



University of Fallujah
College of Medicine



Molecular Biology

Lecture : 1 &2

Stage : 2nd Stage

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Department: Chemistry and Biochemistry

Date: 26/ 4/ 2026

الرؤية

والرسالة

والاهداف

لكلية

طب

الفلوجة

الرؤية

تحقيق الريادة في التعليم الطبي وأن نكون شريكاً فعالاً في الإرتقاء بالمستوى الأكاديمي والصحي على مستوى القطر.

الرسالة

تعليم وتدريب الطلبة في بيئة تعليمية هادفة لتهيئة الخريجين لممارسة طبية متميزة وأمنة مع ترسيخ القيم الانسانية والعلمية والمبادئ والاجتماعية ومعايير الجودة. تخرج اطباء قادرين على الاستجابة للاحتياجات والتحديات الصحية وتوجيه البحث العلمي لحل المشكلات الصحية في المجتمع.

تجنيد وتطوير هيئة تدريسية بمواصفات عالية لتصبح الأفضل في مجال التعليم والبحوث العلمية

الاهداف

تخريج أطباء لديهم المعرفة والإرادة والمهارة التي تمكنهم من ممارسة الطب بشكل آمن مع تجسيد القيم الإنسانية

التحسين المستمر للعملية التعليمية وتطوير مهارات الهيئة التدريسية وفق معايير الجودة بواسطة التعليم والتدريب الطبي المستمر من خلال الورش والمؤتمرات العلمية.

تعزيز علاقات التعاون مع المؤسسات العلمية والطبية داخل وخارج العراق لتطوير المستوى الأكاديمي للهيئة التدريسية ولتعليم الممارسة الطبية الآمنة للطلبة الخريجين.

السعي في أن تكون الكلية مركزاً بحثياً علمياً رائداً في البحوث الصحية التطبيقية مع الاستغلال الأمثل لنتائج تلك البحوث في خدمة المجتمع وبالتعاون مع مختلف الجهات المستفيدة.

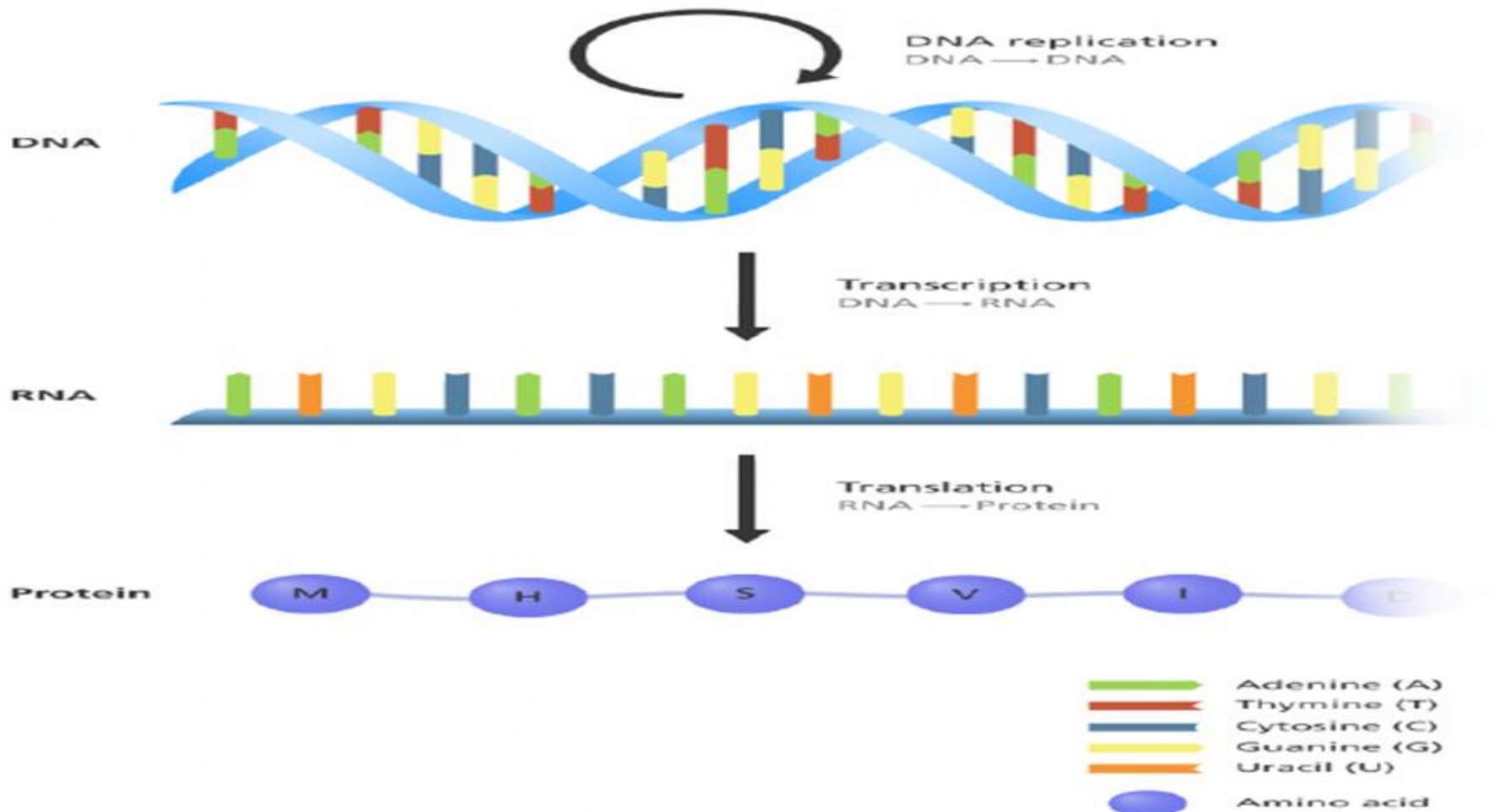
المساهمة في تحسين صحة المجتمع من خلال دعم وتطوير نظام الرعاية الصحية عبر علاقات تكامل وتعاون فعال.

Learn Objective

- Understanding molecular biology structure and tests
- How molecular tests are applied
- How to read these tests

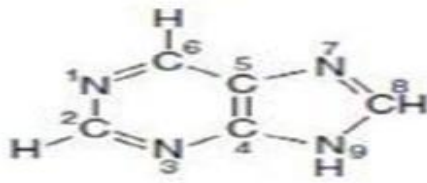
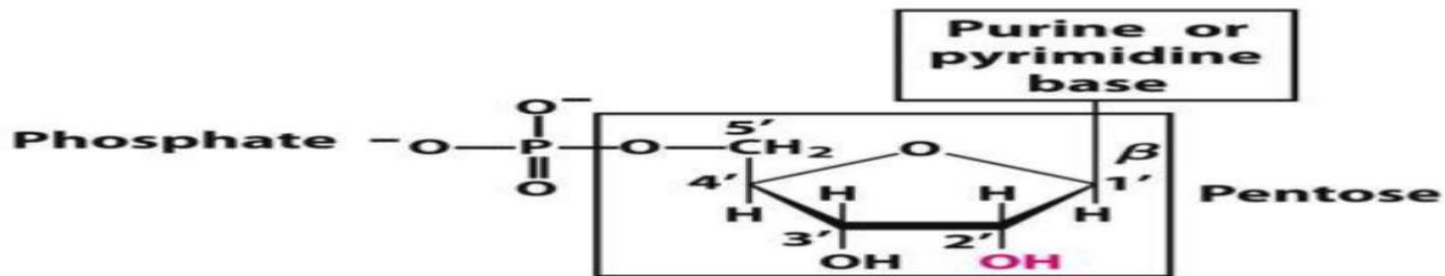
Introduction

Molecular genetics is the study of the processes whereby **biological information is stored, copied, repaired and coded to create protein and other molecules within cells and tissues**



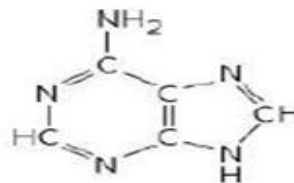
The Structure of DNA

DNA is a **polymer of deoxyribonucleotides**. Each **polynucleotide chain** of DNA contains nucleotides, which consist of a **nitrogenous base** (A, G, C, or T), **deoxyribose**, and **phosphate group**

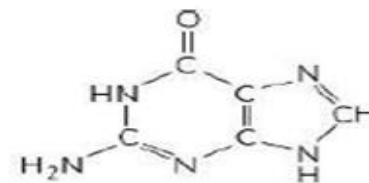


Purine

The parental compound of purine

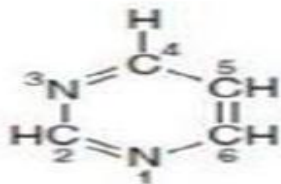


Adenine



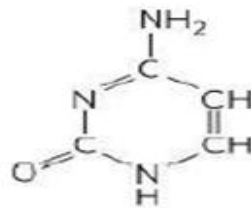
Guanine

The derivatives of purine

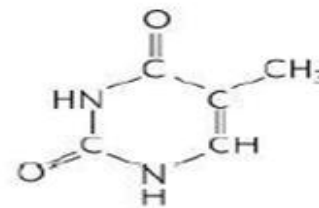


Pyrimidine

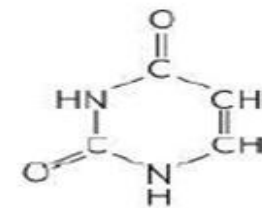
The parental compound of pyrimidine



Cytosine



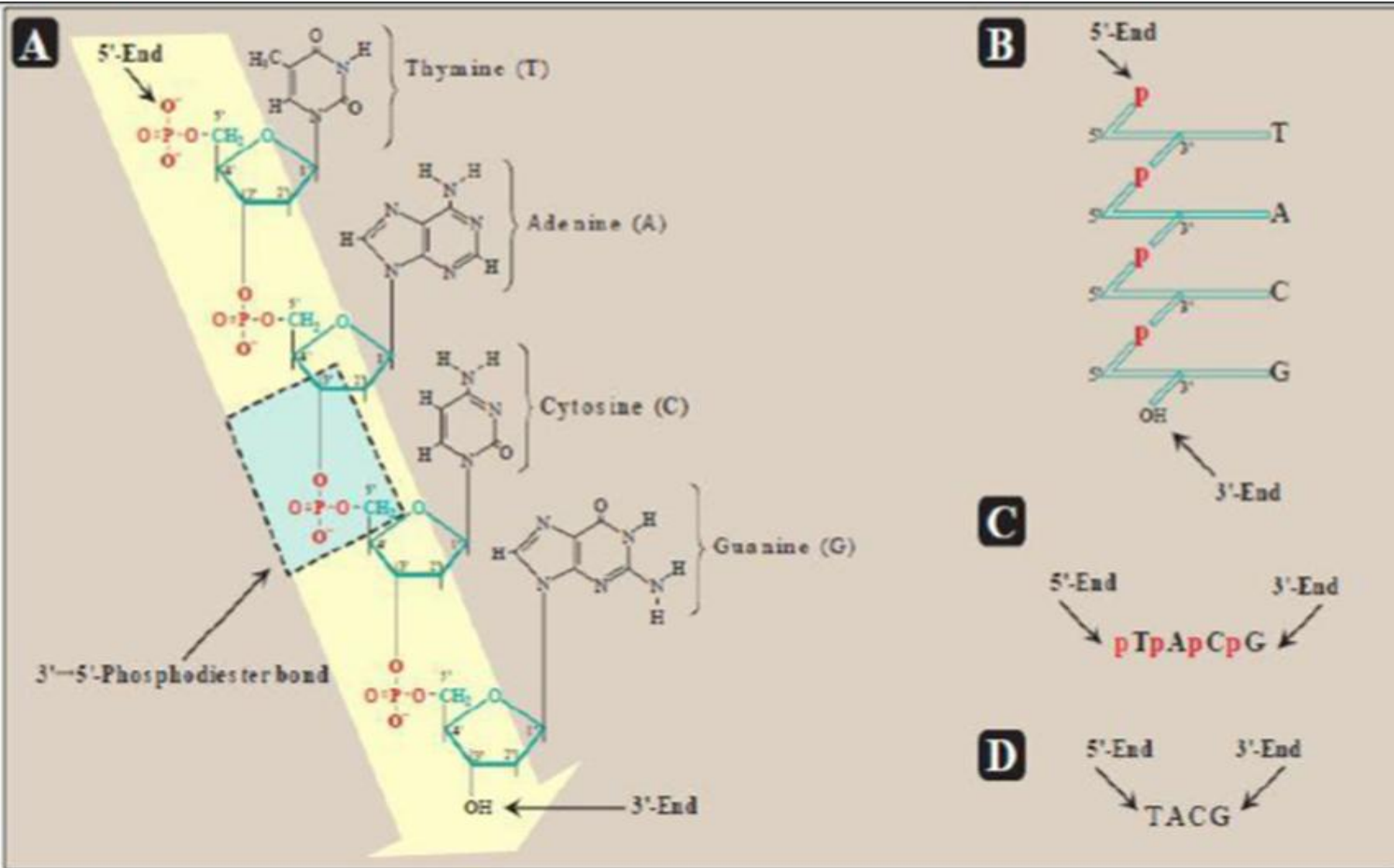
Thymine
(DNA)



Uracil
(RNA)

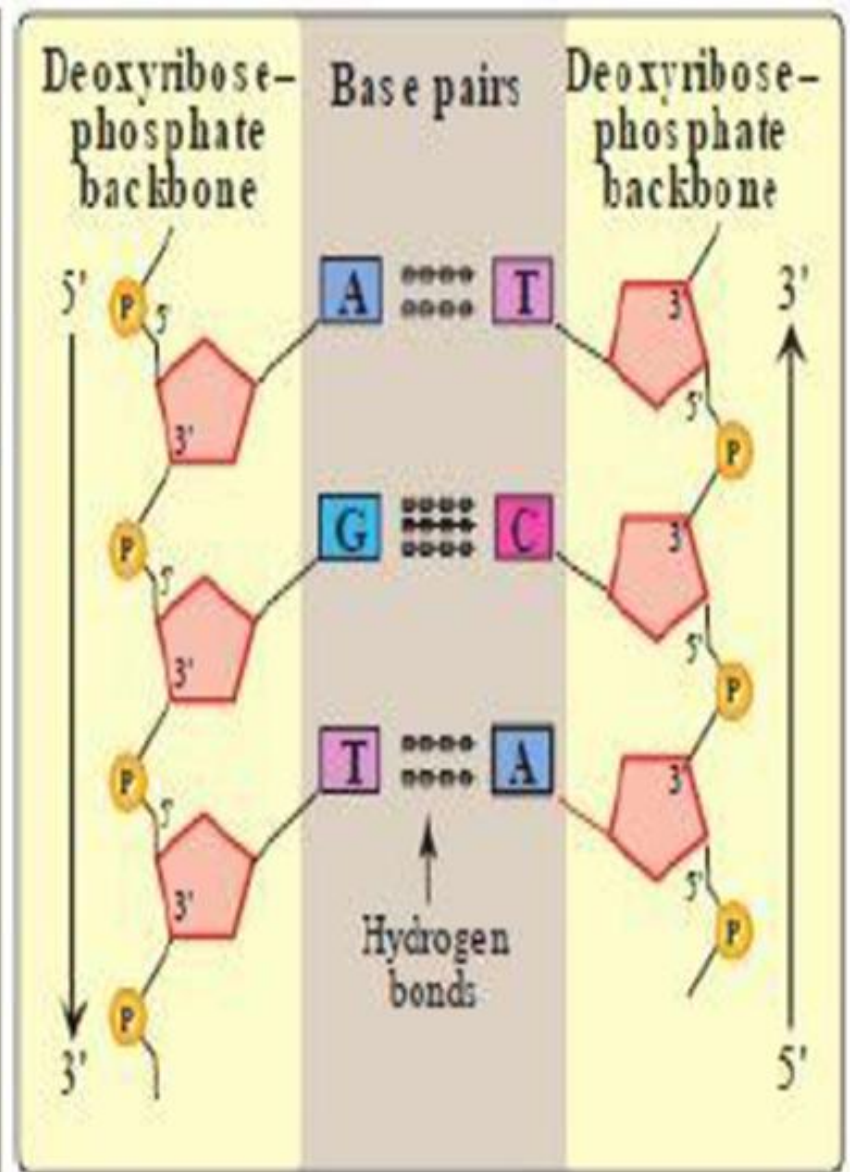
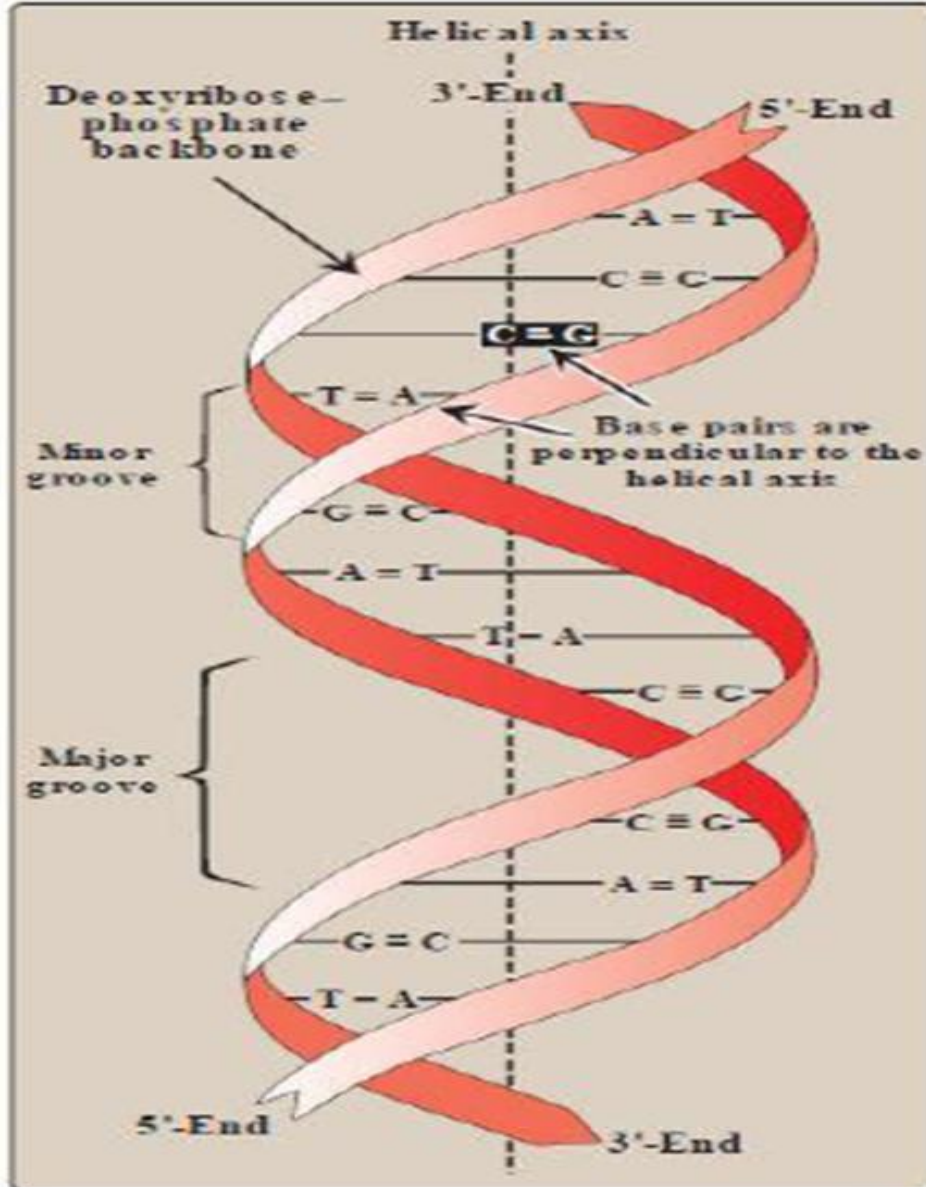
The derivatives of pyrimidine

Primary Structure of DNA



- 1- The deoxyribonucleotides are bound to each other by •
covalent 3`-5` phosphodiester linkage
- 2- That end of the strand which bears a free 5` phosphate •
group without phosphodiester linkage is called the **5`-end**.
The opposite end bears a free 3` – hydroxyl or 3` phosphate
group and is called the **3` end**.
- 3- The primary structure is the number and sequence of •
different deoxyribonucleotides in its strands joined together
by **phosphodiester linkages**.
- 4- The resulting long, **unbranched chain has polarity**, with •
both a 5`-end (the end with the free phosphate) and a 3` -end
(the end with the free hydroxyl) that are not attached to other
nucleotides.
- 5- Phosphodiester linkages between nucleotides can be •
hydrolyzed enzymatically by a family of **nucleases**

Secondary Structure of DNA



1-The chains are paired in an **antiparallel manner** (that is, the 5'-end of one strand is paired with the 3'-end of the other strand) •

2- Adenine base of one strand of DNA is hydrogen bonded to a thymine in the opposite strand; while the guanine is hydrogen bonded to a cytosine. •

3-A = T and G = C •

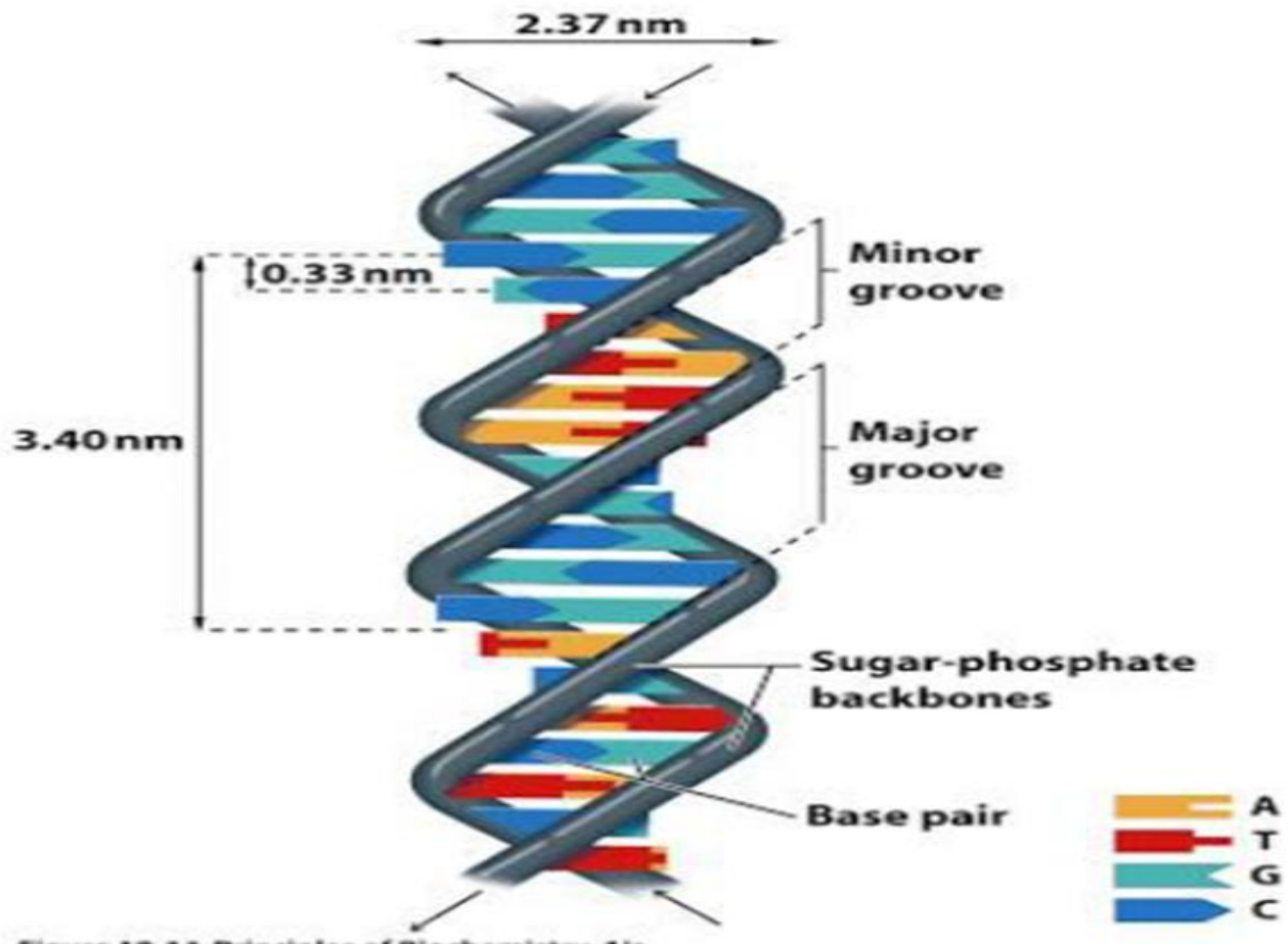
4- the two antiparallel polynucleotide chains of double-helical DNA are not identical in either base sequence or composition. •

5- the **hydrophilic deoxyribose–phosphate backbone of each chain is on the outside of the molecule**, whereas the hydrophobic bases are stacked inside. •

6-G≡C and A=T •

•

Three-Dimensional DNA



Molecular genetics testing (DNA and genome analysis)

1- DNA sequencing

2- Polymerase chain reaction (PCR)

3-types of PCR

4-Applied of PCR

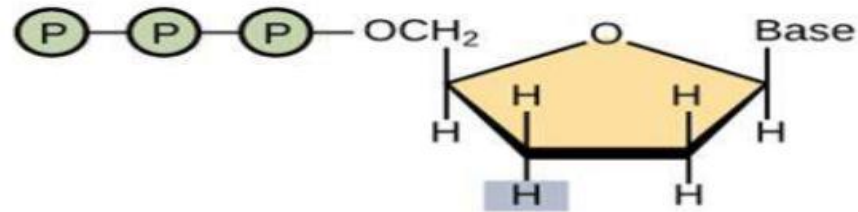
DNA sequencing

DNA sequencing enables us to perform a thorough analysis of DNA because it provides us with the most basic information of all: the sequence of nucleotides. With this knowledge, for example, we can locate regulatory and gene sequences, make comparisons between homologous genes across species and identify mutations

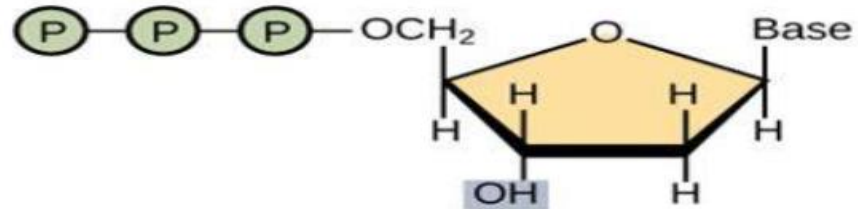
Frederick Sanger's method (Speed, Sanger's method, which is also referred to as dideoxy sequencing or chain termination, is based on the use of dideoxynucleotides (ddNTP's) in addition to the normal nucleotides (NTP's) found in DNA.

They include:

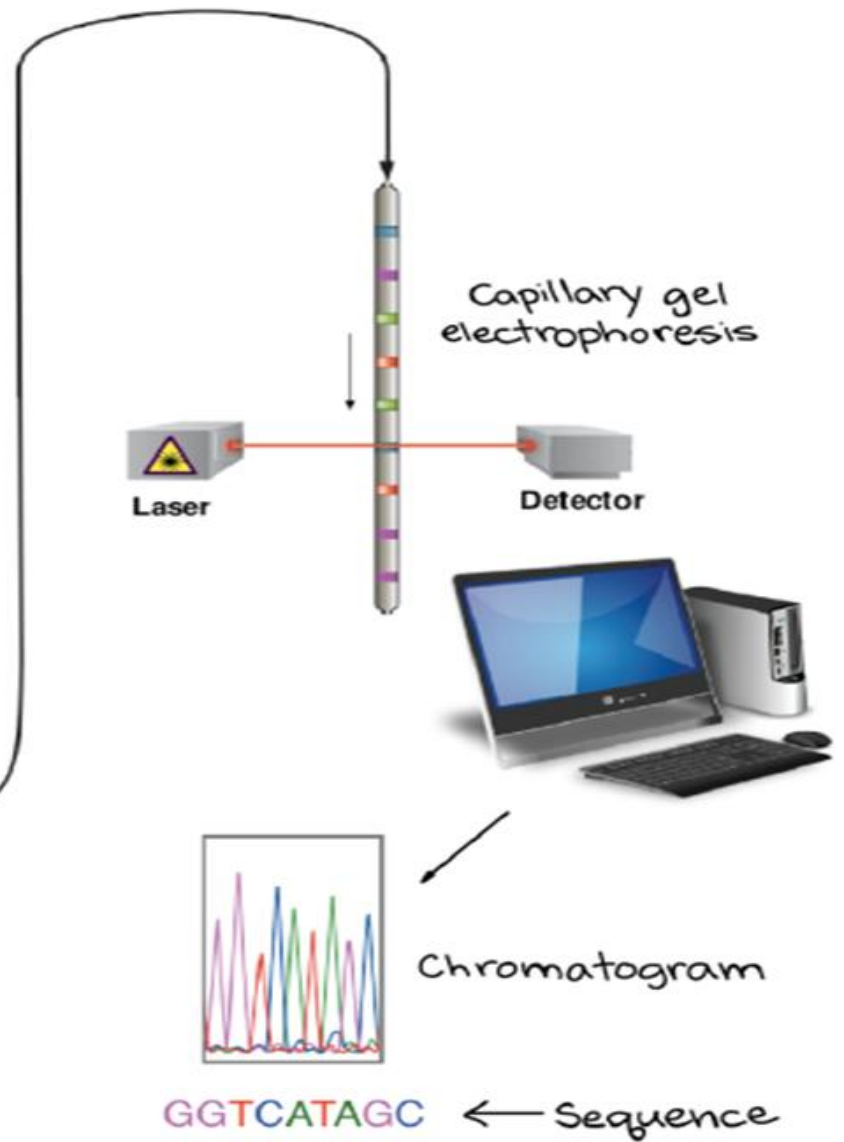
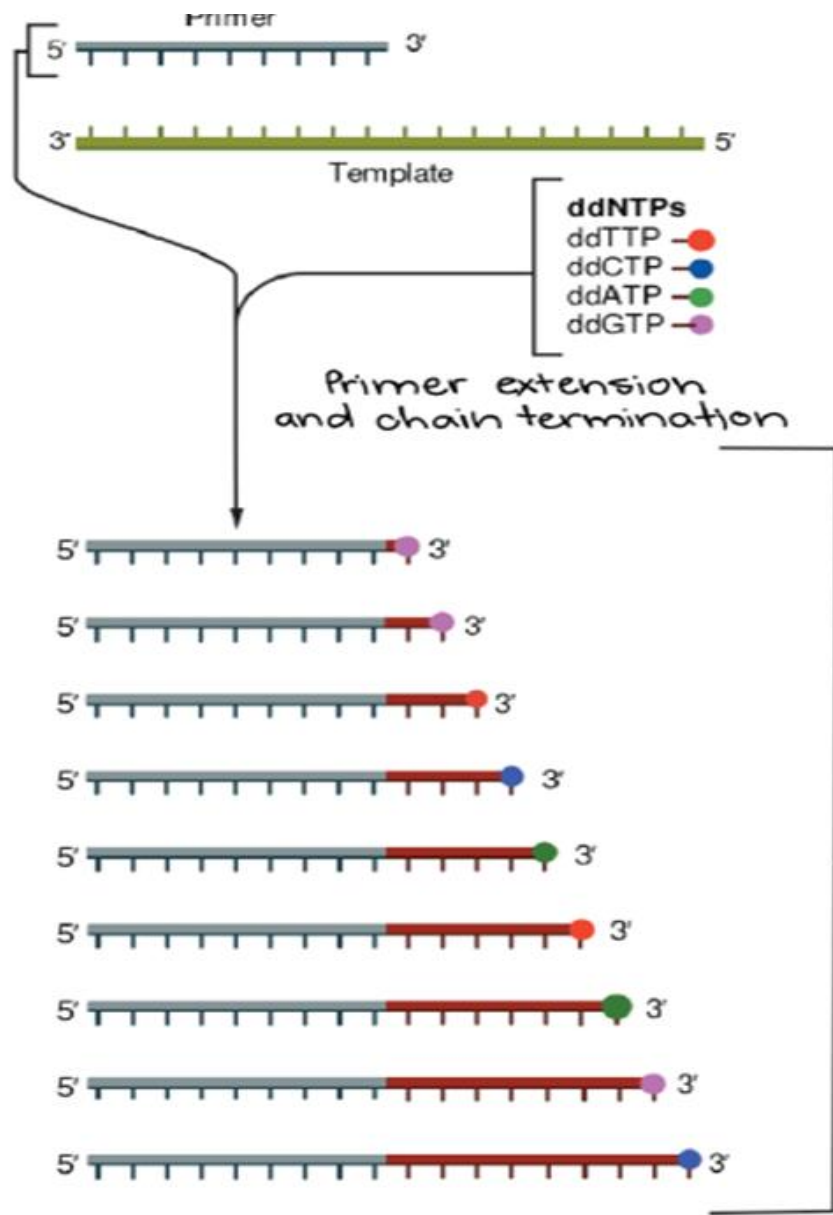
- A **DNA polymerase** enzyme.
- A **primer**, which is a short piece of single-stranded DNA that binds to the template DNA and acts as a "starter" for the polymerase.
- The **four DNA nucleotides** (dATP, dTTP, dCTP, dGTP).
- The **template DNA** to be sequenced.



Dideoxynucleotide (ddNTP)



Deoxynucleotide (dNTP)



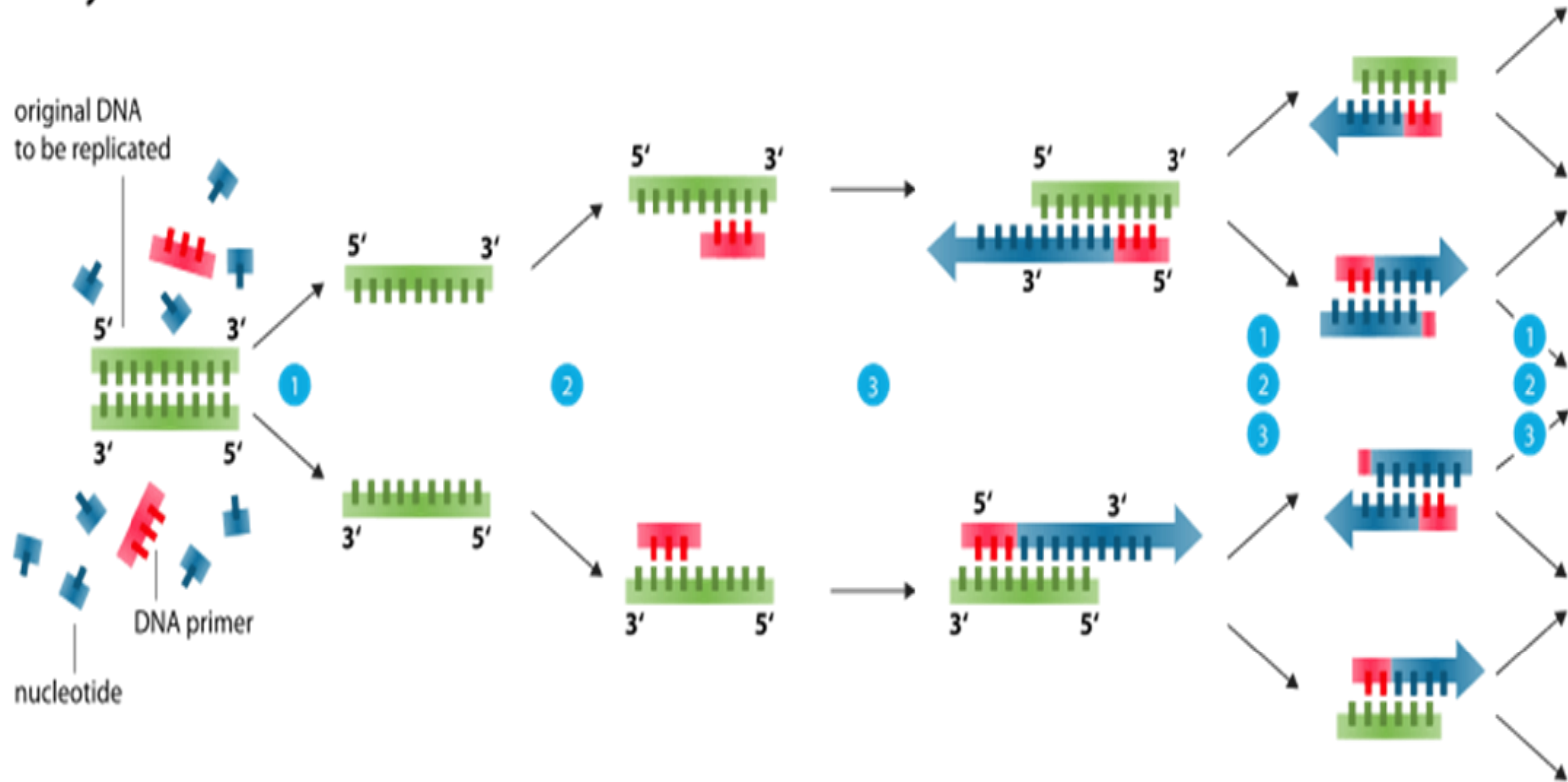
Polymerase Chain Reaction (PCR)

Polymerase chain reaction, or PCR, is a laboratory technique used to make multiple copies of a segment of DNA.

Components of PCR Reaction:

- 1- DNA template
- 2- DNA polymerase
- 3- Mg⁺² ions
- 4- Primers
- 5- Nucleotides
- 6- Buffer solution

Polymerase chain reaction - PCR



- 1 Denaturation** at 94-96°C
- 2 Annealing** at ~68°C
- 3 Elongation** at ca. 72 °C

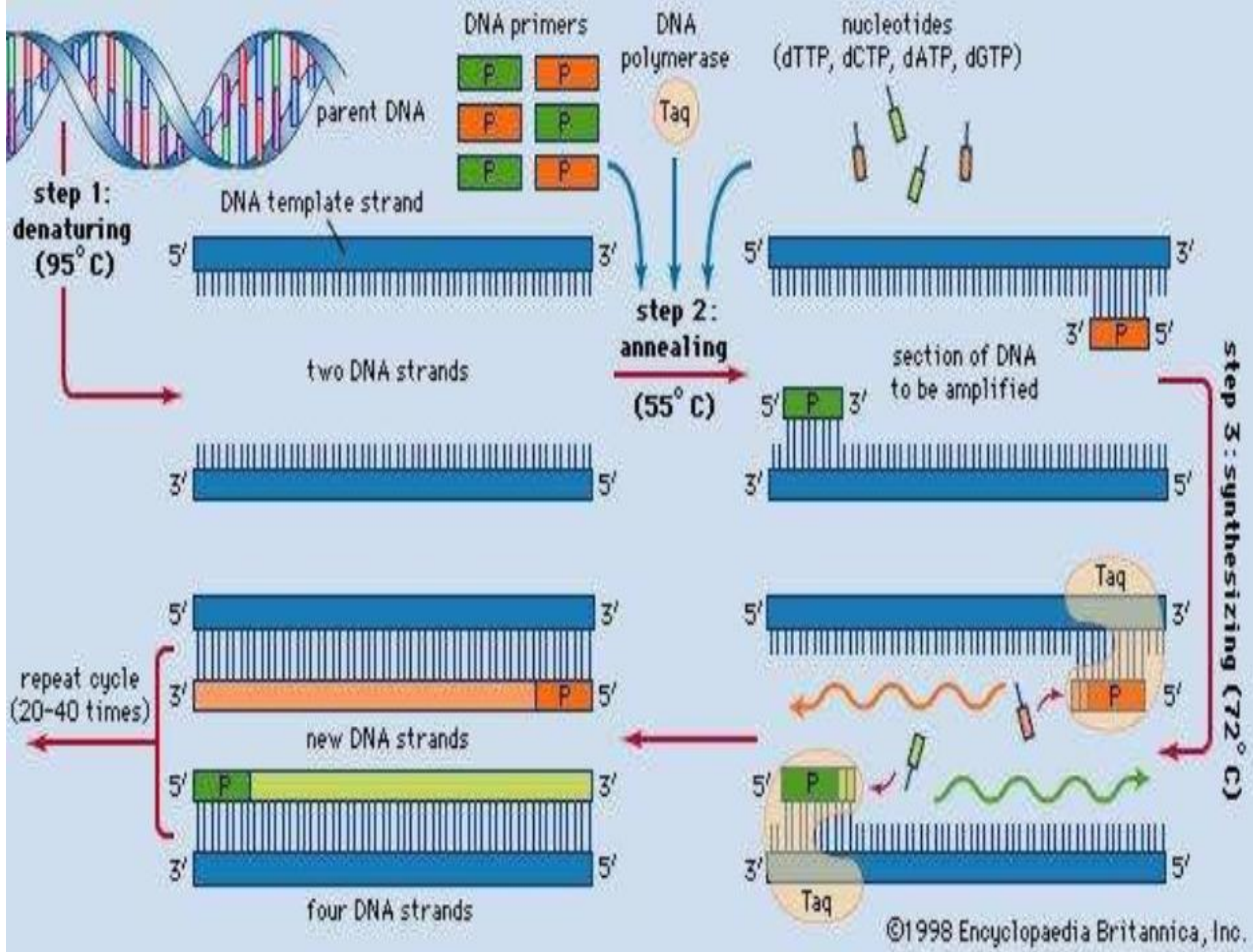
A typical PCR consists of Cycling

1- Denaturation 95 °C

2- Annealing 54°C

melting temperature (T_m)

3- Extension 72 °C Taq DNA
polymerase



Variants of PCR

1. Inverse polymerase chain reaction.

it is used when only one internal sequence of the target DNA is known. It is therefore very useful in identifying DNA sequences.

2. Reverse transcription polymerase chain reaction RT-PCR

It is a sensitive method for the detection of mRNA expression levels. It involves two steps: RNA is first reverse transcribed into cDNA using a reverse transcriptase and then the resulting cDNA is used as templates for subsequent PCR amplification. The technique is used to for diagnosis, staging, and detection of metastatic disease in pediatric alveolar rhabdomyosarcoma (ARMS), Ewing sarcoma family of tumors (ESFT), and desmoplastic small round cell tumors.

3. Real-Time polymerase chain reaction. DNA & RNA

Advantages of Real-Time PCR include the

ease of quantification

greater sensitivity

rapid analysis

Applications of PCR

- *PCR is a highly valuable technique in microbiology
- *In virology, PCR helped detect and characterize the nucleic acids of viruses before the antibodies are formed
- * With the advent of PCR-based DNA fingerprinting, PCR became an invaluable tool in forensic investigations.



THANK YOU