Name of student: …… **Stage: First**

Lecture Name: PCR machine **Number: 5**

Date: 21 / 4/ 2025 **Time: 8:30 AM** **Place: BC 208**

Polymer chain reaction (PCR)

PCR machine is a laboratory device used to **amplify (make many copies of) specific DNA segments**. It works by heating and cooling samples in a controlled way to trigger chemical reactions, allowing scientists to study even tiny amounts of DNA.

This PCR process, invented by Kary Mullis in 1984 in California. The purpose of a PCR is to make a huge number of copies of a gene.

DNA: is Deoxyribonucleic Acid. It is the genetic material found in all living organisms. that is responsible for carrying and transmitting the hereditary materials or the genetic instructions from parents to offsprings.

DNA is known as Deoxyribonucleic Acid. It is an organic compound that has a unique molecular structure. It is found in all **prokaryotic cells and eukaryotic cells.**

DNA was first recognized and identified by the Swiss biologist Johannes Friedrich Mescher in 1869 during his research on white blood cells.

Functions of DNA (Deoxyribonucleic Acid)

1- **Storage of Genetic Information**

- DNA contains the instructions (genes) needed to build and maintain an organism.
- These instructions are encoded in the sequence of four nitrogenous bases: **adenine (A), thymine (T), cytosine (C), and guanine (G)**.

2- **Replication**

- DNA can **make copies of itself**, ensuring that genetic information is passed on during cell division (mitosis and meiosis).
- This is crucial for growth, repair, and reproduction.

3- **Gene Expression (Protein Synthesis)**

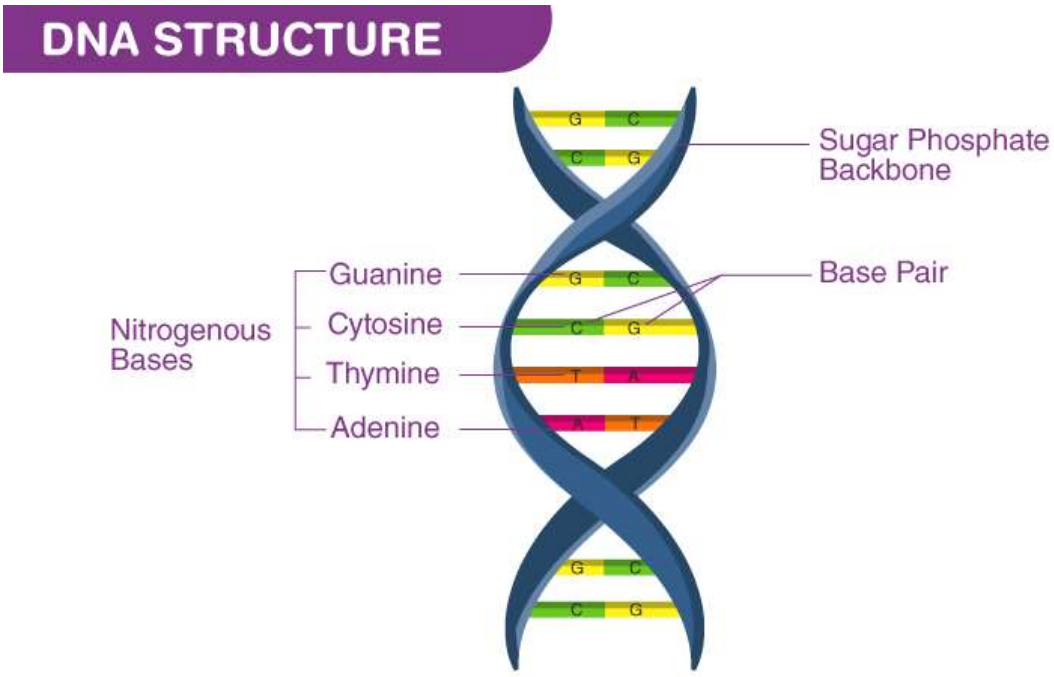
- DNA is transcribed into **RNA**, which is then translated into **proteins**.
- Proteins perform most of the functions in cells (e.g., enzymes, structural components, hormones).

4- **Transmission of Hereditary characteristics**

- DNA carries genetic information from parents to offspring, determining characteristics such as eye color, hair type, height, blood type, and even some behaviors or risk of diseases.
-

DNA Diagram

The following diagram explains the DNA structure representing the different parts of the DNA. DNA comprises a sugar-phosphate backbone and the nucleotide bases (guanine, cytosine, adenine and thymine).



Shape: DNA looks like a twisted ladder (called a double helix).

Made of: Four chemical bases – **Adenine (A), Thymine (T), Cytosine (C),** and **Guanine (G)**.

Location of DNA

1. In Eukaryotic Cells (like humans, animals, plants, fungi):

DNA is found in Nucleus Main location where most of the cell's DNA is stored in chromosomes.

2. In Prokaryotic Cells (like bacteria):

DNA is found in: Cytoplasm, in a region called the nucleoid (no nucleus).

Plasmids, which are small, circular DNA molecules floating in the cytoplasm.

Parts of PCR Machin:

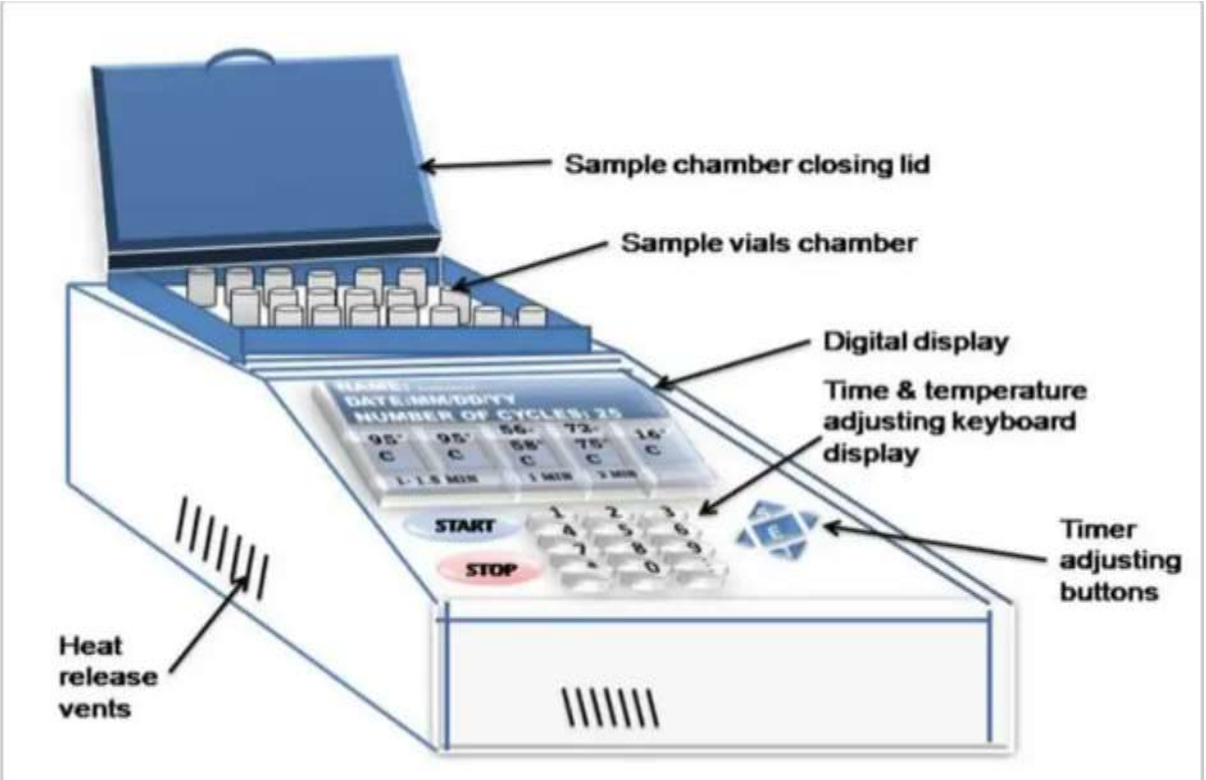
1- Thermal Block: is the metal platform (usually aluminum) inside a PCR machine that holds the reaction tubes or plates. Its main job is to rapidly and accurately change temperatures during PCR cycles.

2- Heating and Cooling System: is what allows the DNA machine to rapidly cycle through precise temperatures, which is essential for PCR (Polymerase Chain Reaction).

3- Heated Lid : is the top part of the PCR machine that gently presses down on the caps of PCR tubes or plate wells during the reaction. It is heated, usually to around **105°C**, and serves a very important purpose during thermal cycling.

4- Control Panel and Display: the user interface of the PCR machine that allow scientists to program, monitor, and control the thermal cycling process.

Parts of PCR Machin



Principle of PCR:

Denaturation

- When the reaction mixture is heated for 0.5 to 2 minutes to 94°C, denaturation takes place.
- A single-stranded DNA is created as a result of the hydrogen bonds between the DNA's two strands being broken.
- The single DNA strands now serve as a template for the synthesis of additional DNA strands.

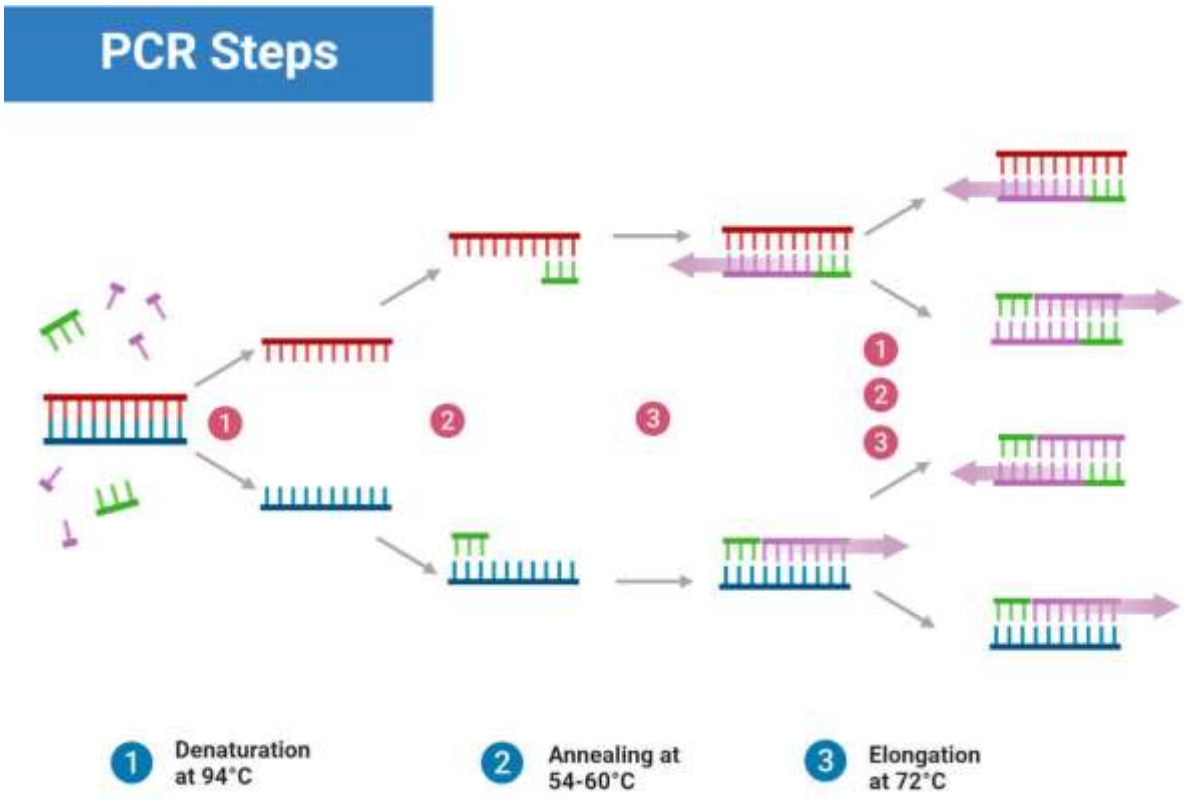
Annealing

- For around 20 to 40 seconds, the reaction temperature is decreased to 54 to 60 °C.

- The primers attach to the template DNA's complimentary sequences in this circumstance.
- Primer sequences are 20–30 bases long, single-strand DNA or RNA segments.
- They act as the precursor in the production of DNA.
- There are two primers forward primer and a reverse primer the two separated strands run in opposing directions.

Elongation

- The temperature is increased to between 72 and 80 degrees Celsius at this stage.
- The Taq polymerase enzyme tacks the bases onto the primer's 3′ end. As a result, the DNA stretches from 3 to 5.
- Taq Polymerase can withstand extremely high temperatures. A double-stranded DNA molecule is produced as a result.



Applications of PCR

1- Medicine: The PCR technique enables early diagnosis of malignant diseases.

2- Classification of organisms.

3- Mutation detection.

4- Detection of pathogens.

5- Gene therapy.

6- Finger print.

7- Forensic science: PCR is very important for the identification of criminal

PCR Advantages:

- Allows for quicker, more informed decision making
- Rapid identification of bacteremia, especially for specimens with low bacterial counts
- Effective in identifying cases in extra pulmonary specimens that smear and/or culture may have missed.
- Important for identifying certain diseases that are challenging to cultivate in vitro or take a long time to cultivate. Significantly faster at producing results than cultivating
- It is still regarded as an auxiliary test for some diagnostic procedures that depend on smear and culture such as Tuberculosis.
- It has the ability to test for antimicrobial resistance.

PCR machine