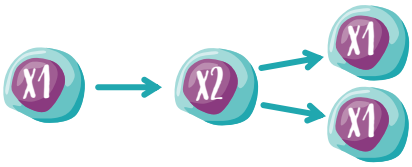
# DNA Replication

## DNA Replication

Make sure you revise the structure of **DNA** we learned in section **A1.2** before revising this section.

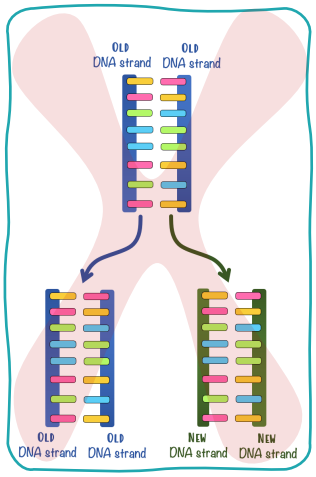
### Why do we need DNA Replication?

Cells need to divide to allow for **GROWTH**, **REPAIR** damaged tissues, and replace old or worn-out cells, ensuring the organism's overall health and function.

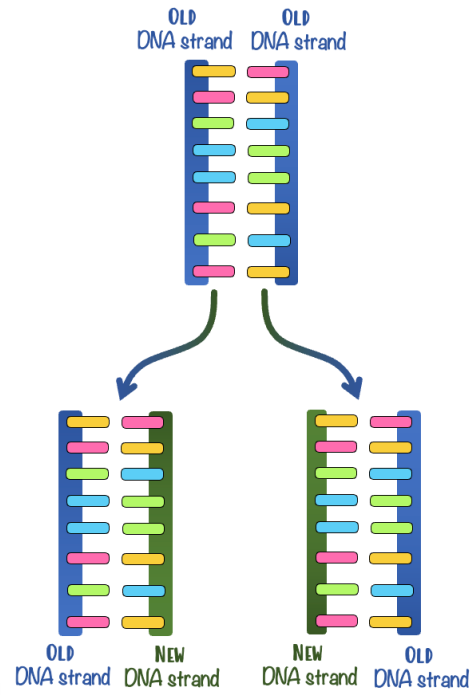



Before **MITOSIS** (cell division), the replication of **DNA** is necessary to ensure that each cell is provided with a full set of identical genetic material.

This is **NOT** how **DNA** replication occurs




**SEMI-CONSERVATIVE process:** each original strand serves as a template for the new complementary strand, this ensures that genetic information is accurately passed on to the daughter cells.

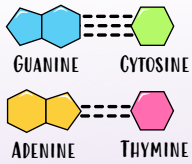


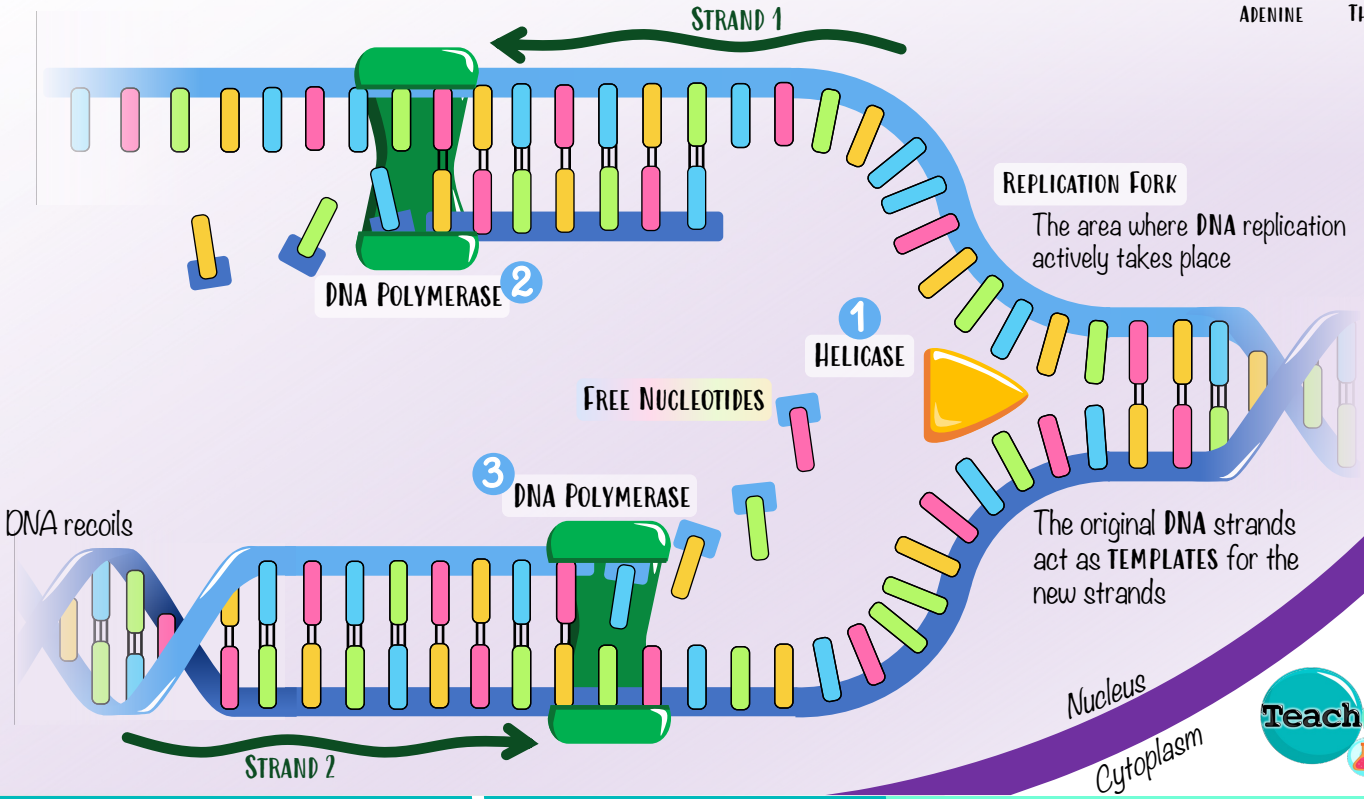

### Steps

1. DNA double helix is unwound and separated using **HELICASE**.
   - **STRAND 1**
   - **STRAND 2**
2. **DNA POLYMERASE** adds free nucleotides in sequence **AWAY** from the replication fork.
3. **DNA POLYMERASE** adds free nucleotides in sequence **TOWARDS** the replication fork.

**DNA POLYMERASE** catalyzes covalent bonding between adjacent nucleotides. It also **PROOFREADS** to ensure it hasn't added the wrong nucleotide.

The free nucleotides are added to the template strand acording to **COMPLEMENTARY BASE PAIRING!**



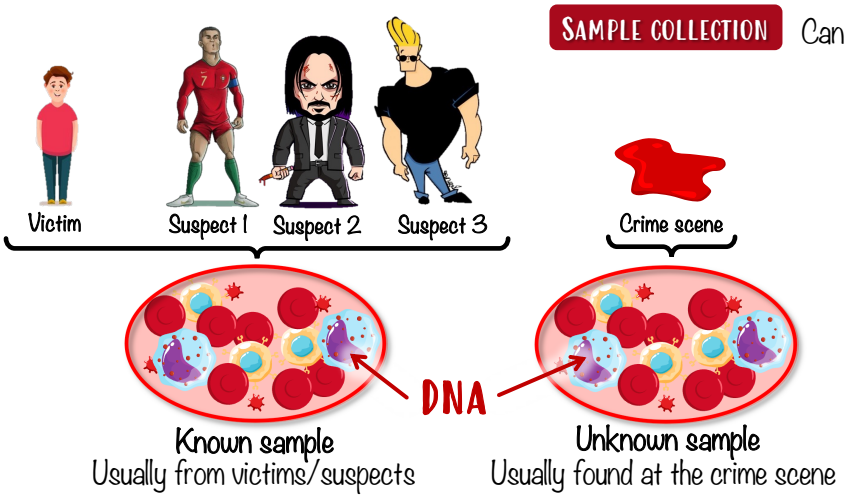
# DNA Replication

**DNA PROFILING** The process of matching an **UNKNOWN** sample of **DNA** to a **KNOWN** sample of **DNA** to see if they correspond. Also called **DNA** fingerprinting.

DNA profiling includes **5** main steps:

Sample Collection → DNA Extraction → PCR → Gel Electrophoresis → Results Interpretation

**SAMPLE COLLECTION** Can be anything from blood, saliva, etc...



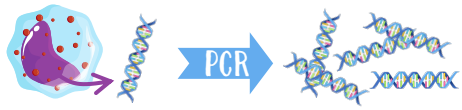

**DNA EXTRACTION** *but . . .*

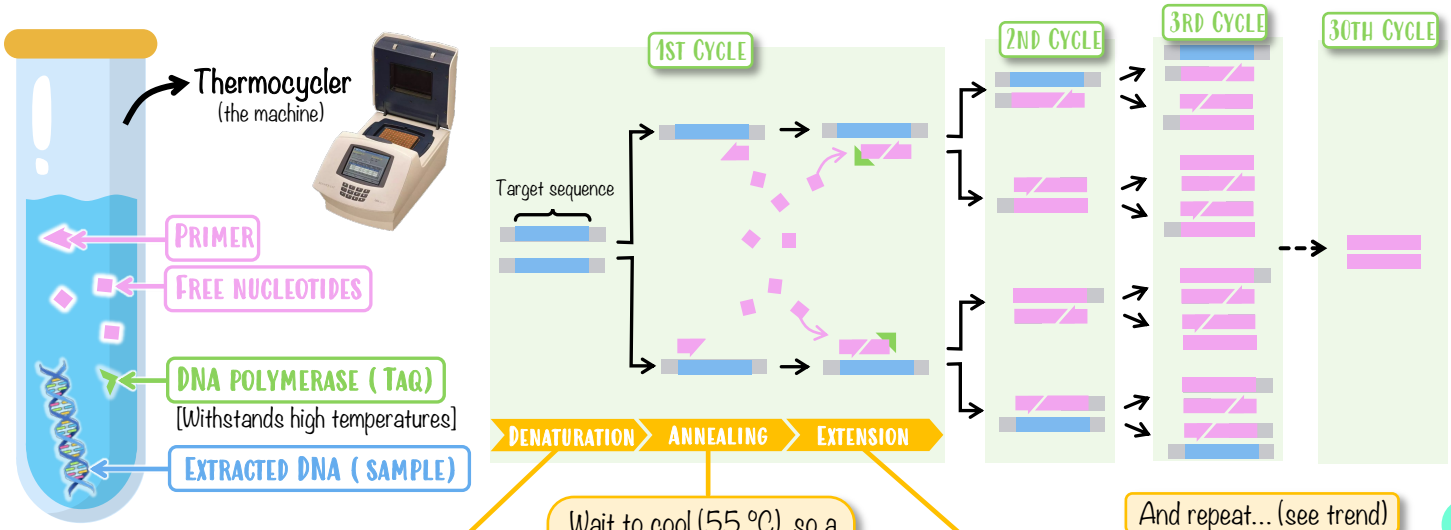
Normally, the **DNA** from a crime scene is **NOT ENOUGH** to analyze for the scientist.

So we need to replicate this **DNA** sample multiple time using a technique called **PCR** (Polymerase Chain Reaction) to obtain a larger sample (think of it as a photocopier)

## POLYMERASE CHAIN REACTION ( PCR)

A laboratory technique, which takes a small number of **DNA** and copies all the nucleotides to make many of copies of the **DNA**.




DNA heated to 95°C to break the hydrogen bonds between the double strands of DNA.

Wait to cool (55 °C), so a PRIMER can be added on both strands, at the end of the target sequence.

FREE NUCLEOTIDES are added (75°C) by special DNA POLYMERASE ( TAQ). Now two total copies exist.

And repeat... (see trend)

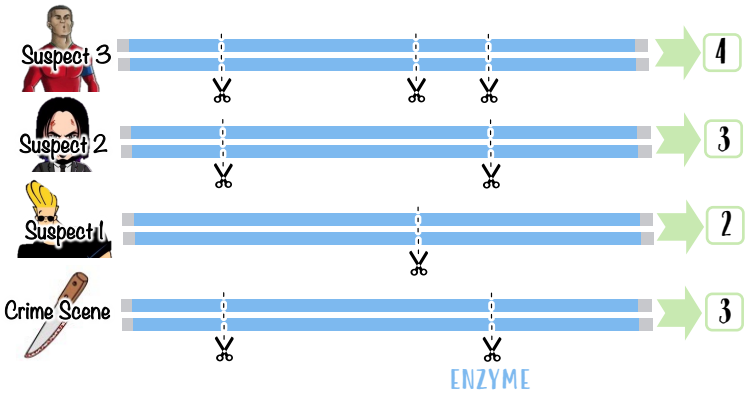
$2^N$ = # COPIES

$2^1$ = 2 COPIES — $2^2$ = 4 COPIES — $2^3$ = 8 COPIES — $2^{30}$ = $10^9$ COPIES

# DNA Replication

## Gel Electrophoresis

A laboratory technique used to separate certain molecules according to size and other properties. Works for **DNA**, **RNA**, **PROTEINS**.

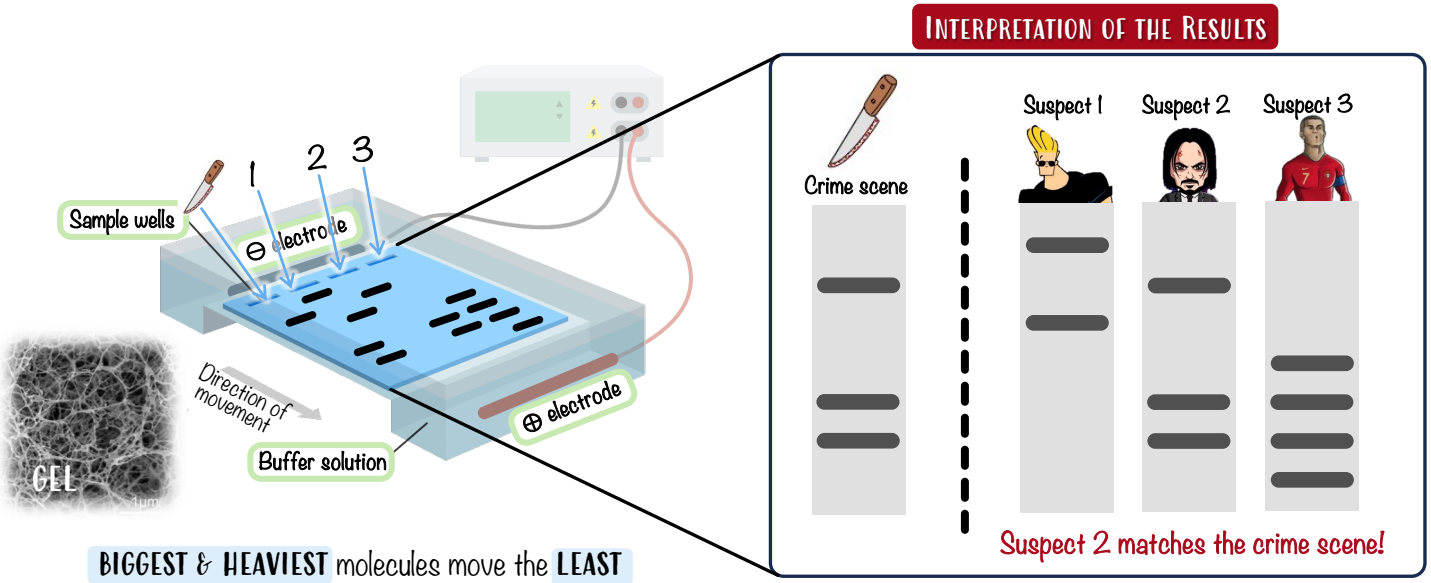



**DNA** samples are cut using ENZYMES, which create fragments of varying lengths: different individuals will cause the enzymes to cut in different locations.

The **DNA** found at the crime scene matches one of the suspects (guilty one) and thus the enzyme will cut in the same places.

*(notice similarities between suspect 2 and the crime scene)*

These samples are placed into wells at one end of a gel matrix inside an electrophoresis tank. An ELECTRIC CURRENT is applied: **DNA** fragments, which are negatively charged, move towards the positive electrode, with smaller fragments moving faster and traveling further than larger ones. The resulting pattern of BANDS can be compared to a sample from a crime scene to identify similarities.




**BIGGEST & HEAVIEST** molecules move the **LEAST**

**SMALLEST & LIGHTEST** molecules move the **MOST**

## Purposes of DNA Profiling

# notes