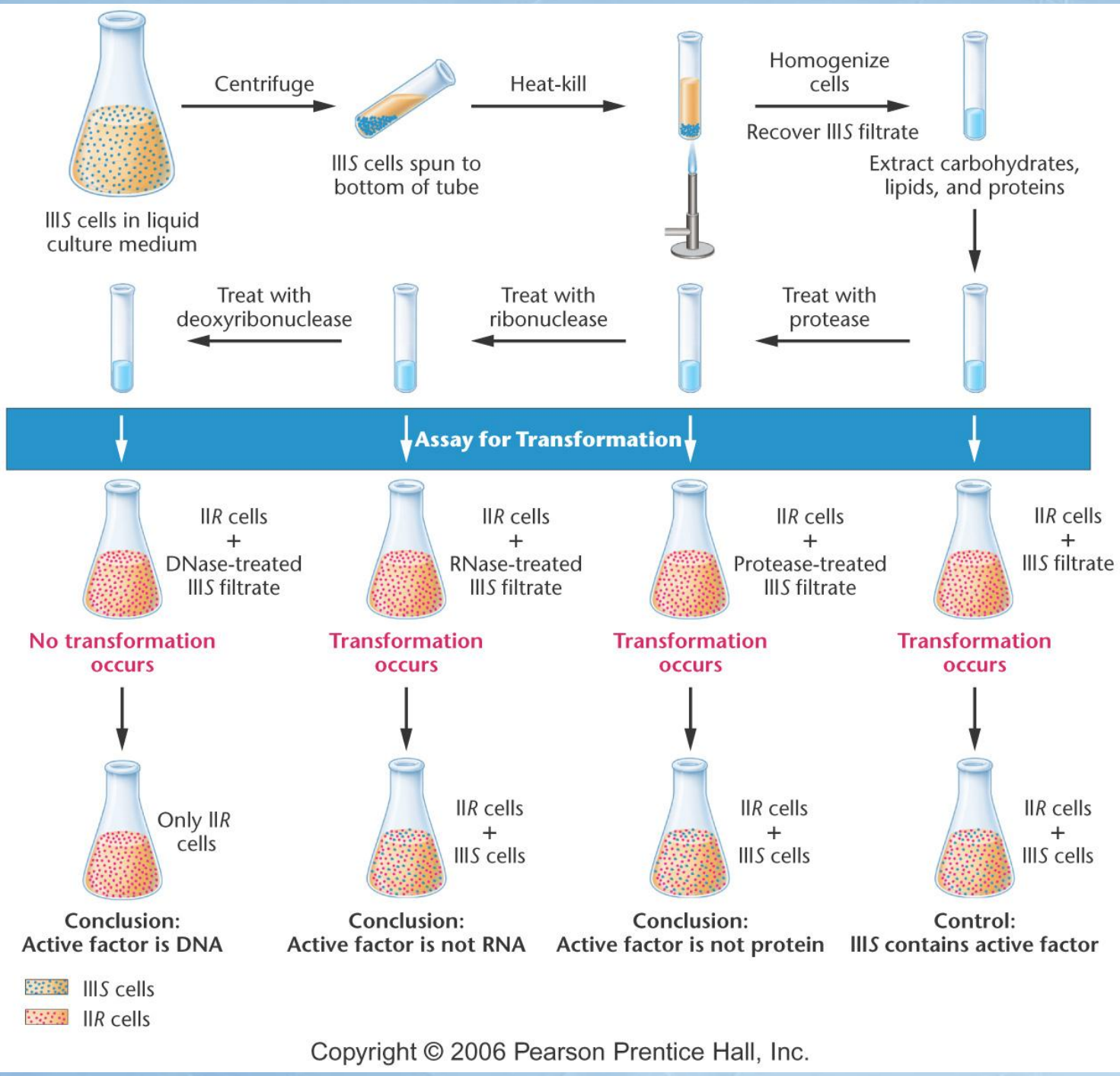
- When Griffith injected mice with disease-causing bacteria, the mice developed pneumonia and died.

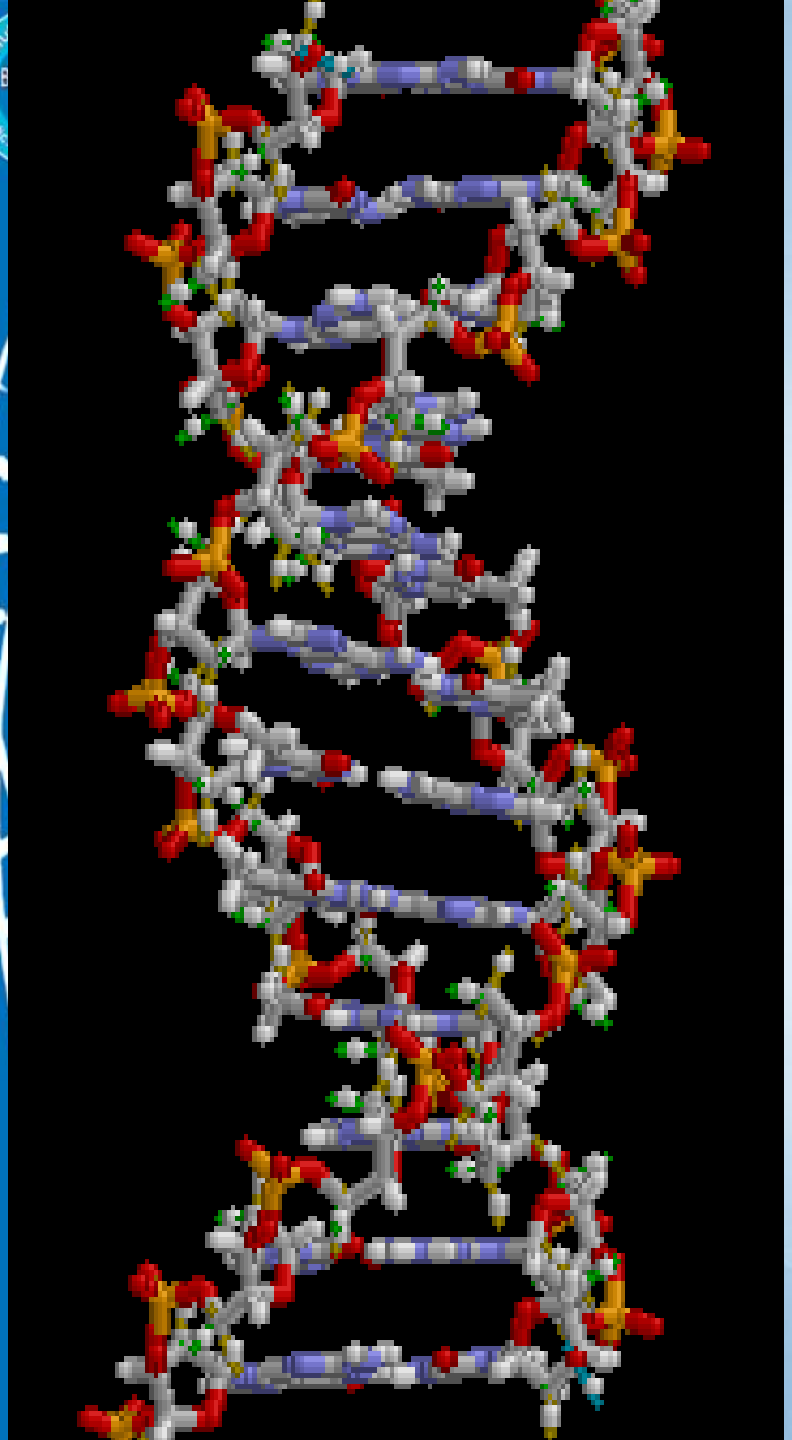
- When he injected mice with harmless bacteria, the mice stayed healthy.



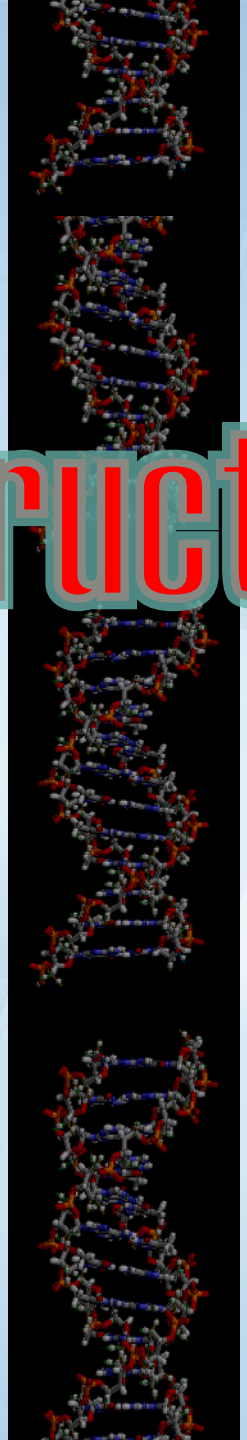
Griffith's Experiment

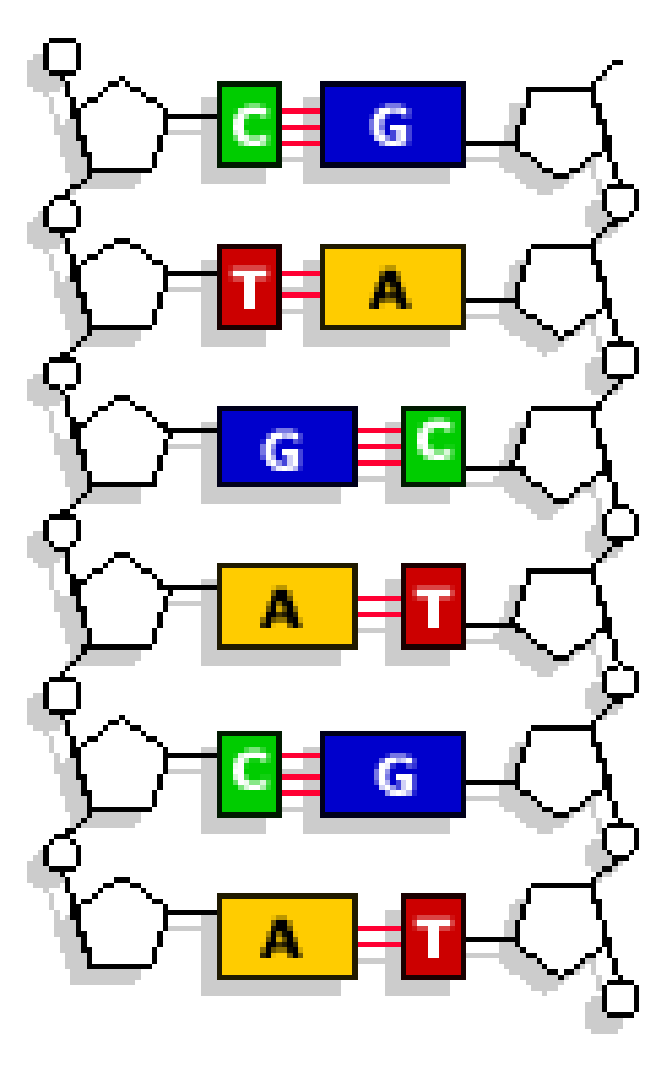
Avery, McCarty and MacLeod 1944





DNA Structure





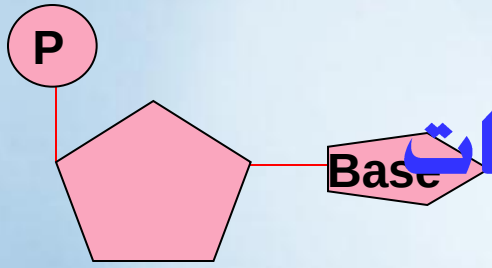
DNA

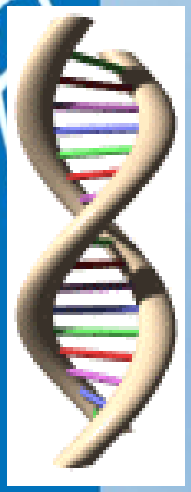
تتكون النيوكليوتيدة من ثلاثة أجزاء هي :

1- سكر خماسي الكربون ديوكسي ريبوز.

2- مجموعة من الفوسفات

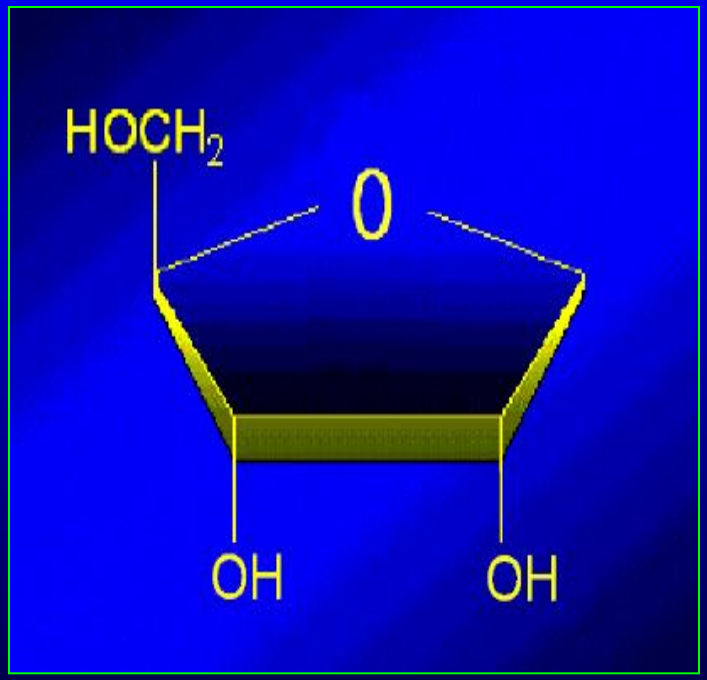
3- قاعدة نيتروجينية





Ribose

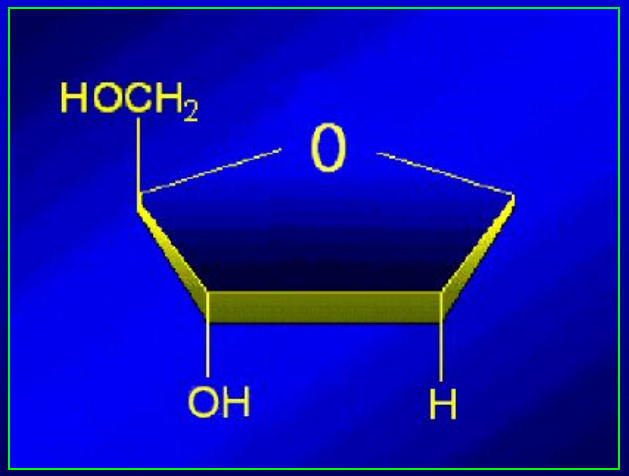
ريبوز



the five-carbon sugar
found in RNA.

Deoxyribose

ديوكسي ريبوز

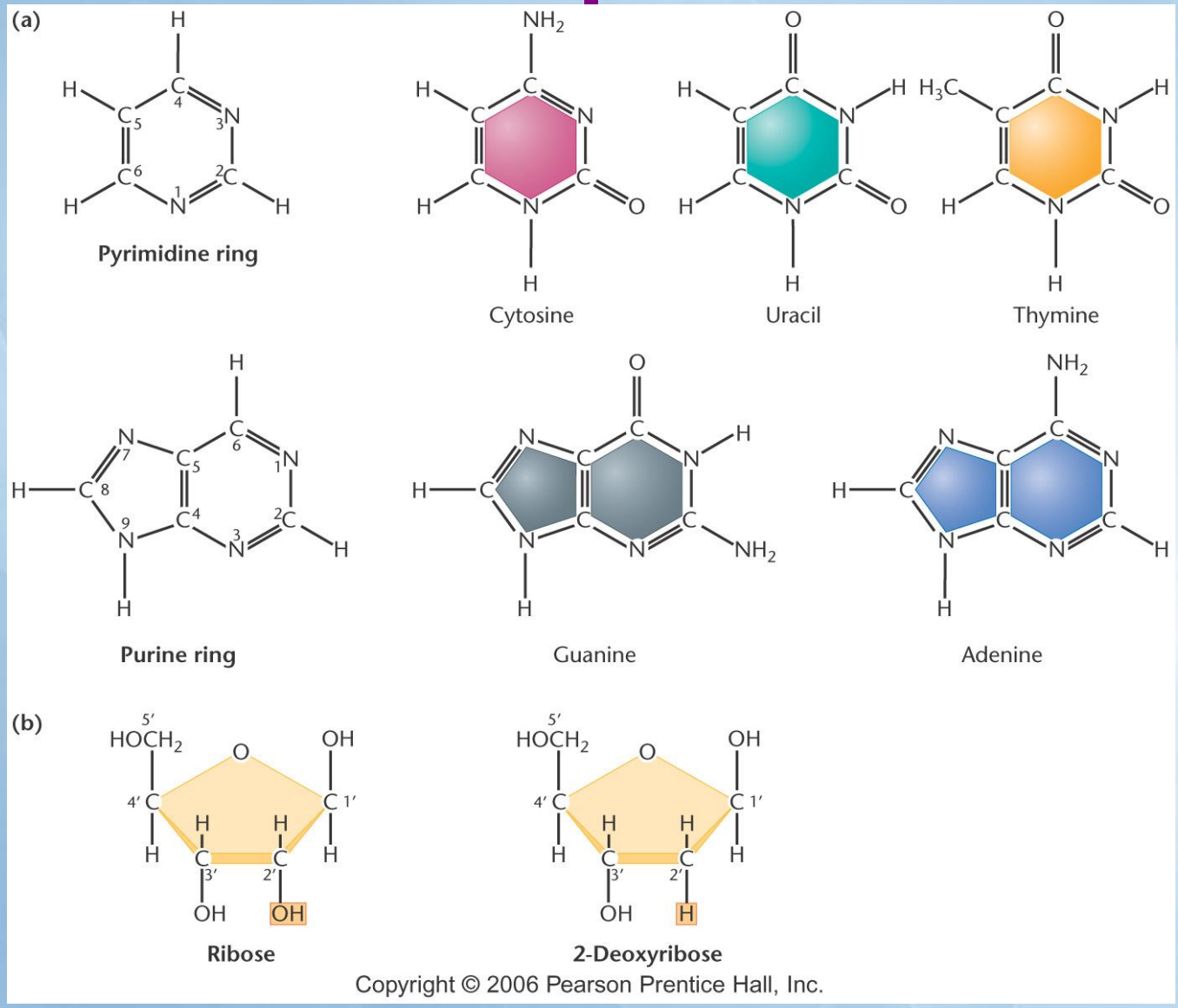


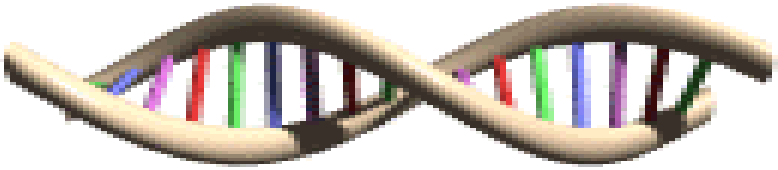
the five-carbon sugar
found in DNA.

ribose

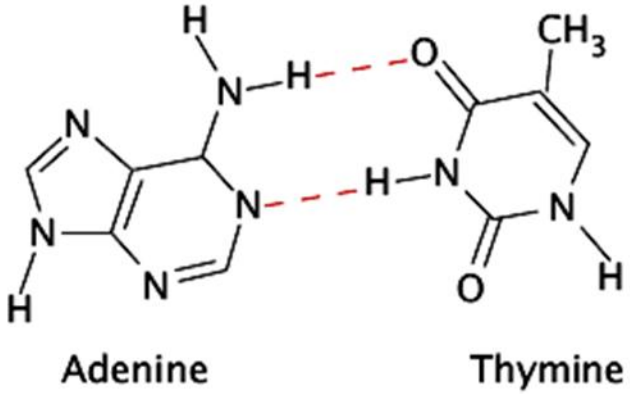
deoxyribose

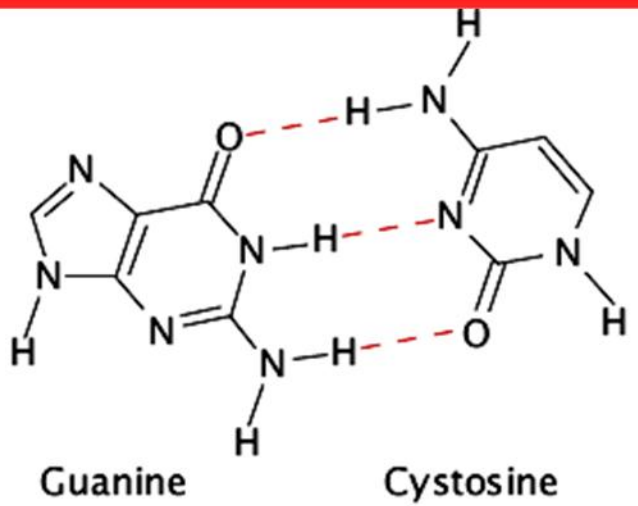
What is the diffrence

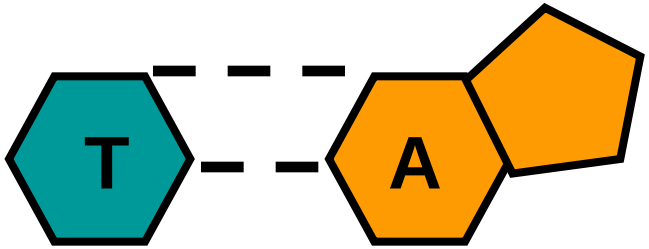


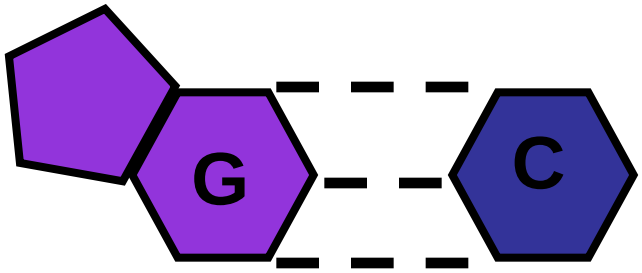


ارتباط القواعد

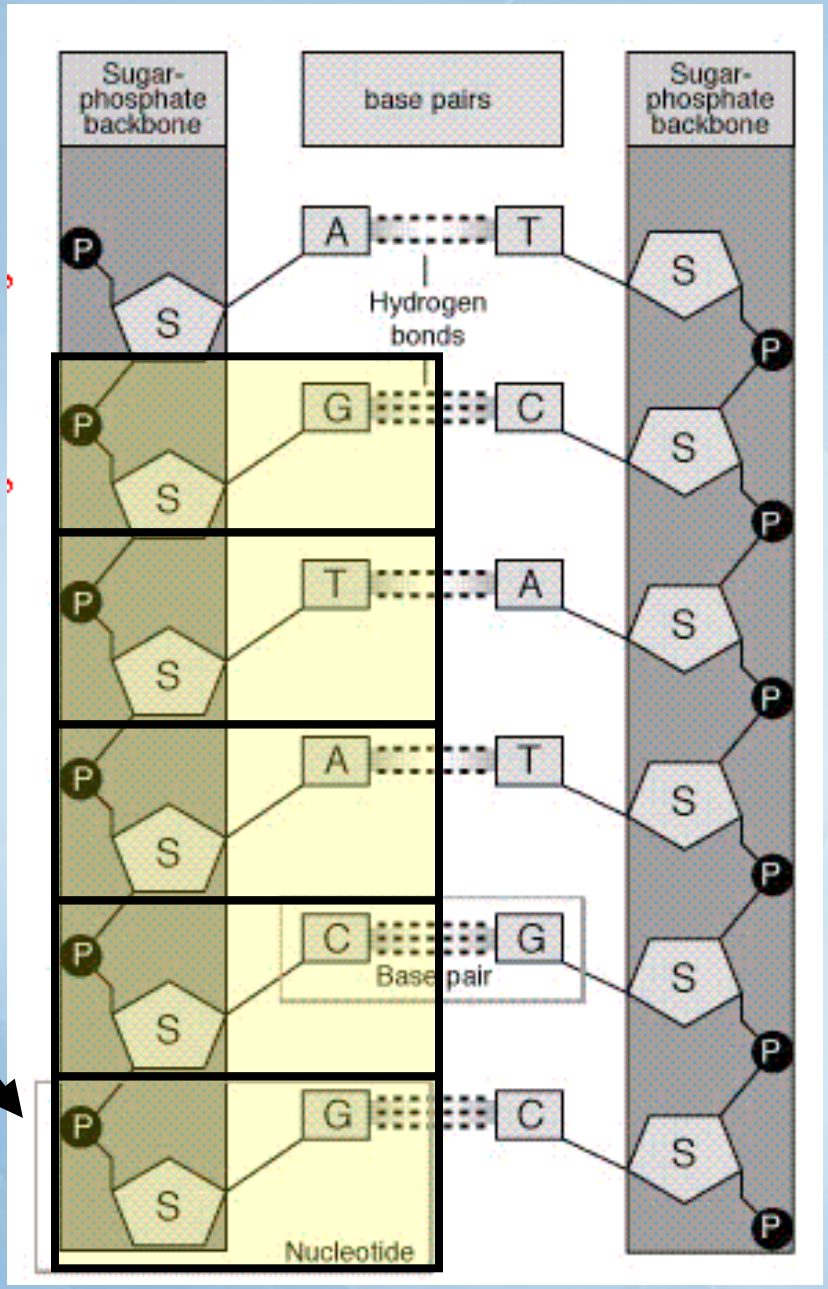




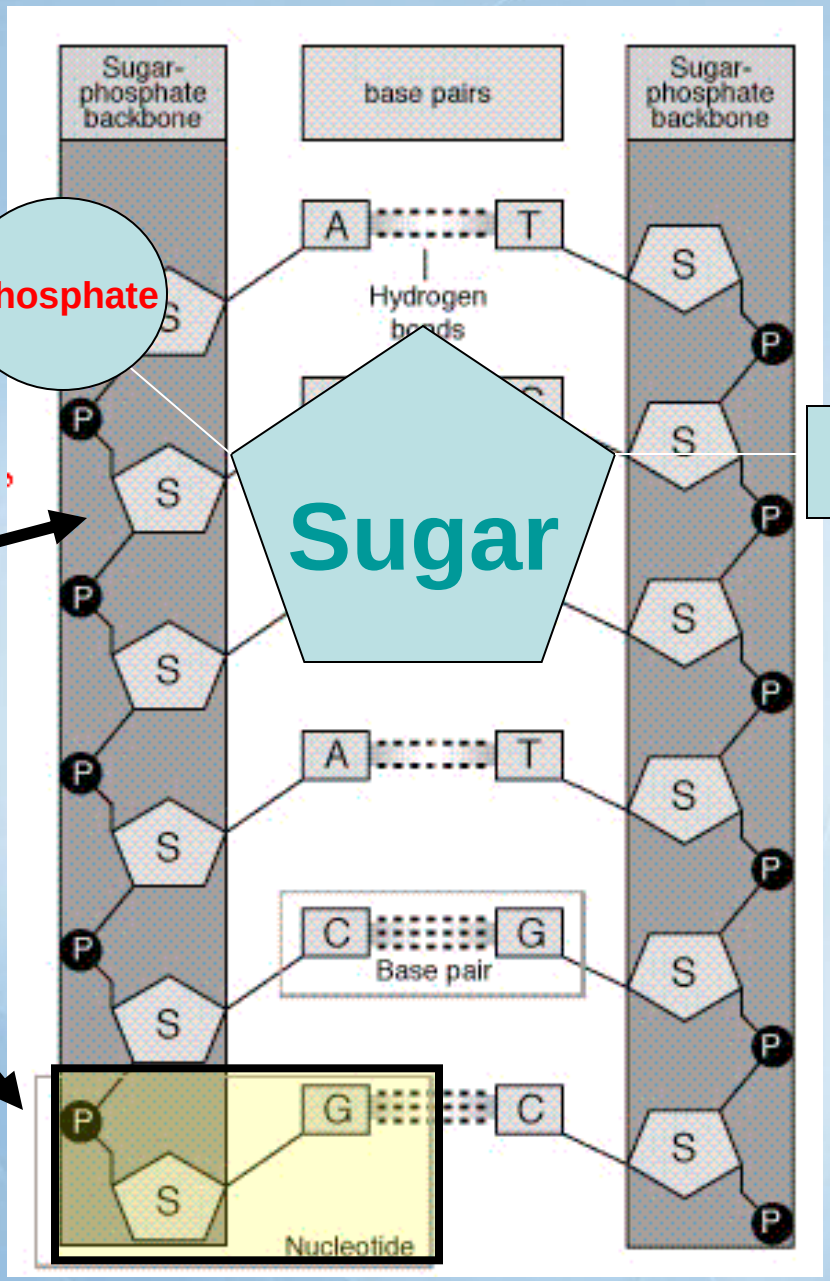




Nucleotide

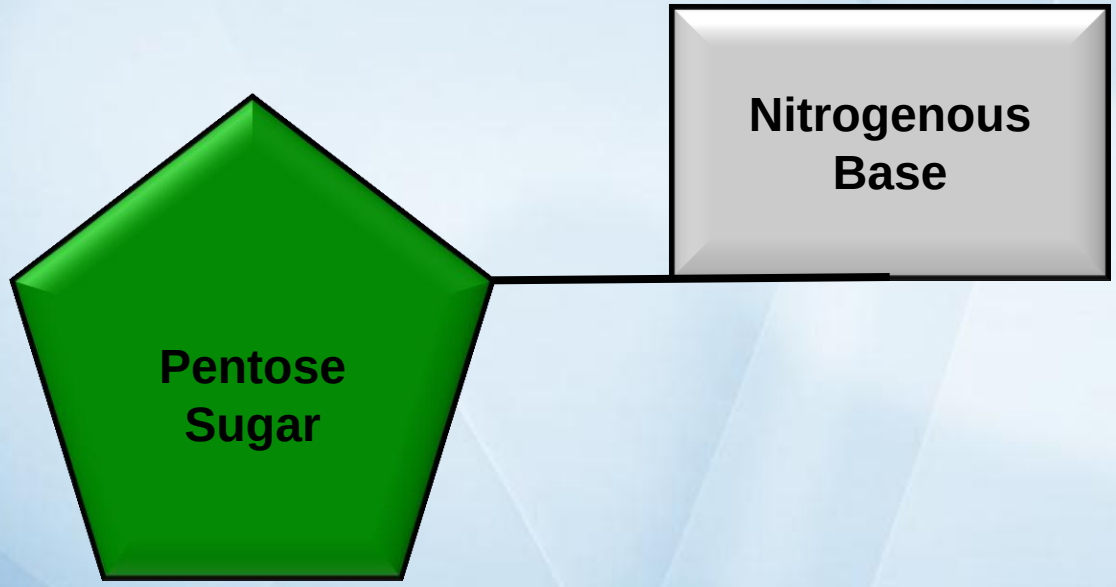


DNA


Sugar-phosphate backbone
base pairs
Sugar-phosphate backbone
Phosphate
A
T
Hydrogen bonds
S
P
Sugar
Base
C
G
Base pair
Nucleotide

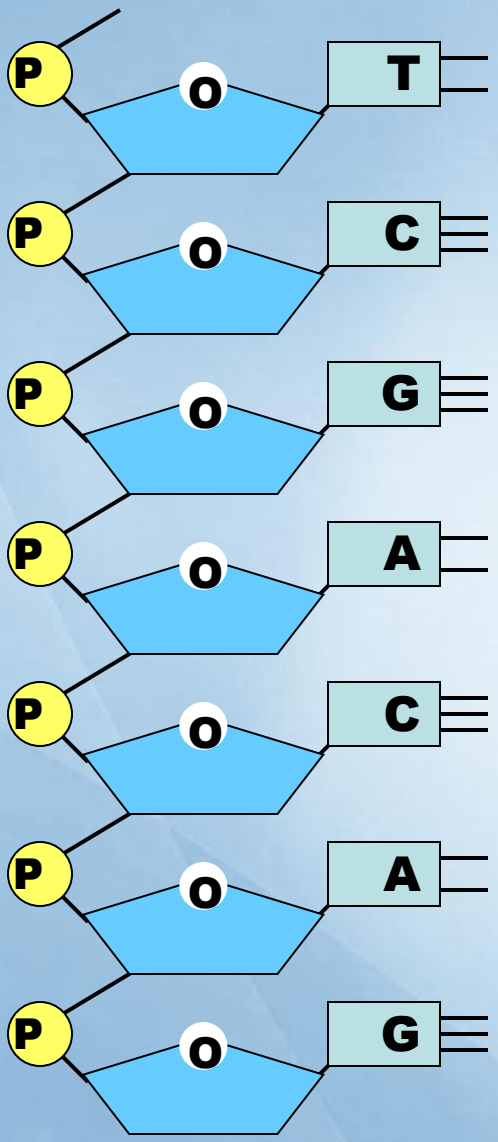
Nucleotide

Nucleosides

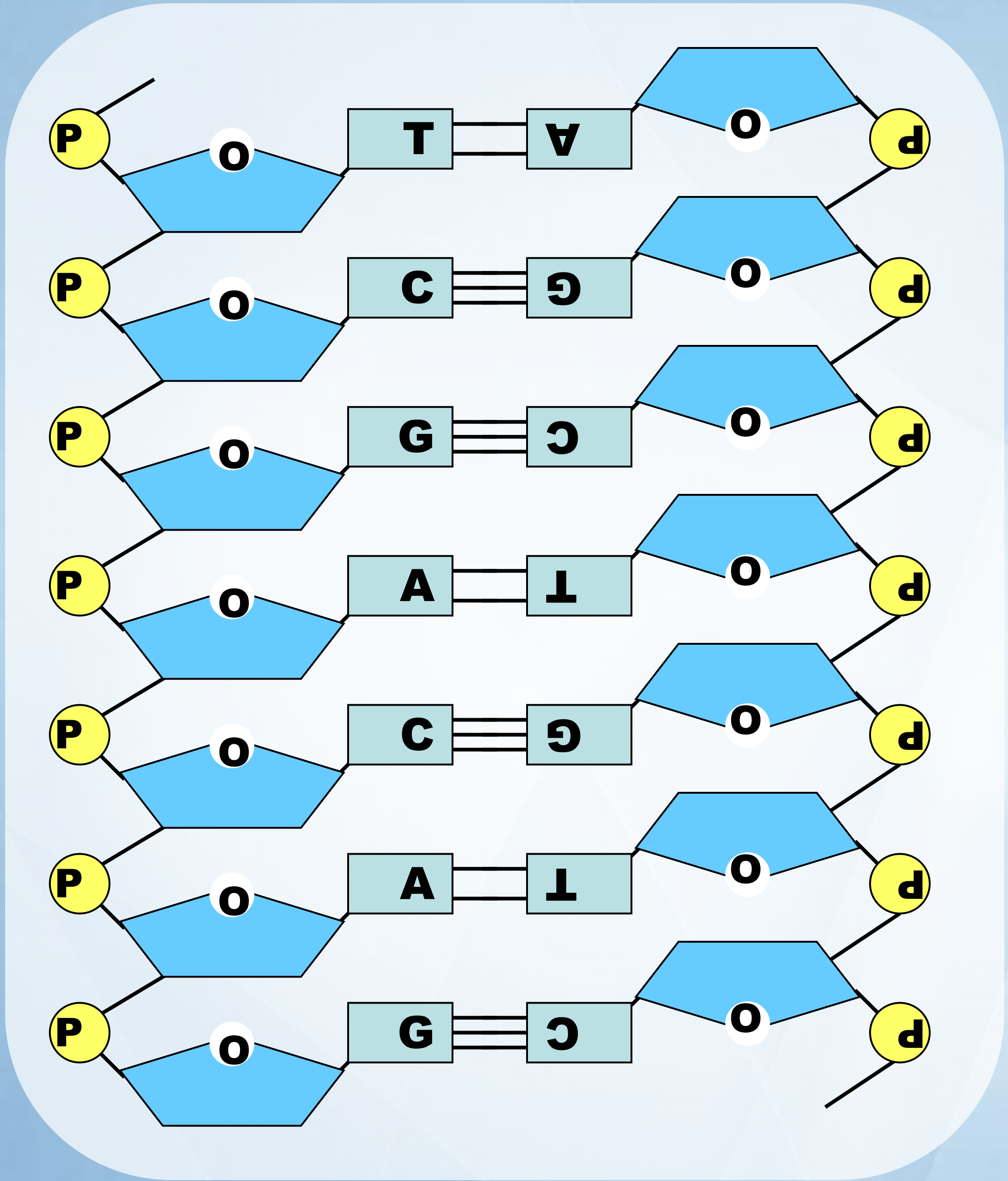


DNA

Structure

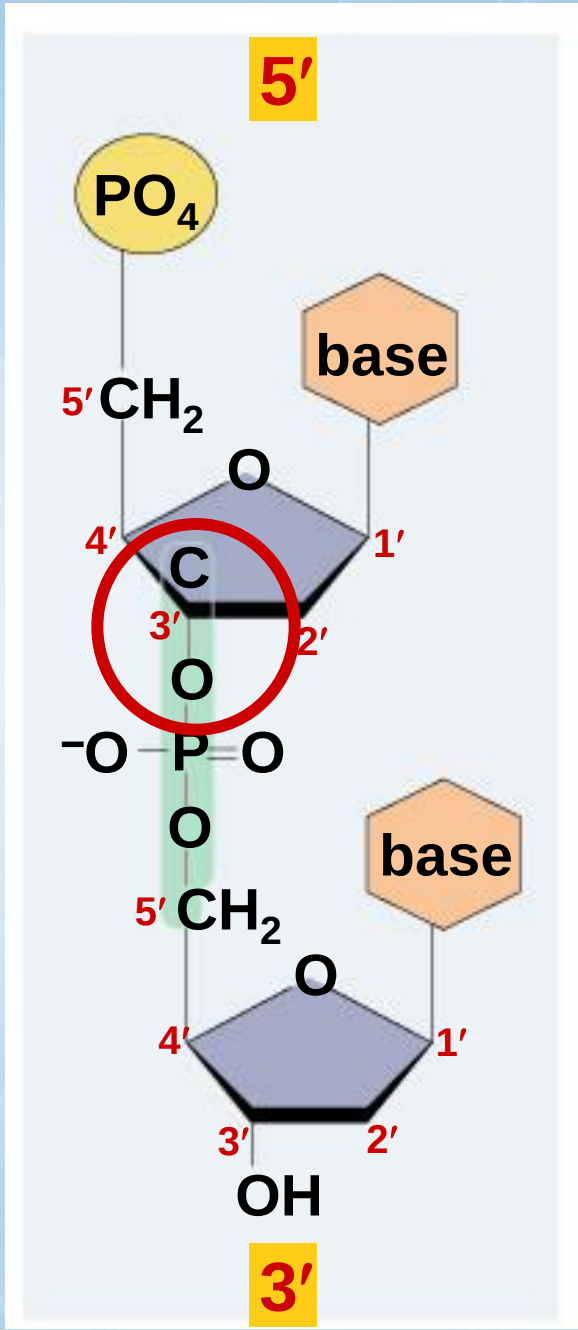


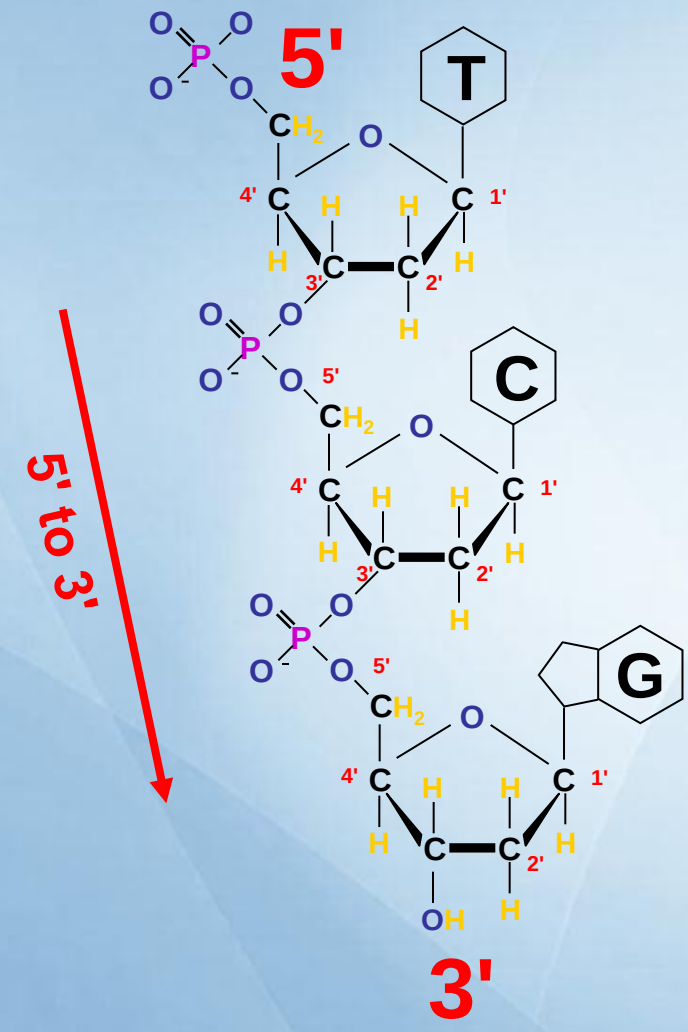
ارتباط النيوكليوتيدات لتكوين DNA

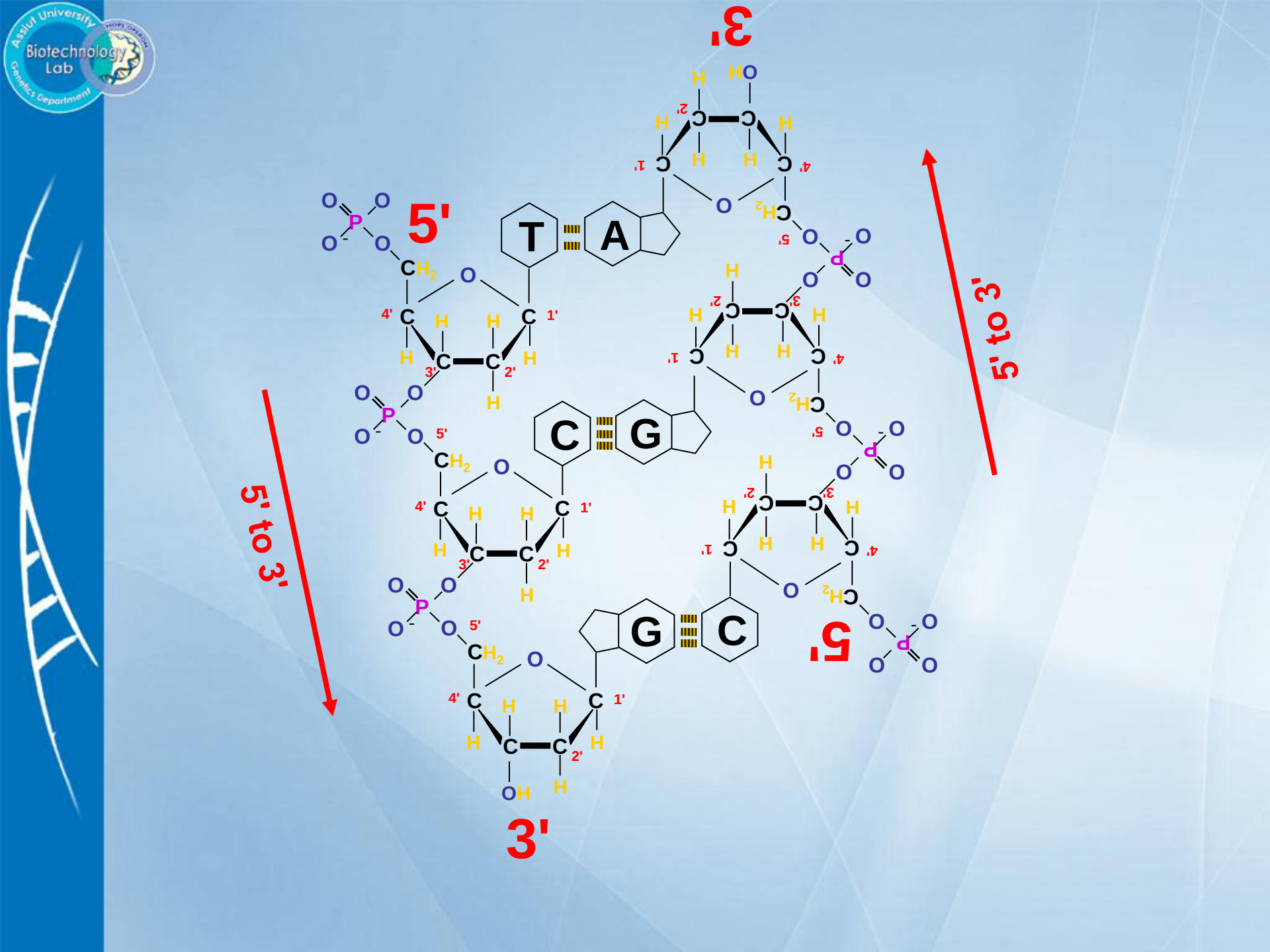


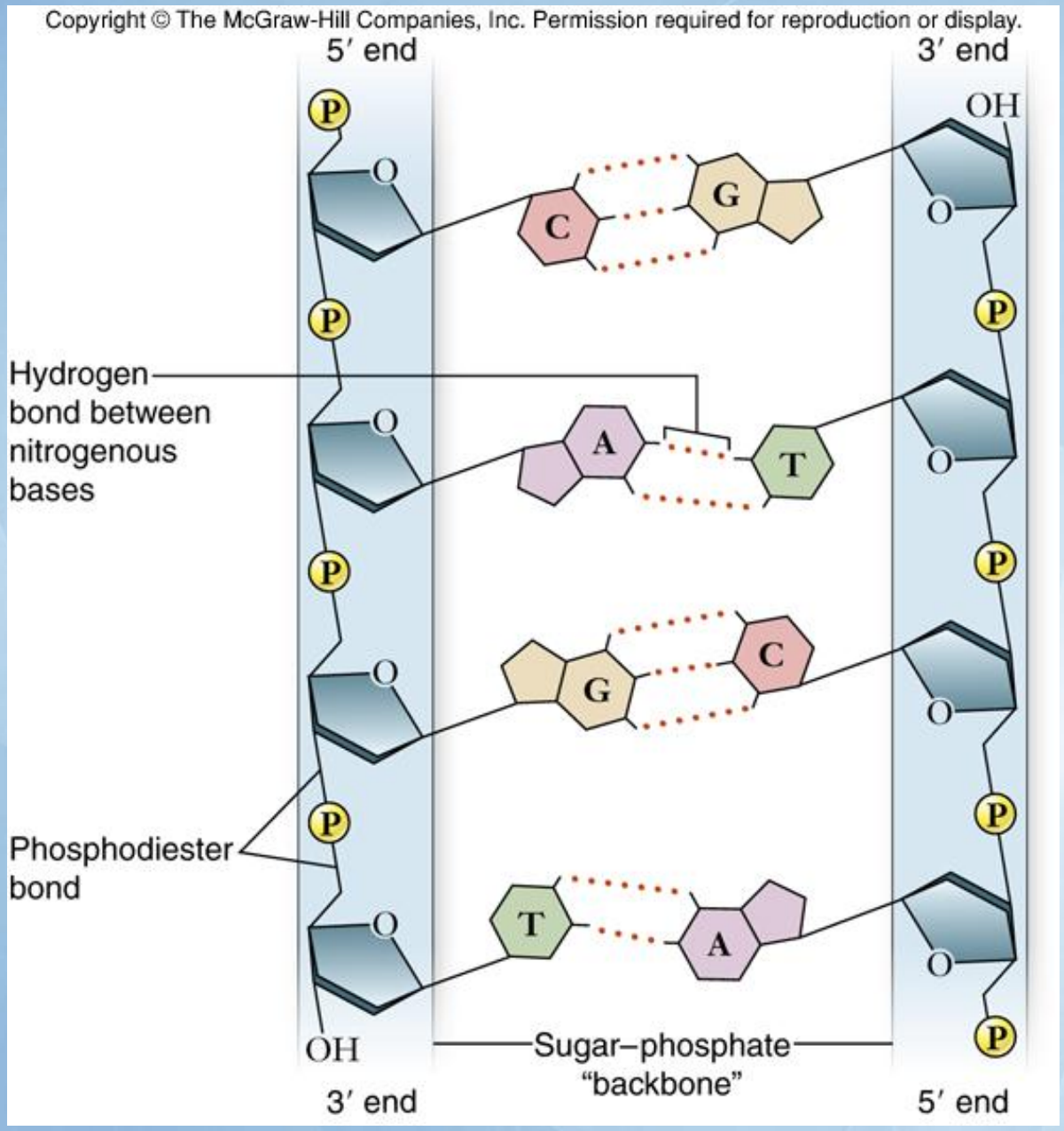
The DNA backbone

- Putting the DNA backbone together
  - refer to the 3′ and 5′ – ends of the DNA
    - the last trailing carbon



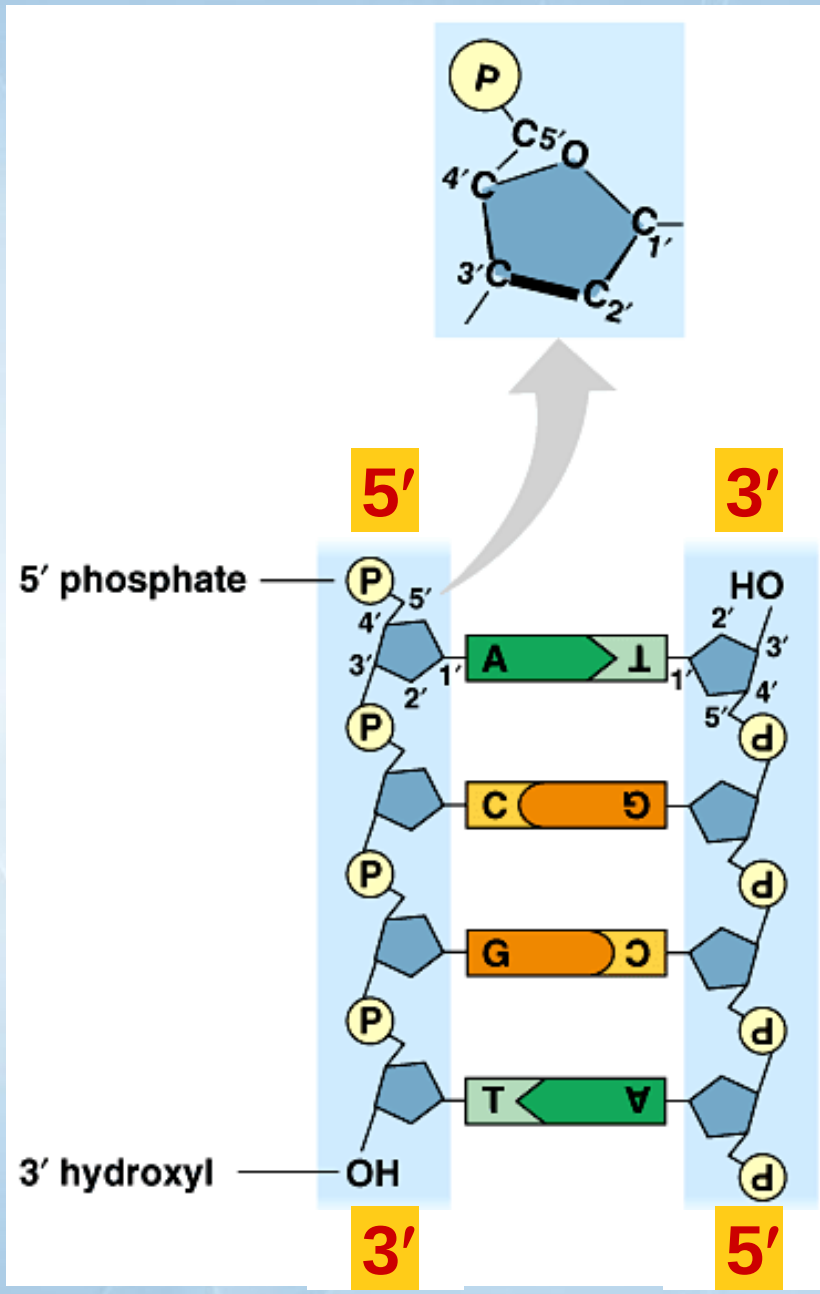

5'
T
C
G
5' to 3'
3'


3'
5'
T
A
C
G
G
C
5' to 3'
5' to 3'
5'
3'



Anti-parallel strands

- Nucleotides in DNA backbone are bonded from phosphate to sugar between 3′ & 5′ carbons
  - DNA molecule has “direction”
  - complementary strand runs in opposite direction

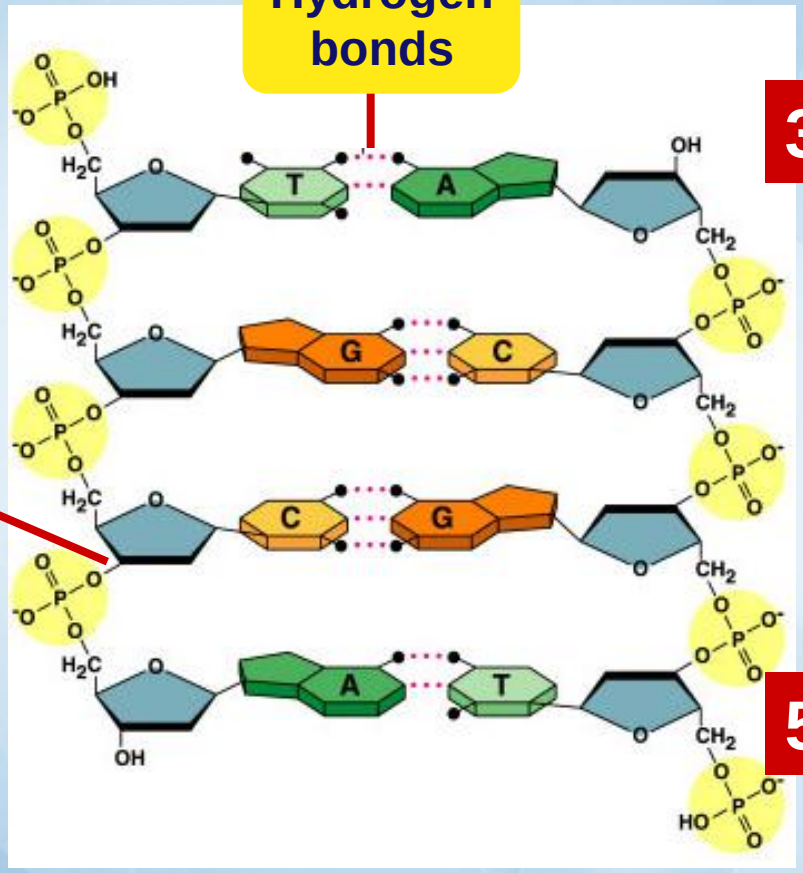


Hydrogen bonds

5′

3′

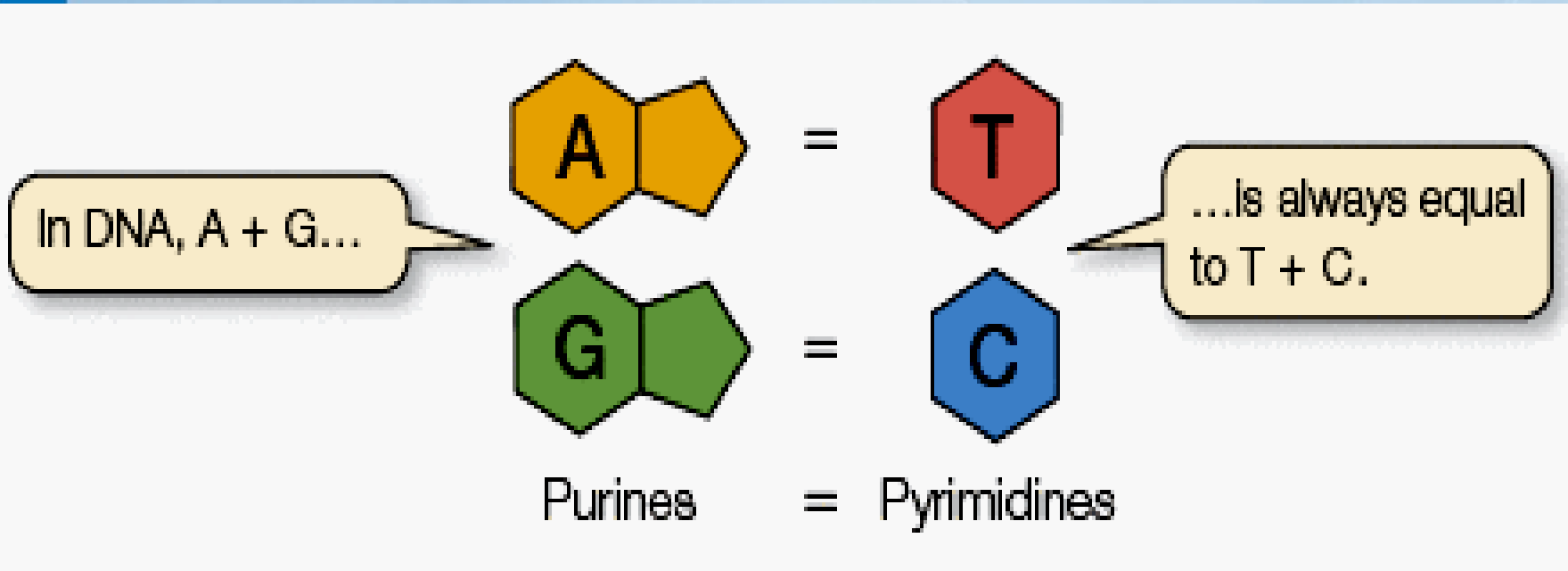
covalent phosphodiester Bonds



3′

5′

Chargaff's rule



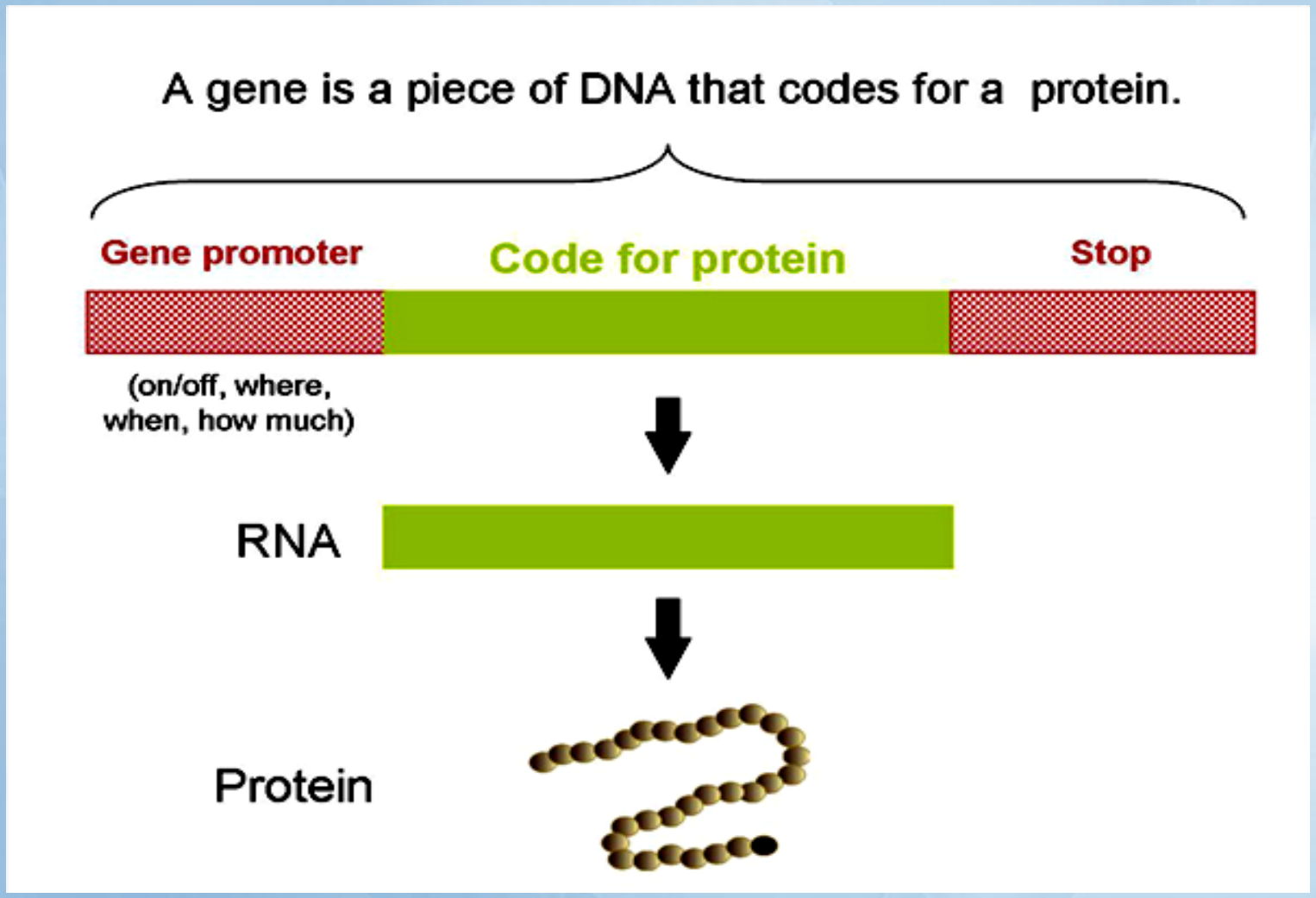
A+T / G+C = Constant

A+G / T+C = 1

DNA turn = 10 bp

DNA turn length = 34 A^{o}

What is the gene

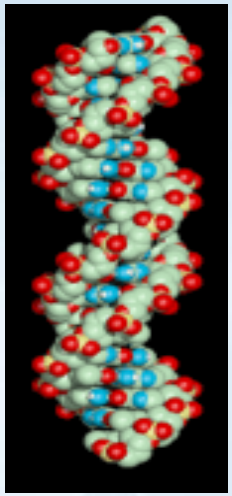


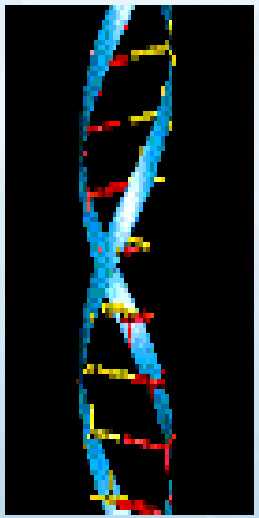
Thank you

Dr. A. Hesham

DNA Replication

تضاعف الDNA-

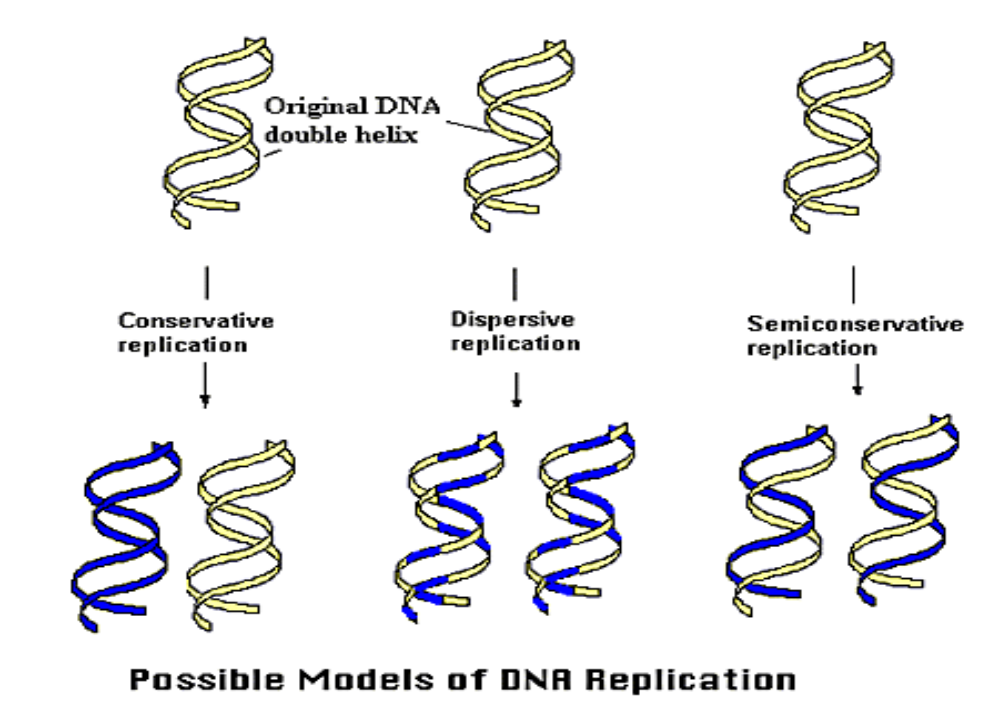




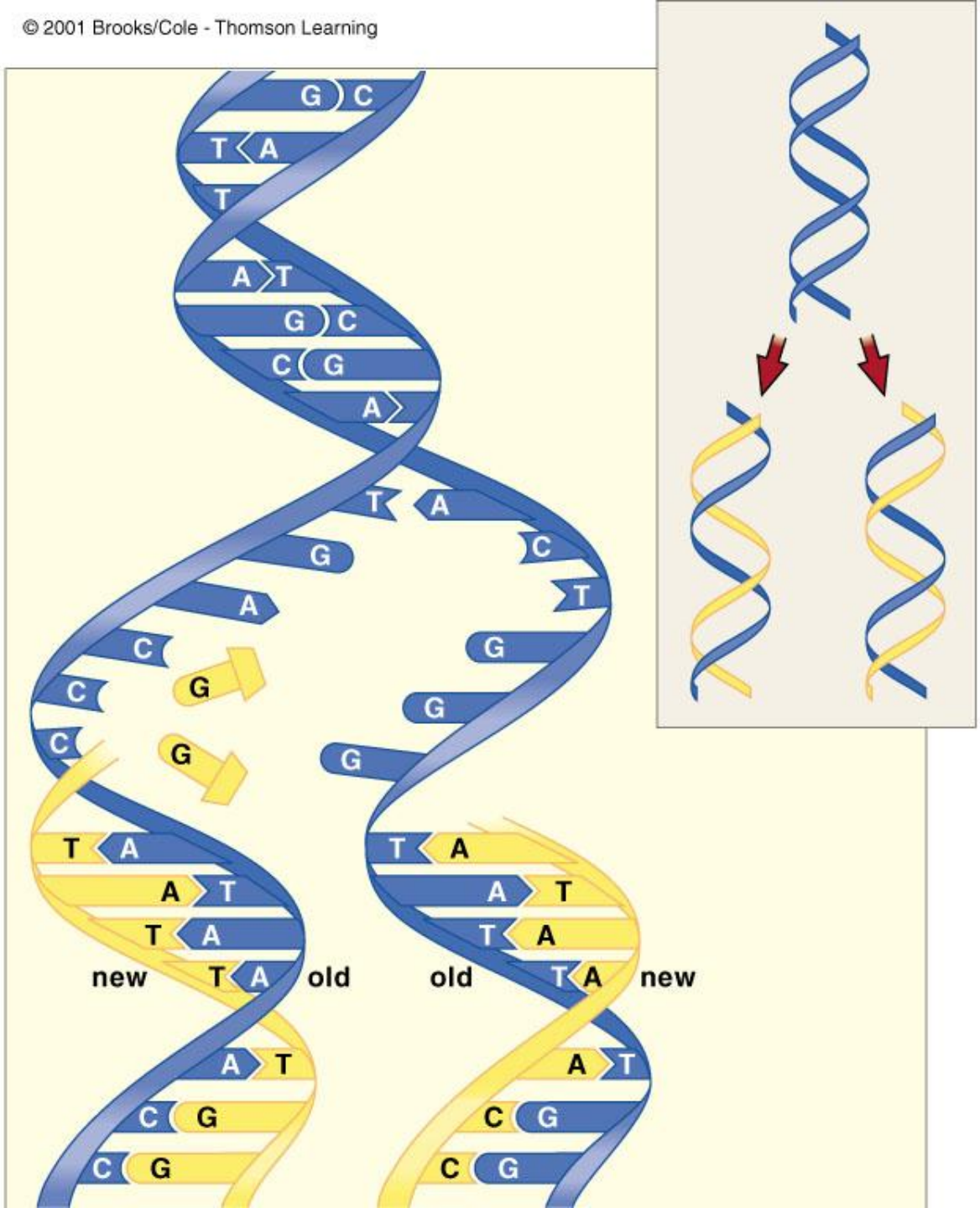
DNA Replication

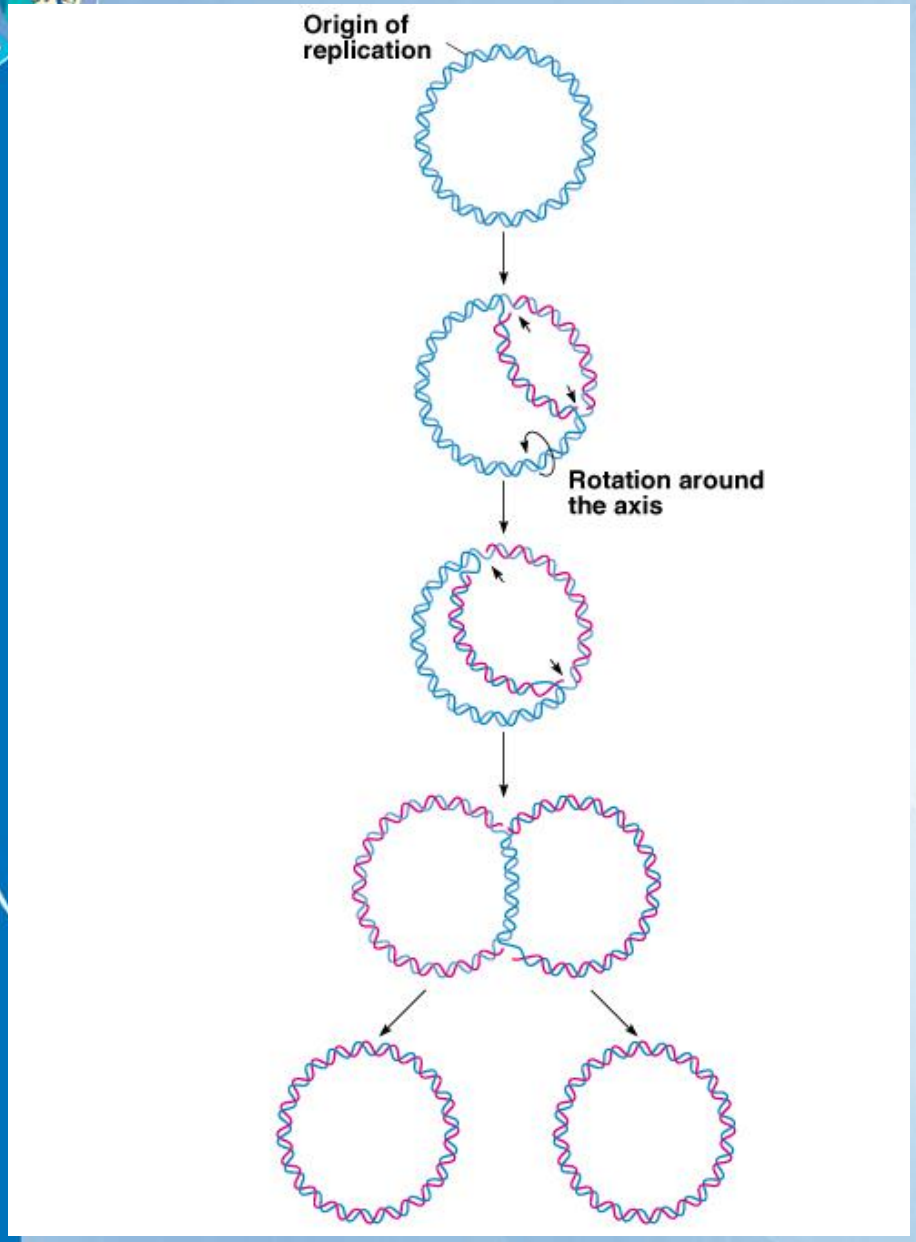
Possible Models of DNA Replication

Semiconservative -1
Conservative -2
Dispersive -3



Possible Models of DNA Replication





Replication of circular DNA in *E. coli* (3.10):

1. **Two replication forks result in a theta-like (θ) structure.**
2. **As strands separate, positive supercoils form elsewhere in the molecule.**
3. **Topoisomerases relieve tensions in the supercoils, allowing the DNA to continue to separate.**

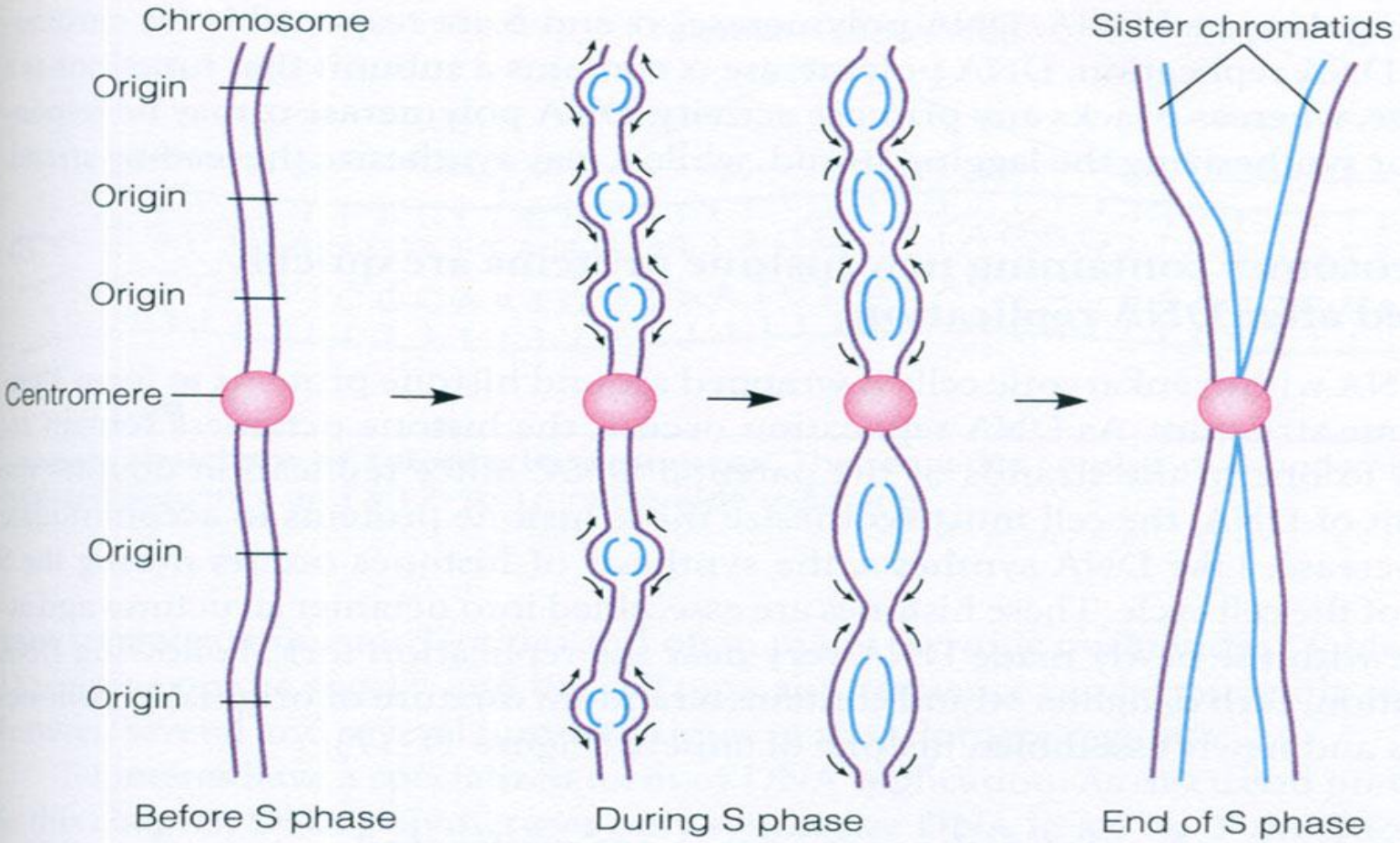
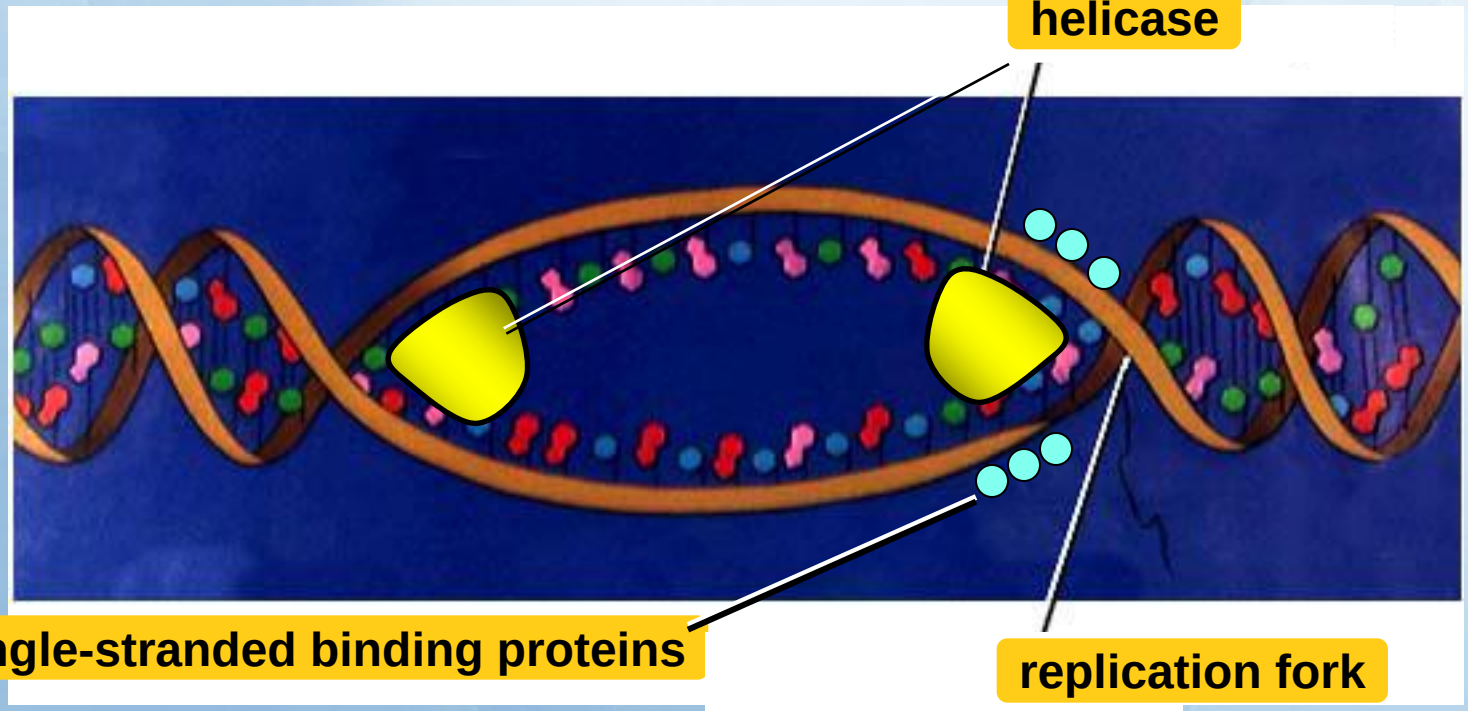


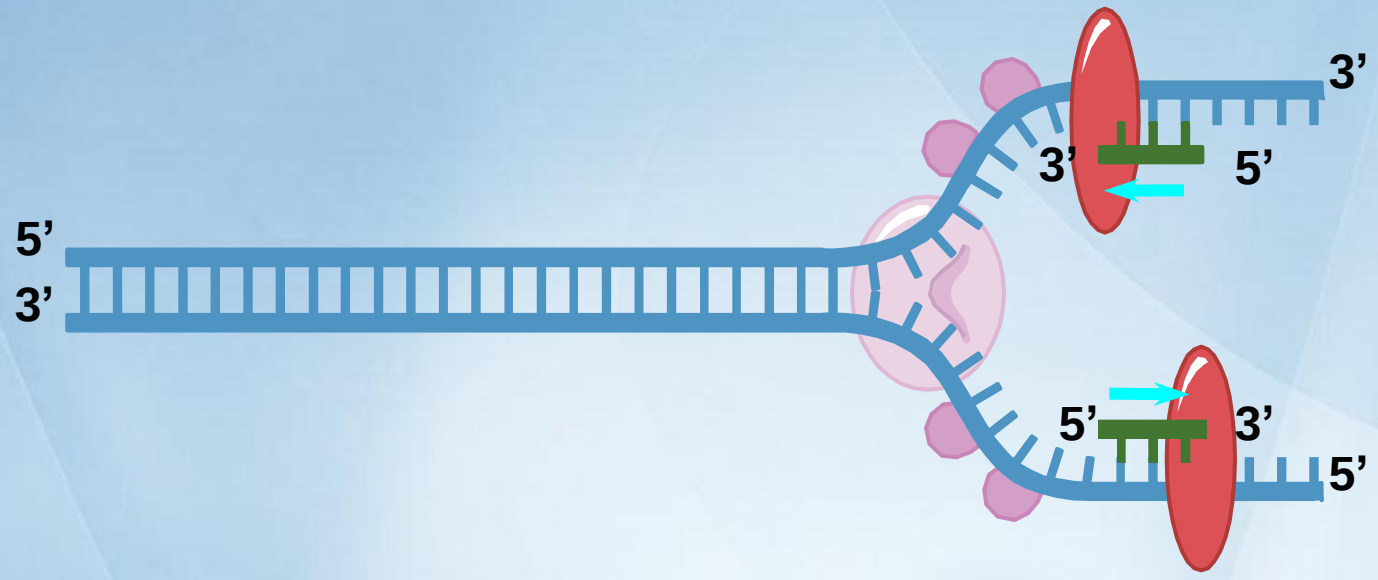
FIGURE **11-16**

The replication of eukaryotic chromosomes. At the beginning of the S phase of the cell cycle, eukaryotic chromosome replication begins from multiple origins of replication. As the S phase continues, the replication forks move bidirectionally to replicate the DNA. By the end of the S phase, all the replication forks have merged. The net result is two sister chromatids that are attached to each other at the centromere.

Replication: steps

- Unwind DNA
  - helicase enzyme
    - unwinds part of DNA helix
    - stabilized by single-stranded binding proteins





Unwind DNA

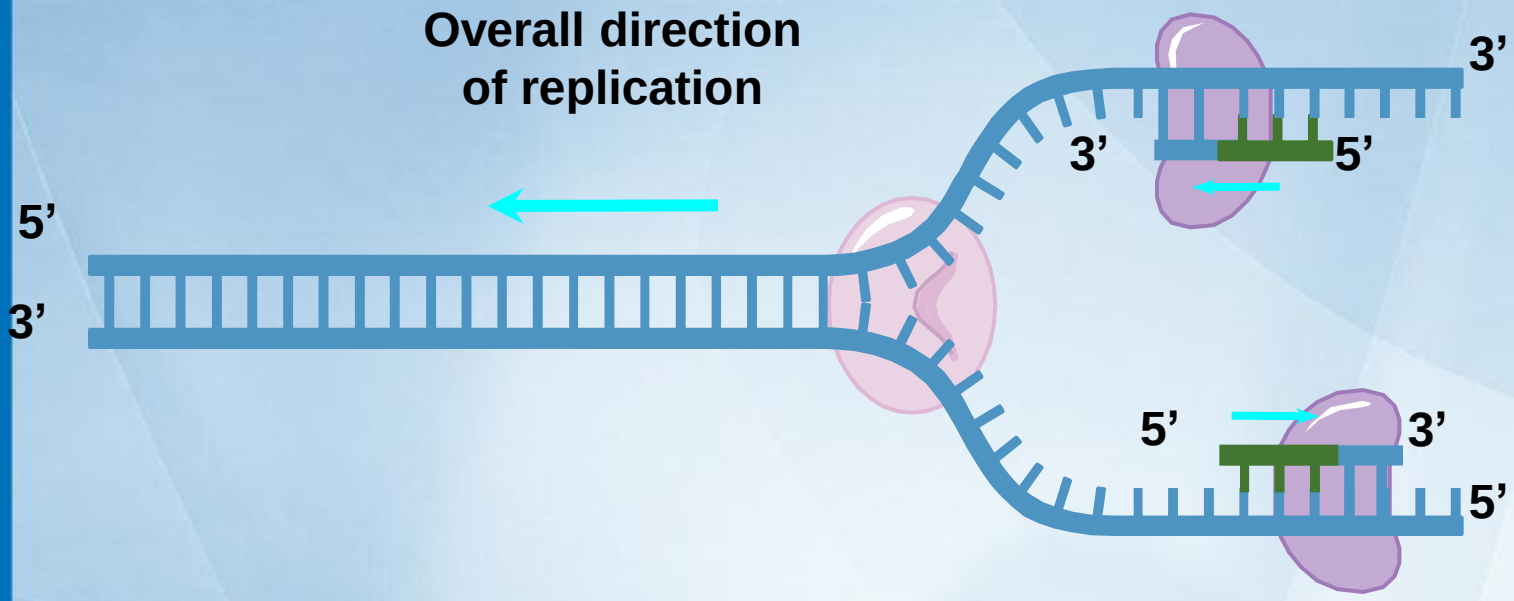
– 1- Helicase enzyme

- unwinds part of DNA helix

2- stabilized by single-stranded binding proteins

3- **Primase: responsible for SYNTHESIS the** RNA primer

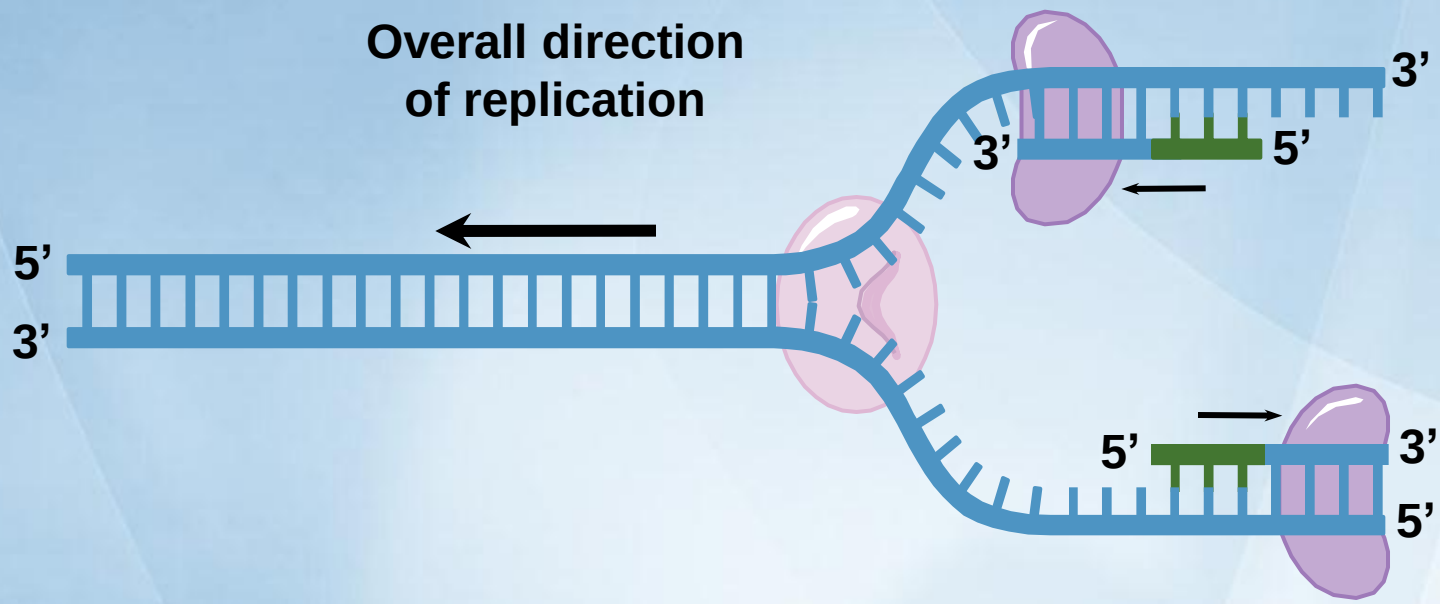
Replication



4- DNA polymerase III

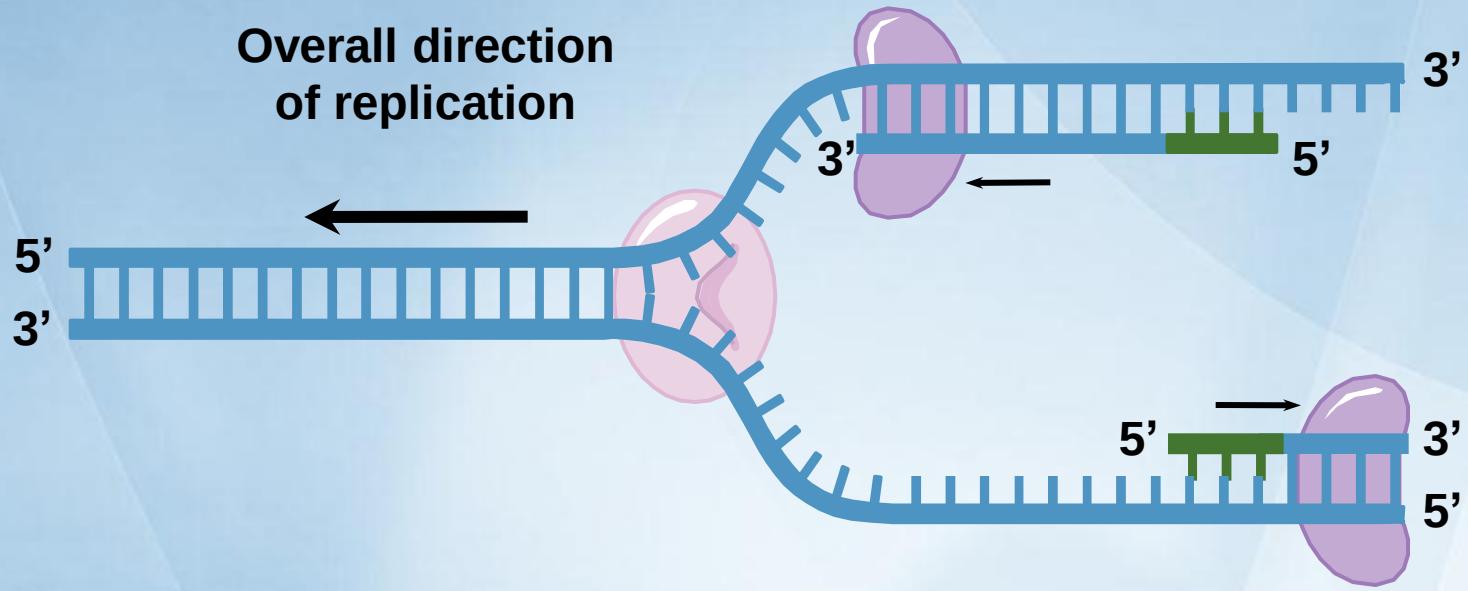
DNA polymerase **III**
is responsible for synthesizing DNA

Replication



حيث يقوم باضافة النيوكليوتيدات الى RNA primer

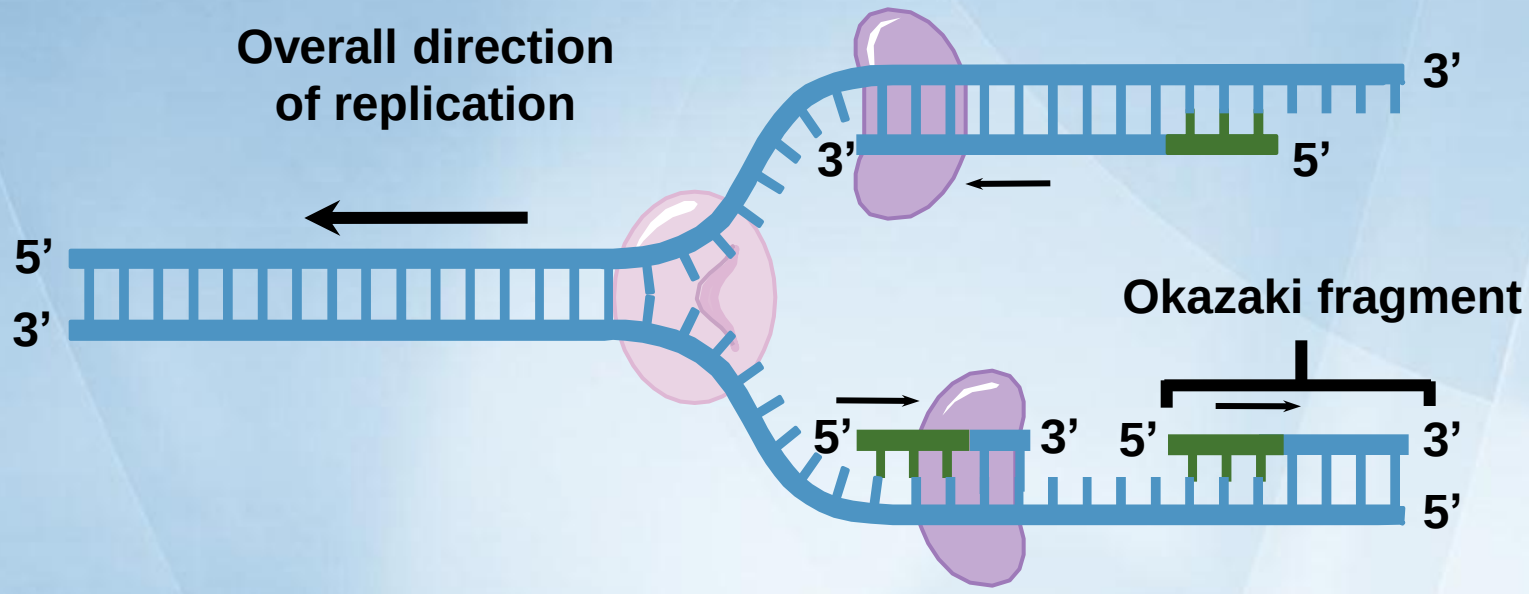
Replication



:leading strand

3’ ⟵ **-- 5’** synthesized

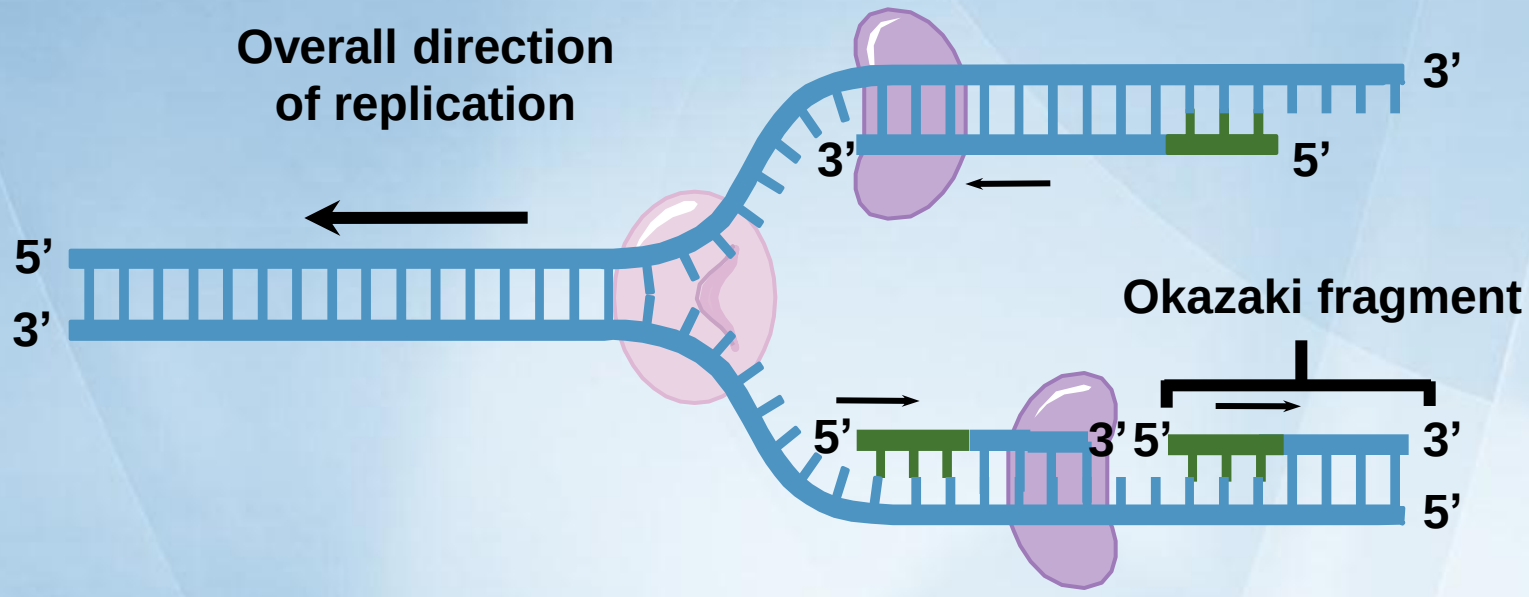
Replication



Leading strand synthesis continues in a 5’ to 3’ direction.

Discontinuous synthesis produces 5’ to 3’ DNA segments called Okazaki fragments.

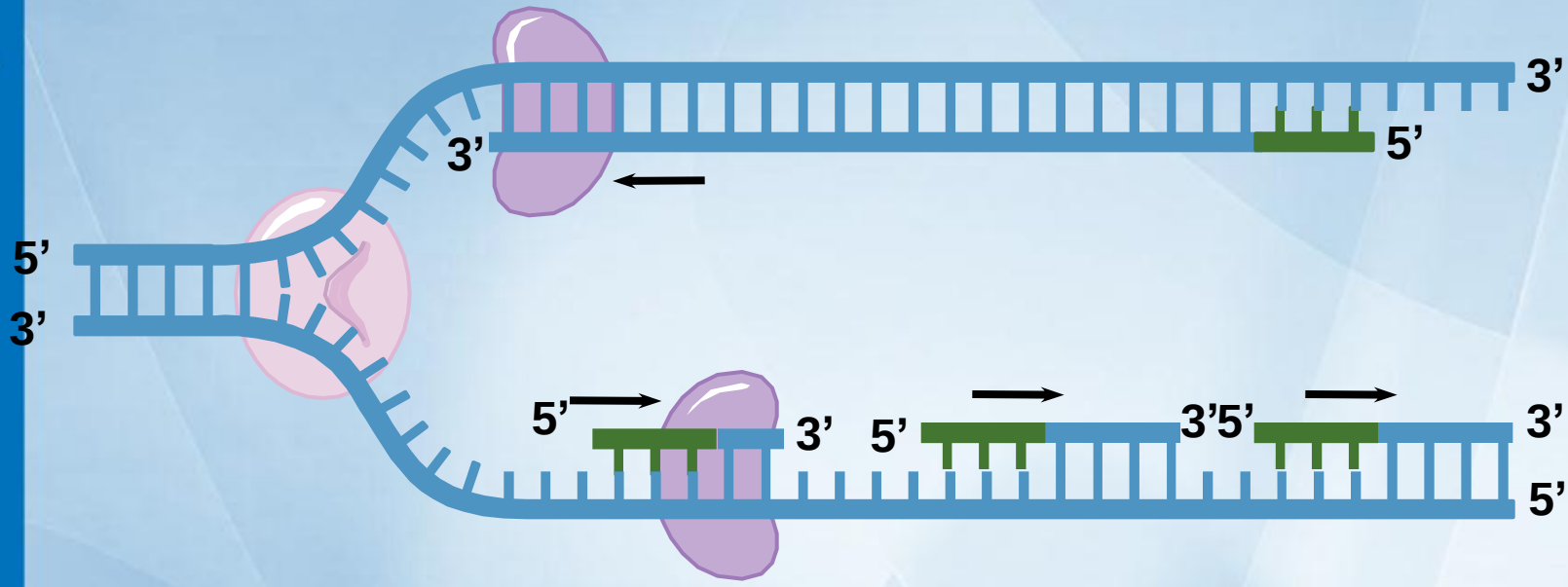
Replication



Leading strand synthesis continues in a 5’ to 3’ direction.

Discontinuous synthesis produces 5’ to 3’ DNA segments called Okazaki fragments.

Replication



Leading strand synthesis continues in a 5’ to 3’ direction.

Discontinuous synthesis produces 5’ to 3’ DNA segments called Okazaki fragments.