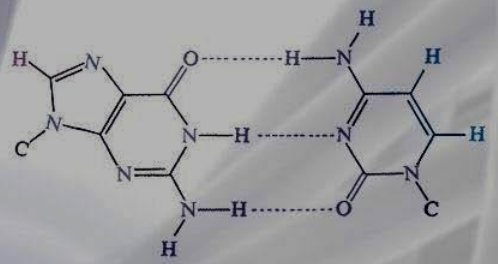
Grade 12 Life Sciences
Session 1

Topic : DNA The Code of Life

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

DNA
Structure



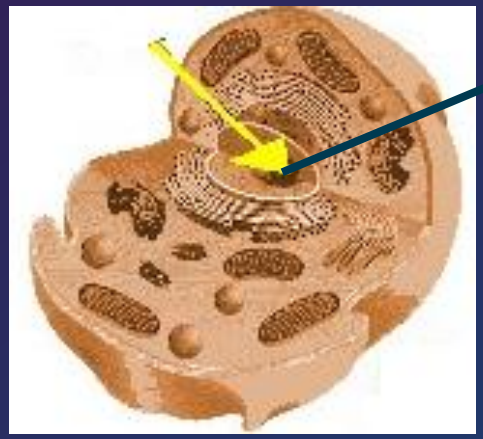
deoxyribonucleic acid

WJ

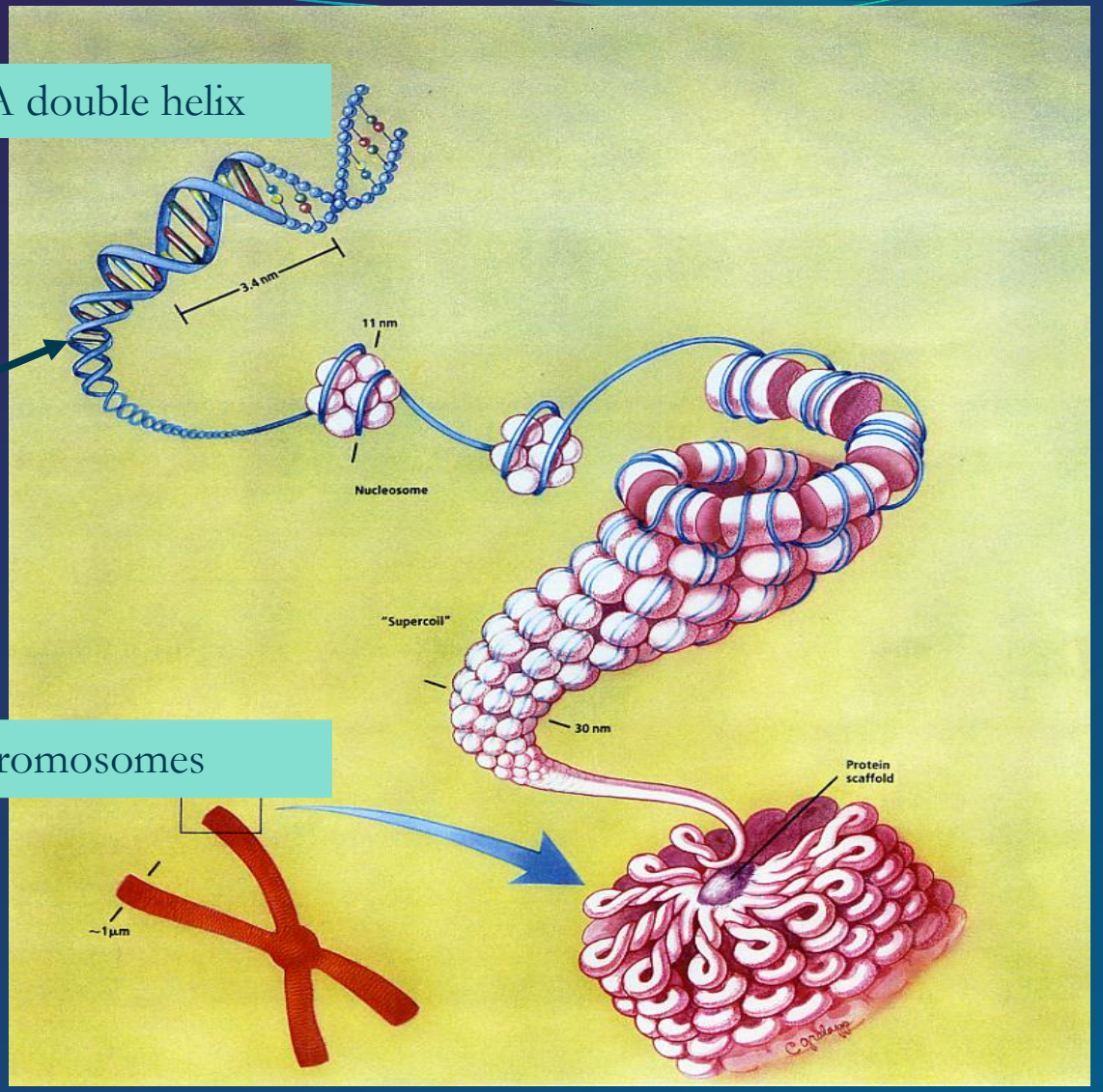
DNA –Position in the cell

DNA double helix

Nucleus

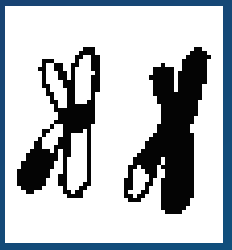


Chromosomes



In the nucleus of almost every cell in your body is the collection of DNA needed to make you.

DNA in the nucleus is grouped into 23 sets of chromosomes that are called your "genome."

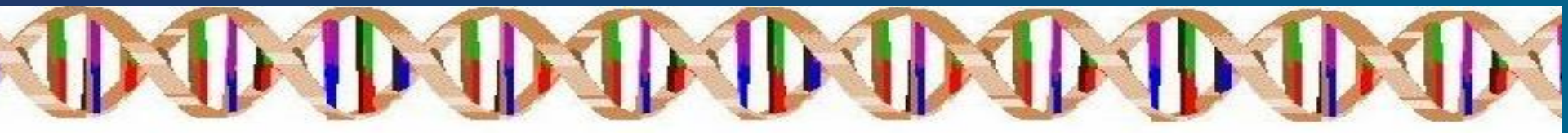


- In each chromosome, the DNA is grouped into "genes."
- Your genome contains about 35,000 genes.

Instructions to make your whole body and keep it working is contained in DNA

- **Instructions is called genetic code**

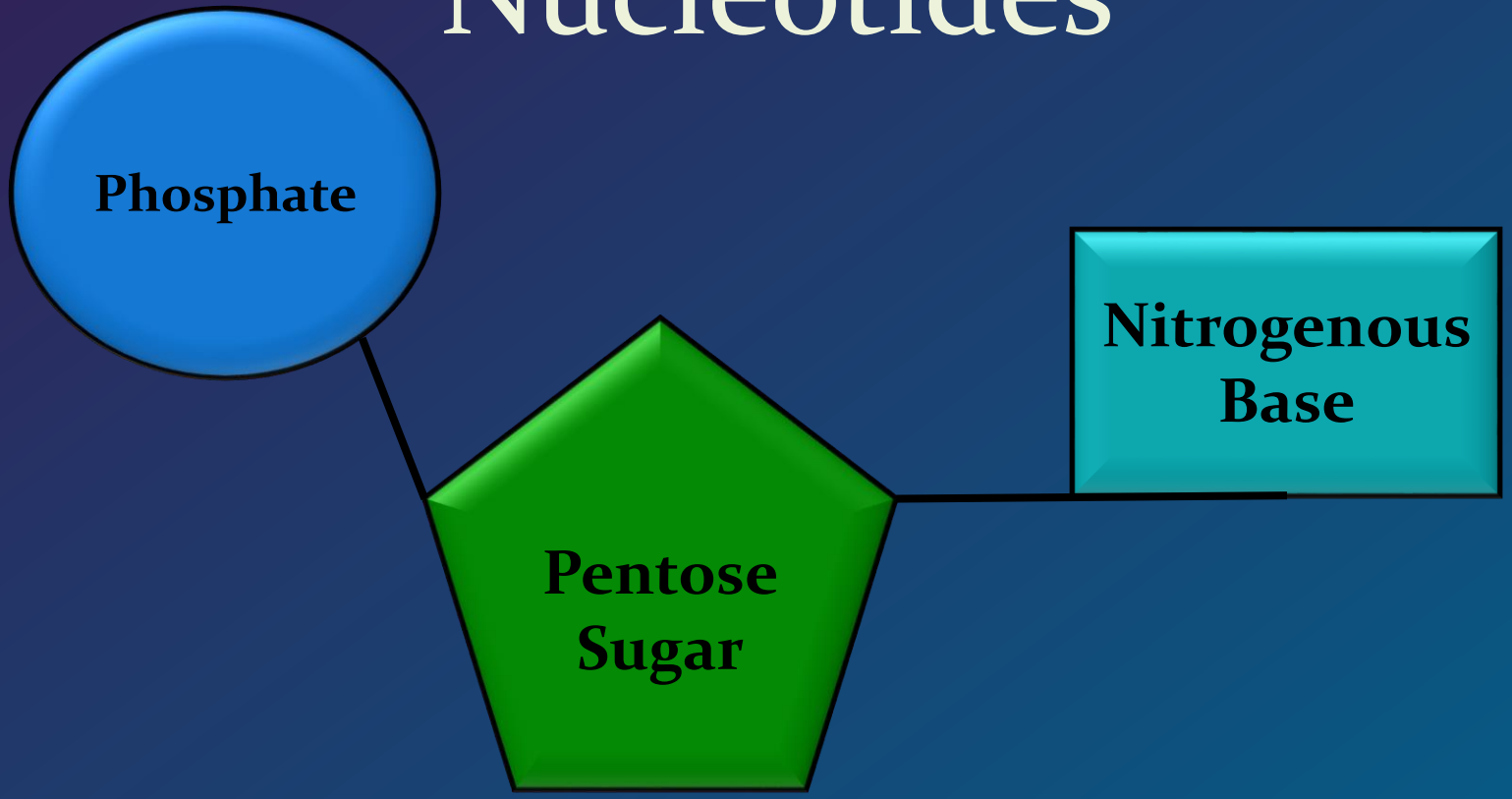
- **The DNA in your genes tells the cell what amino acids (protein building blocks) to put together to make a protein.**



DNA Structure

- DNA consists of two molecules that are arranged into a ladder-like structure called a **Double Helix**.
- A molecule of DNA is made up of millions of tiny subunits called **Nucleotides**.
- Each nucleotide consists of:
  1. Phosphate group
  2. Pentose sugar
  3. Nitrogenous base

Nucleotides



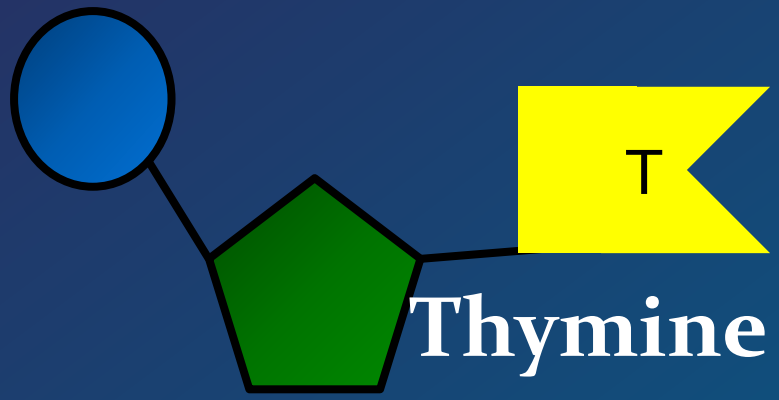
Nucleotides

- The phosphate and sugar form the backbone of the DNA molecule, whereas the bases form the “rungs”.

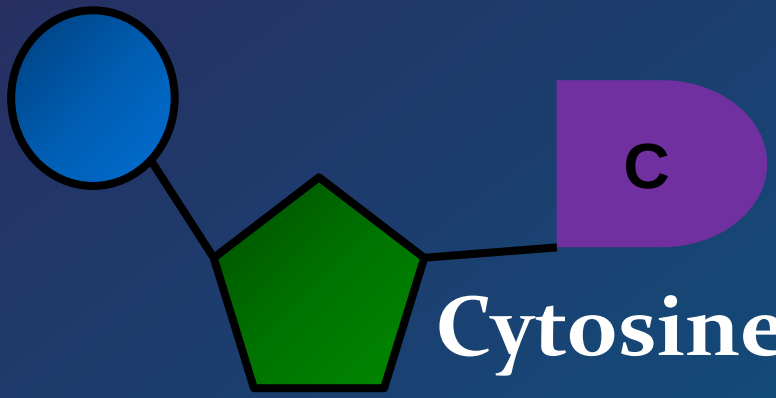
- There are four types of nitrogenous bases.

Nucleotides

Adenine



Thymine



Cytosine

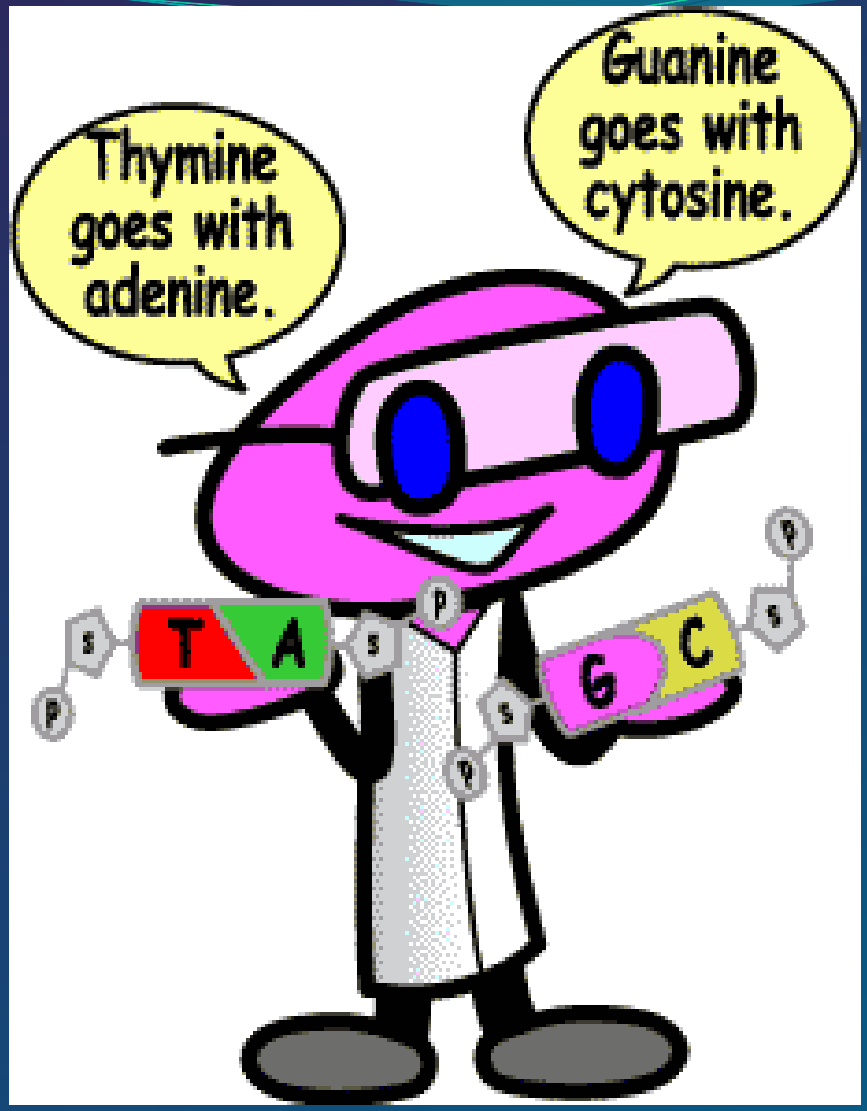
Guanine

Remember

DNA

T – A

G - C



Nucleotides

- Each base will only bond with one other specific base.

- Adenine (A)
- Thymine (T)

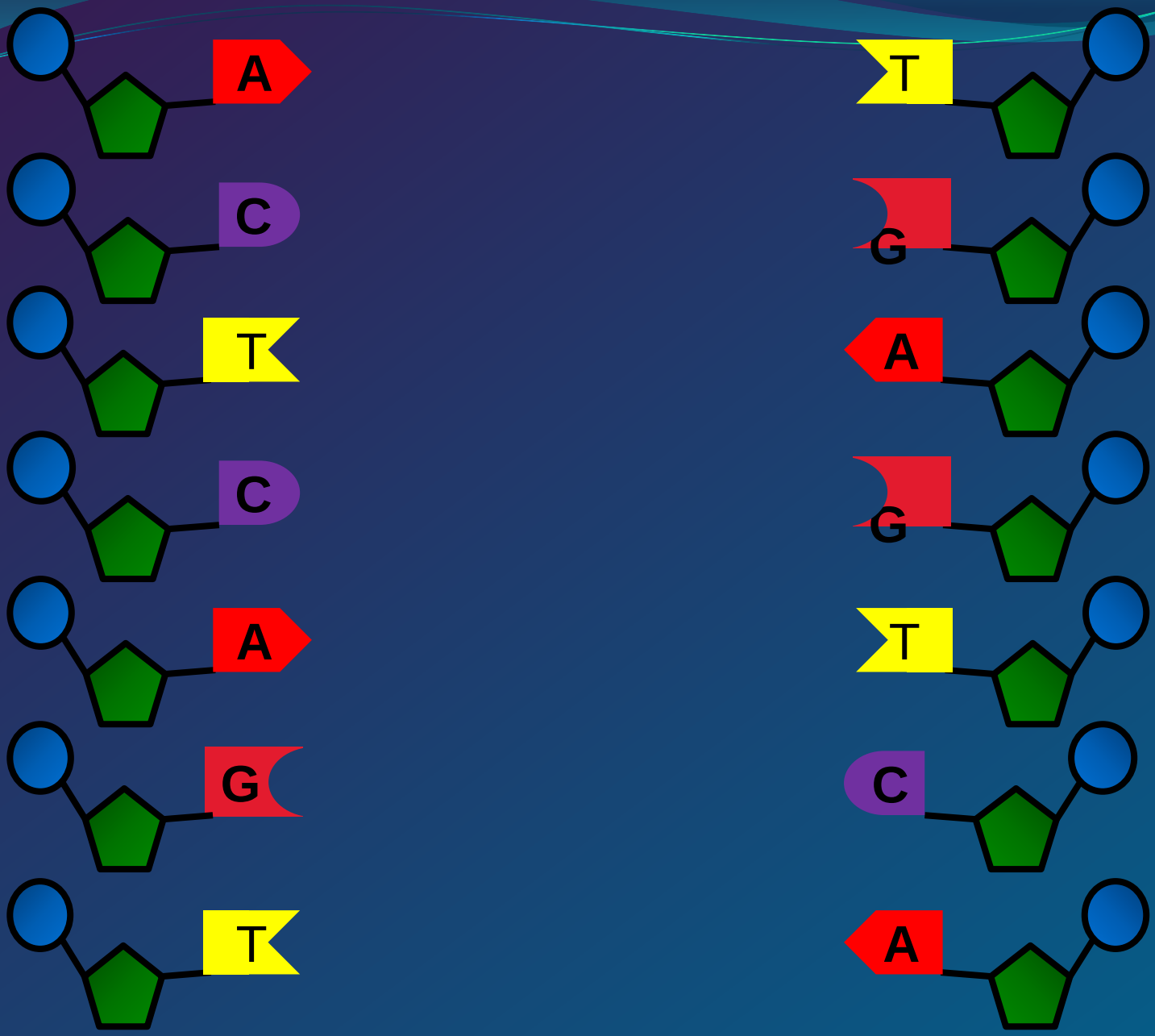
} Form a base pair.

- Cytosine (C)
- Guanine (G)

} Form a base pair.

DNA Structure

- Because of this complementary base pairing, the order of the bases in one strand determines the order of the bases in the other strand.


A
C
T
C
A
G
T
T
G
A
G
T
C
A

DNA Structure

- To crack the genetic code found in DNA we need to look at the sequence of bases.

- The bases are arranged in triplets called codons.

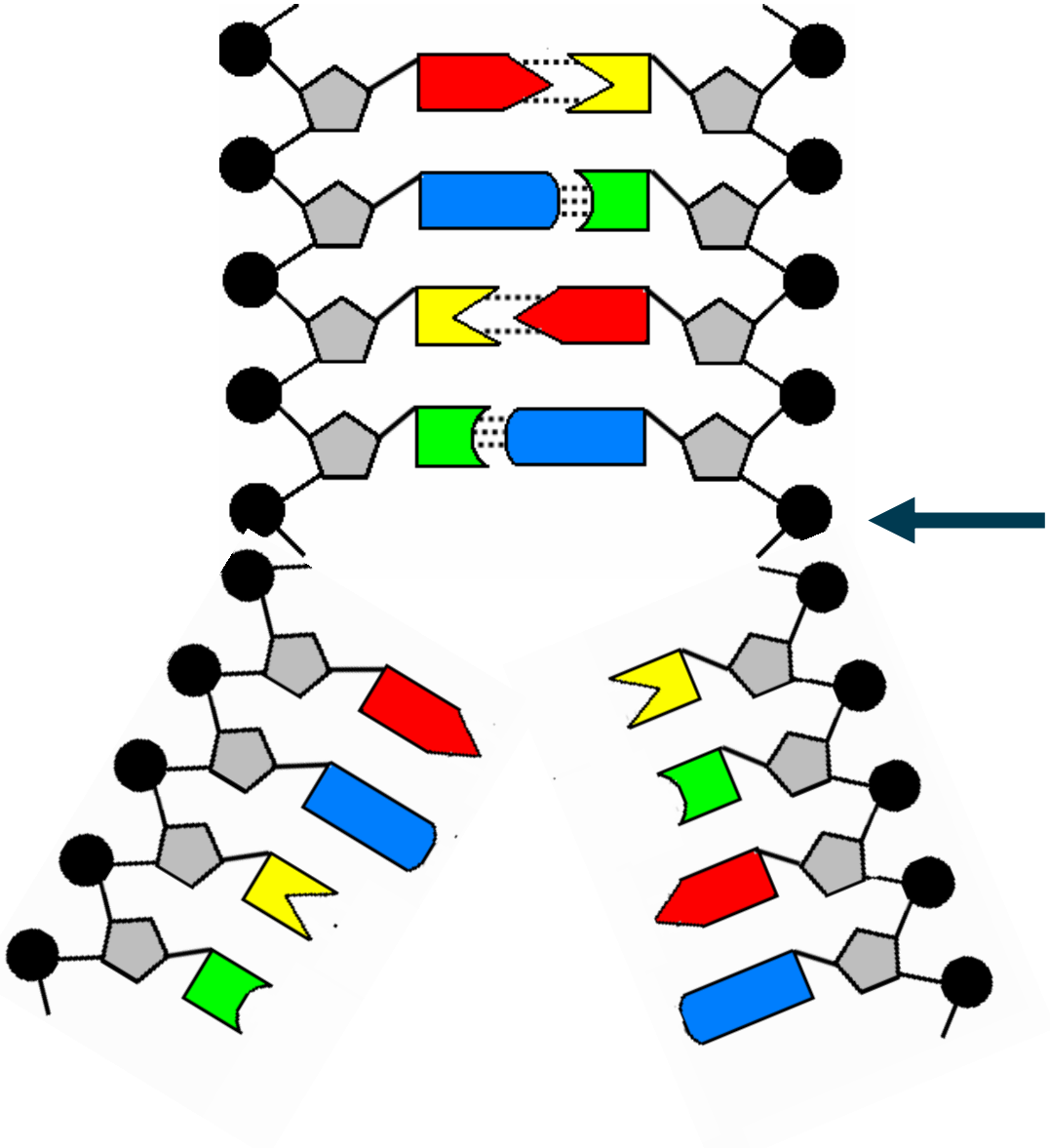
A G G - C T C - A A G - T C C - T A G

T C C - G A G - T T C - A G G - A T C

DNA Structure

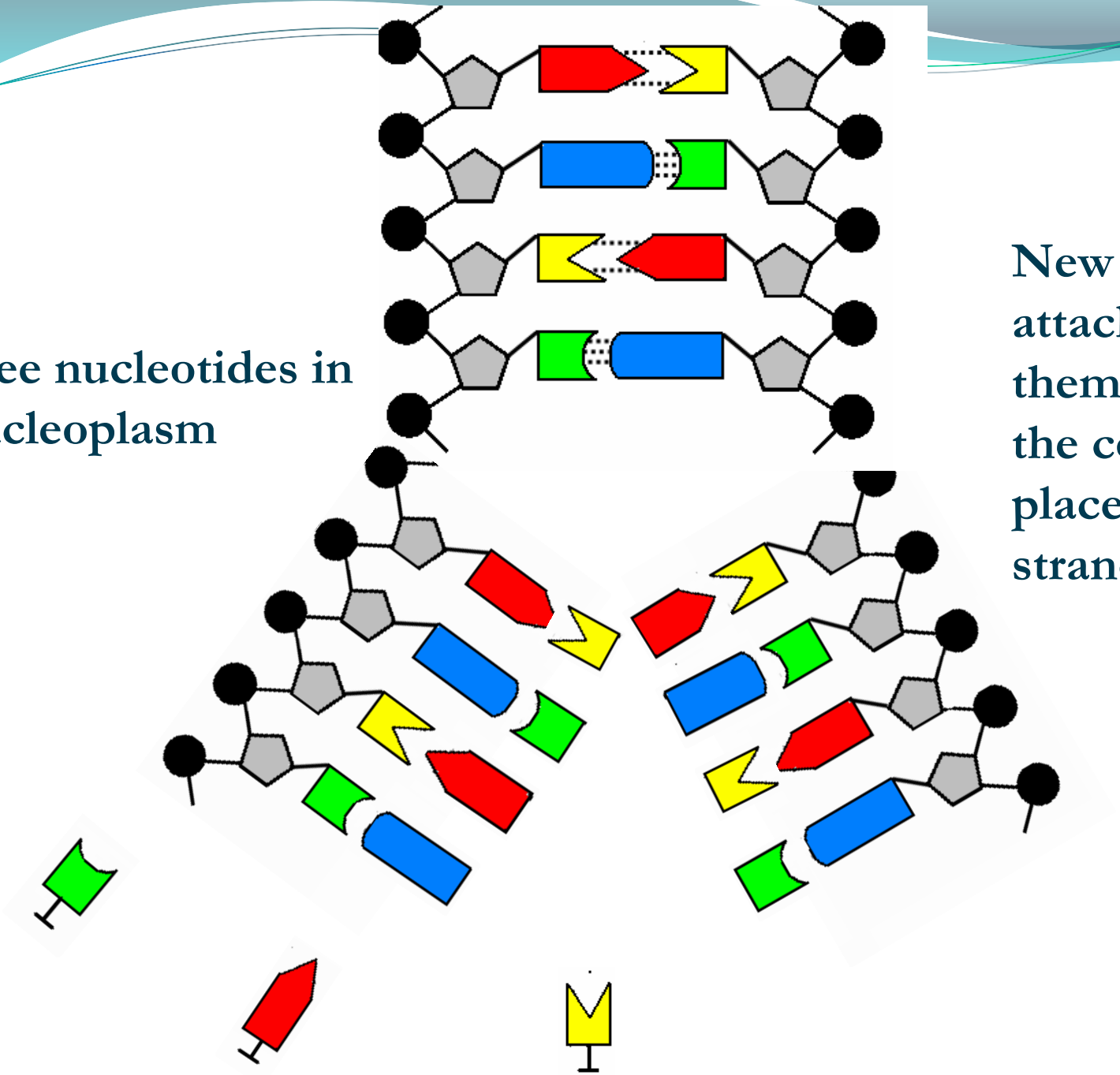
- A gene is a section of DNA that codes for a **protein**.
- Each unique gene has a unique sequence of bases.
- This unique sequence of bases will code for the production of a unique protein.
- It is these proteins and combination of proteins that give us a unique **phenotype**.

DNA Replication



Unzip into two single strands

Free nucleotides in nucleoplasm

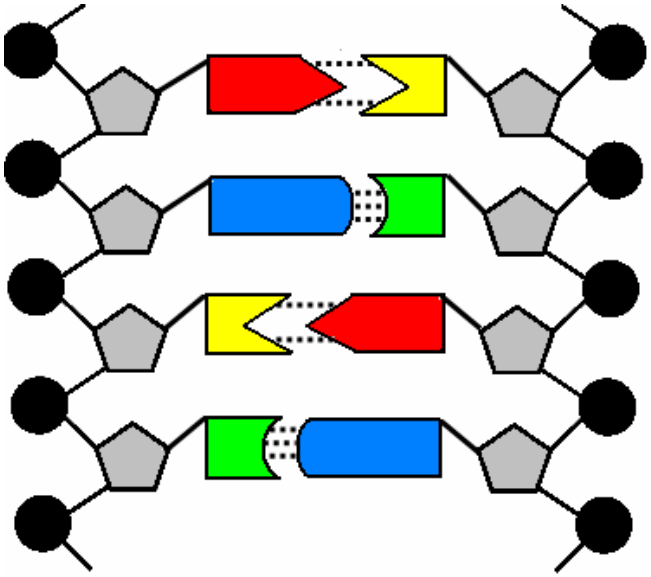


New bases attached themselves in the correct place of each strand

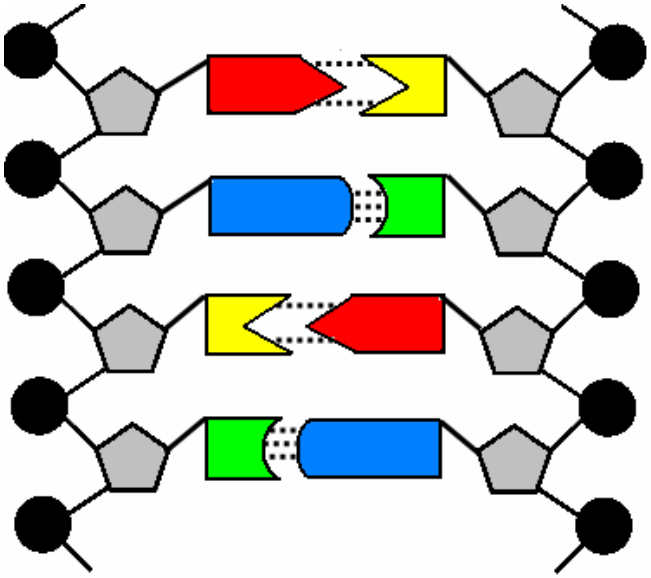
Two identical strands are formed

Each strand now becomes a double helix.

Strand 1



Strand 2



3. DNA Replication

1. The double helix unwinds.

2. Weak hydrogen bonds between nitrogenous bases break and two DNA strands unzip *(separate).*

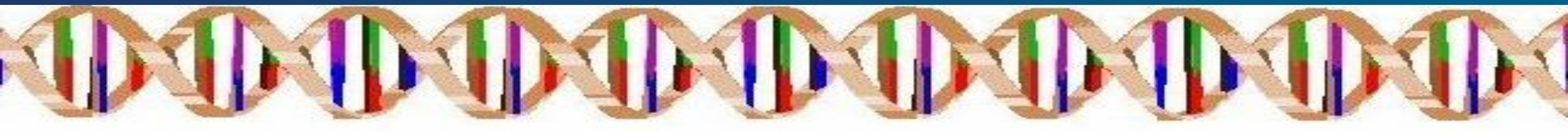
3. *Each original* DNA strand serves as a template on which its complement is built.

4. Free nucleotides build a DNA strand onto each of the original two DNA strands by attaching to their complementary nitrogenous bases (A to T and C to G)

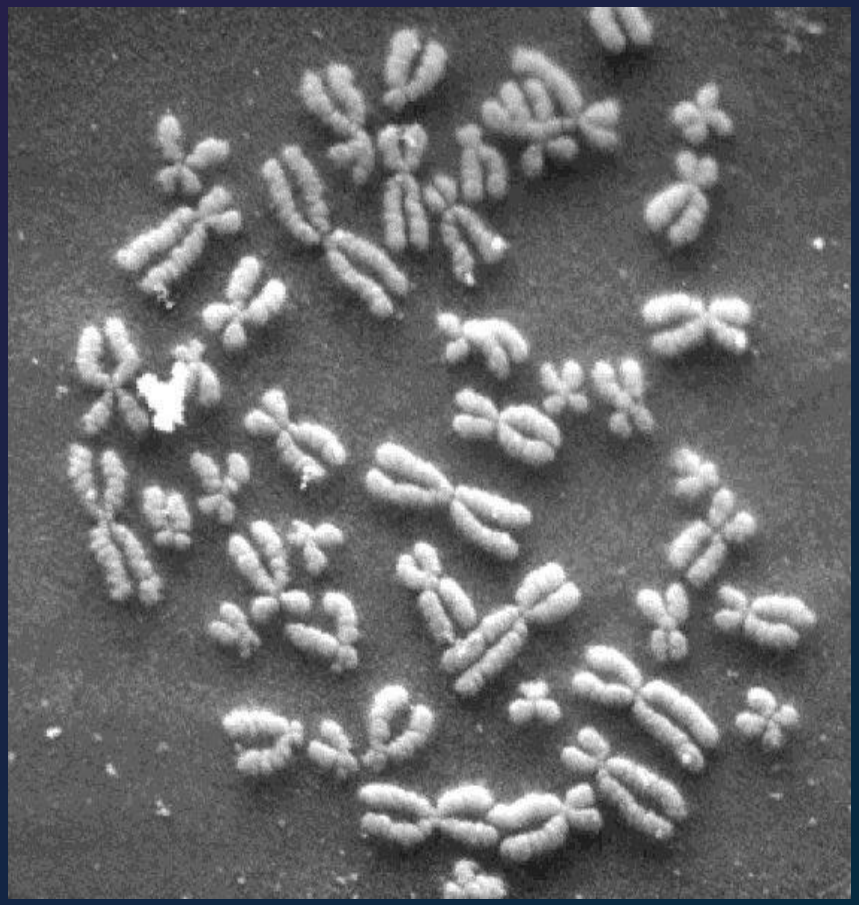
5. This results in two identical DNA molecules. Each molecule consists of one original strand and one new strand

4.Significance of DNA replication:

- Important for growth, reproduction
- Mutations can cause variation
- The main enzyme that catalyze the process is DNA polymerases
- Forms building block for amino acids that forms proteins
- Three bases provides more than the 20 combinations needed to code amino acids
- The sequence of the three bases is called a codon.



DNA Profiling

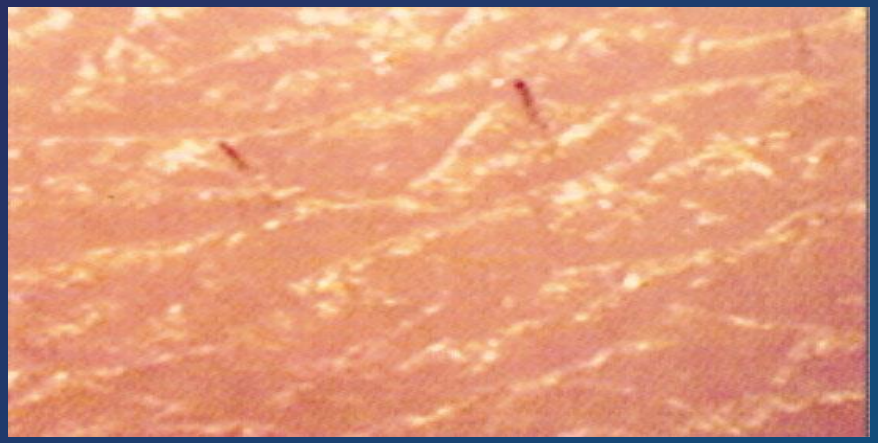


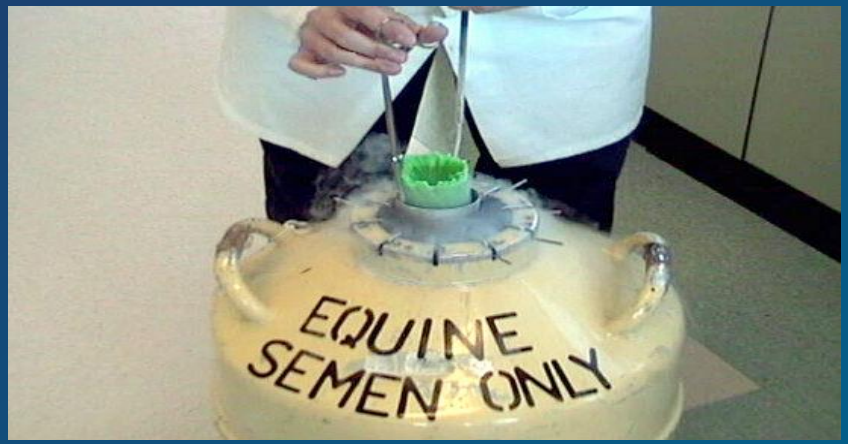
Each PERSON'S DNA profile is unique!

What is DNA Profiling?

A technique used by scientists to distinguish between individuals of the same species using only samples of their DNA

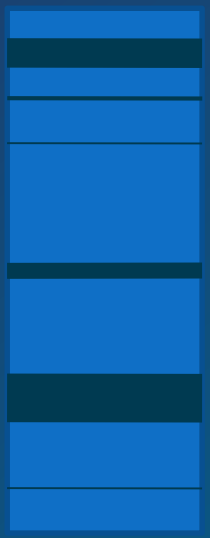
Where do we get DNA





DNA profiling

- Technique used to identify sequence of bases
- The nucleotides are separated from each other in the order that they are found in strand of DNA
- Nucleotides appear as dark bands
- The sequence in this segment of DNA reads CTT- AGT



- Use as DNA fingerprint - Unique for every person

DNA PROFILING IS DIFFERENT FROM FINGERPRINTS

DNA Profiling can solve crimes

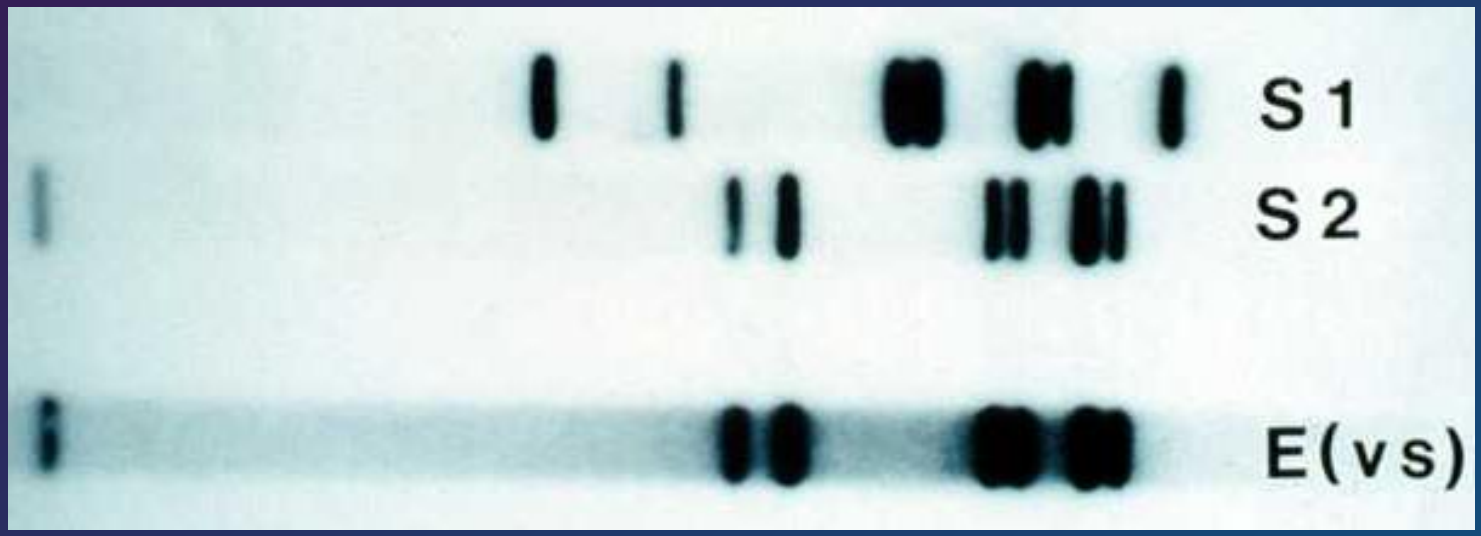
- **The pattern of the DNA profile is then compared with those of the victim and the suspect.**
- **If the profile matches the suspect it provides strong evidence that the suspect was present at the crime scene (NB: it does not prove they committed the crime).**
- **If the profile doesn't match the suspect then that suspect may be eliminated from the enquiry.**

Solving Medical Problems

- A child's paternity (father) and maternity(mother) can be determined.

- This information can be used in
  - -Paternity suits
  - -Inheritance cases
  - -Immigration cases

DNA Profiling

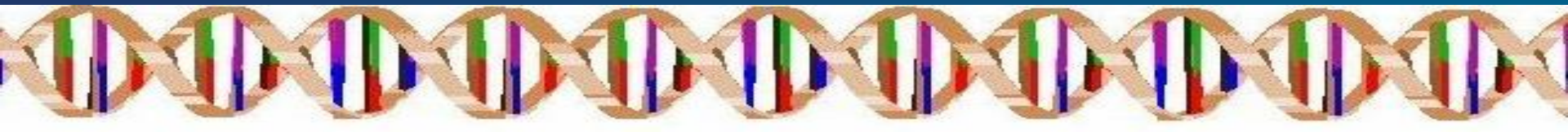


- **DNA fingerprinting is often used by the police in identifying the suspect of a crime.**

- **A useful but controversial method**
- **A sample of a suspect's bodily fluid or tissue is to be compared with a sample found at the scene of a crime.**
- **The pattern of lines represents a person's specific genetic make-up.**
- **DNA fingerprinting use in 11/9 disaster to identify victims**

Three types of RNA and their functions

1. Messenger RNA (mRNA)
2. Transfer RNA (tRNA)
3. Ribosomal RNA (rRNA)



1. Messenger RNA (mRNA)

- **Acts as a template for protein synthesis**
- **Has the same sequence of bases as the DNA strand that has the gene sequence.**

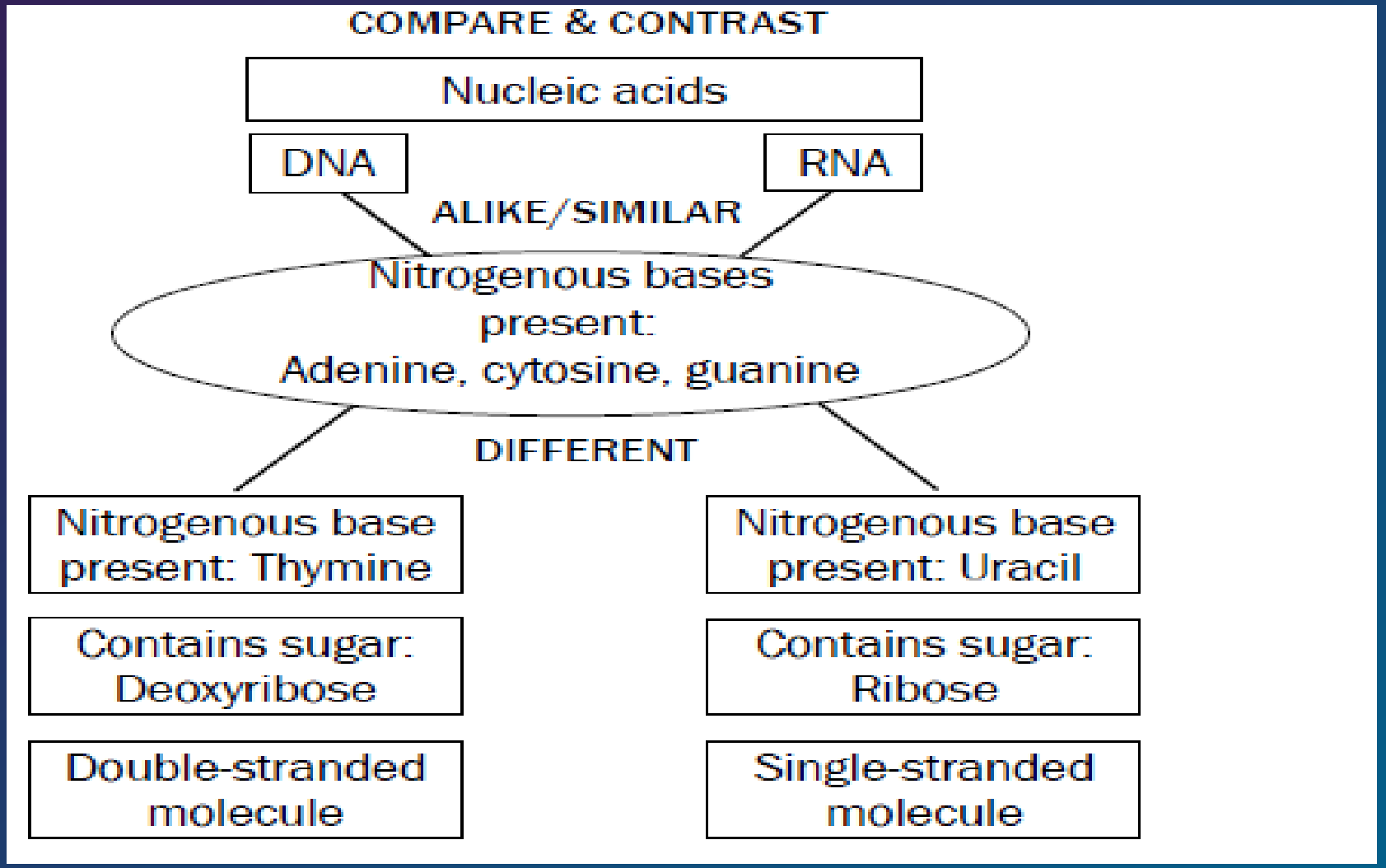
2. Transfer RNA (tRNA)

- One for each triplet codon that codes for a specific amino-acid (the building blocks of proteins).
- tRNA molecules are covalently attached to the corresponding amino-acid at one end
- At the other end they have a triplet sequence (called the anti-codon) that is complementary to the triplet codon on the mRNA.

3. Ribosomal RNA (rRNA)

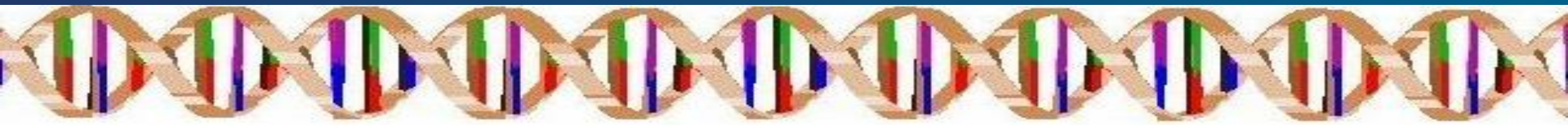
- Make up an integral part of the ribosome, the protein synthesis machinery in the cell.

COMPARE & CONTRAST DNA & RNA

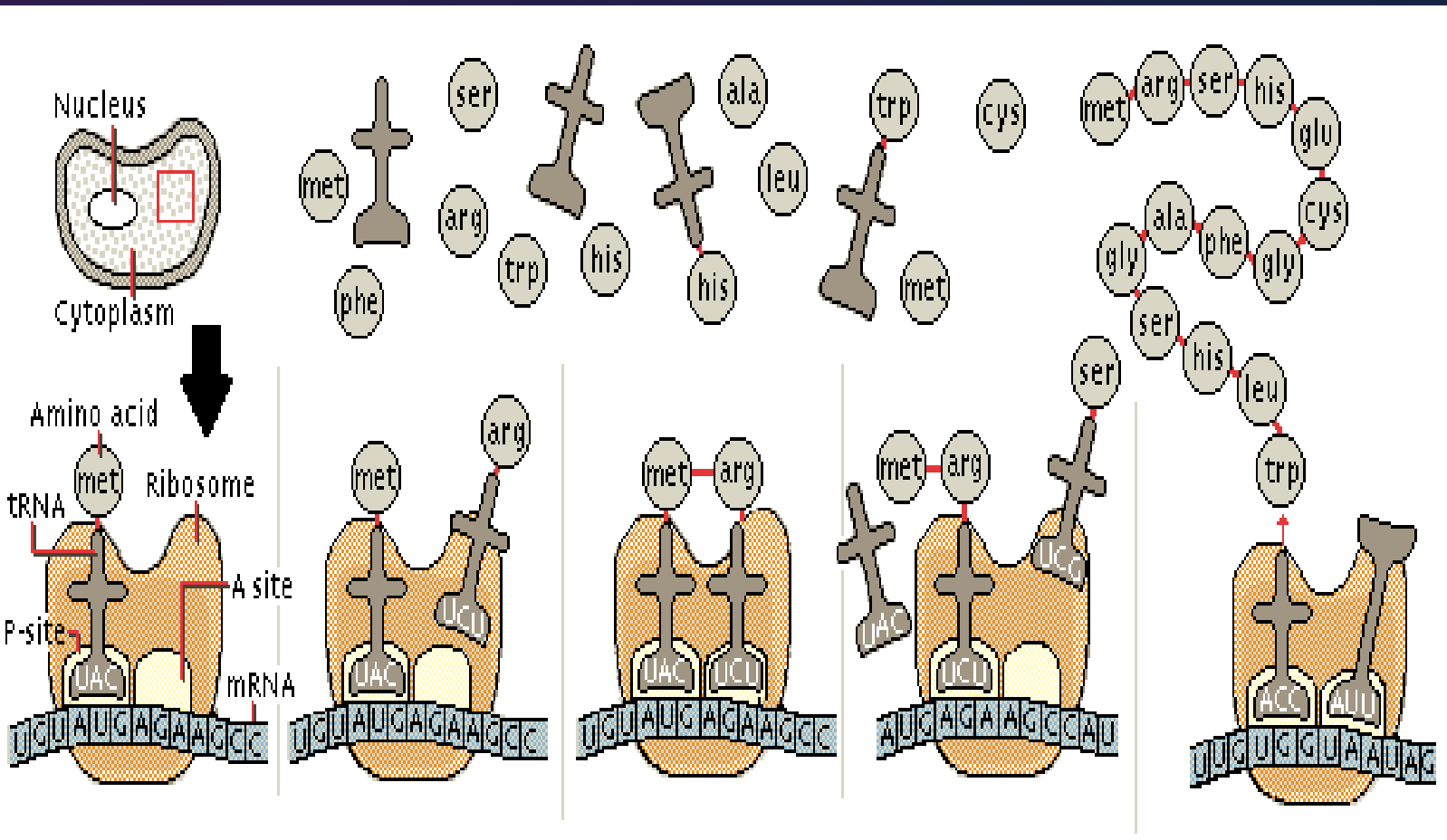


Differences between DNA and RNA

DNA	RNA
Double strand	Single strand
Deoxyribose sugar	Ribose sugar
Thymine and Adenine	Thymine and Uracil
Guanine and Cytosine	Guanine and Cytosine

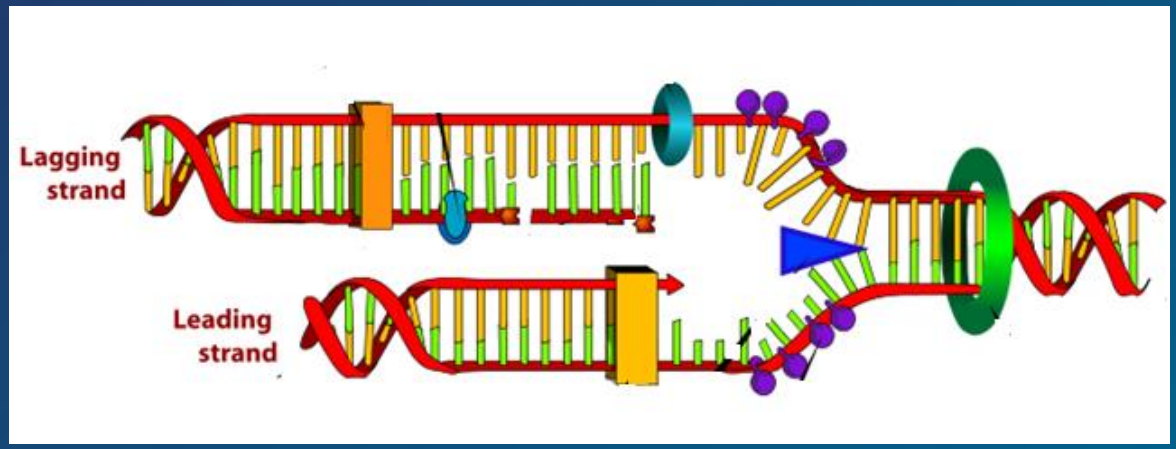


PROTEIN SYNTHESIS

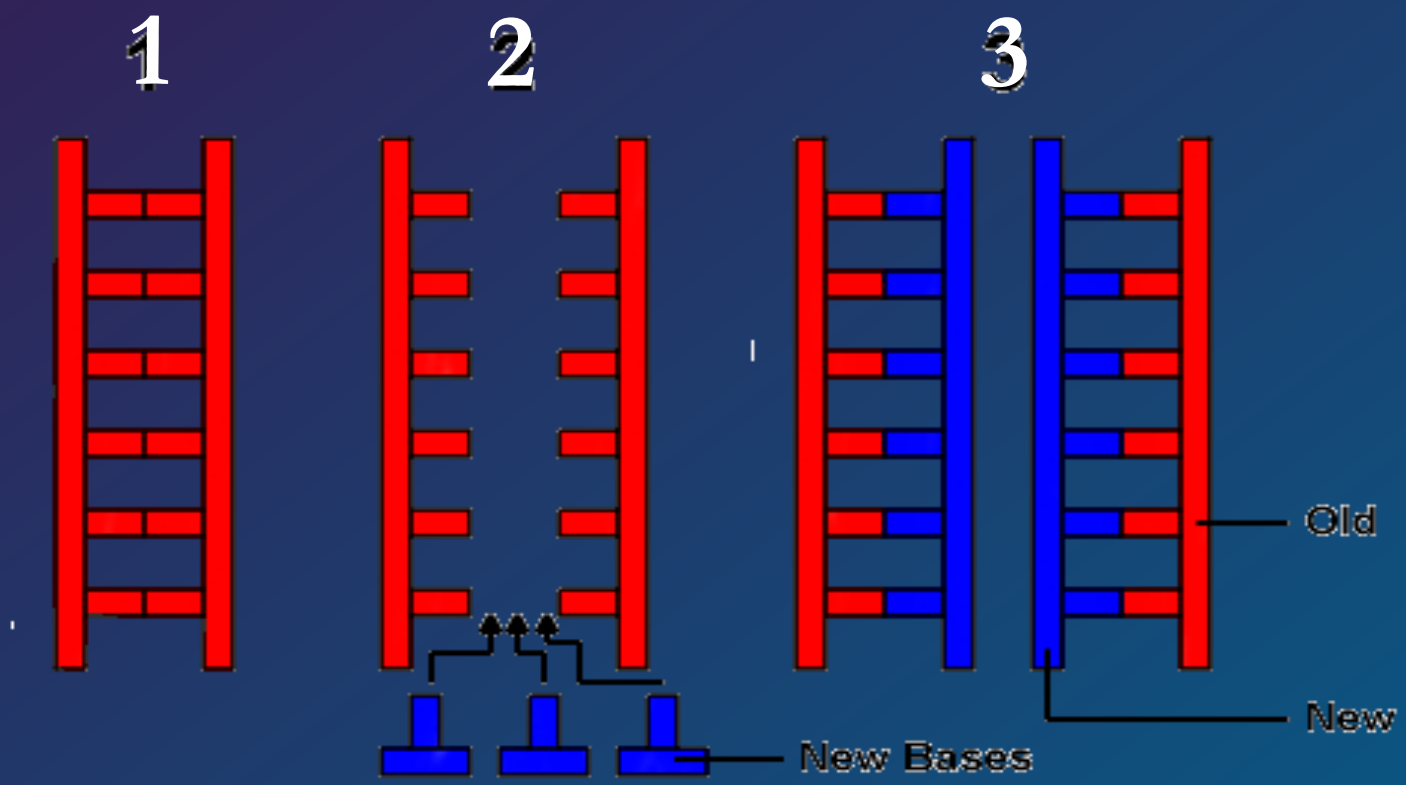


IMPORTANCE OF PROTEINS

- Play essential roles in the cells of all living creatures.
- They serve as building blocks of cells, control chemical reactions, and transport materials to and from cells.
- Composed of long chains of amino acids.
- The specific sequence of amino acids in a chain determines the exact function of the protein.



DNA MUST REPLICATE

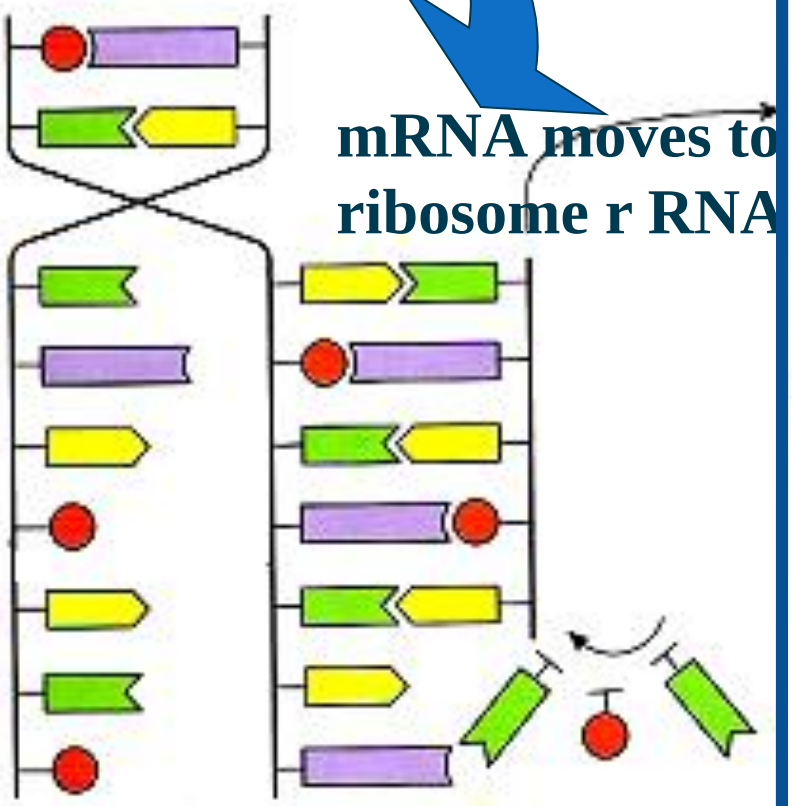


In preparation for the manufacture of mRNA, a DNA molecule in the nucleus separates into two strands in the region of a gene carrying instructions for a specific protein. Each sequence of three bases in a DNA strand is called a *triplet, which is a code* for one of 20 amino acids, the building blocks of protein.

IN NUCLEUS

IN CYTOPLASM

TRANSCRIPTION

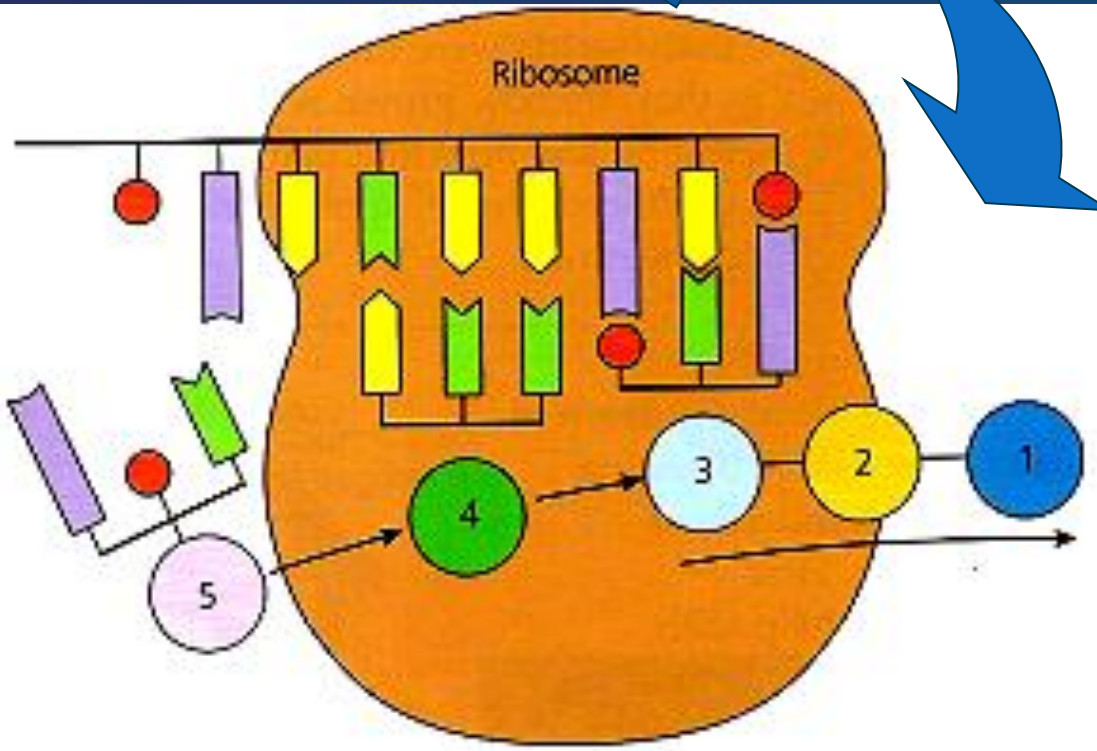


mRNA moves to ribosome r RNA

DNA unzip to expose a gene

mRNA copies the gene

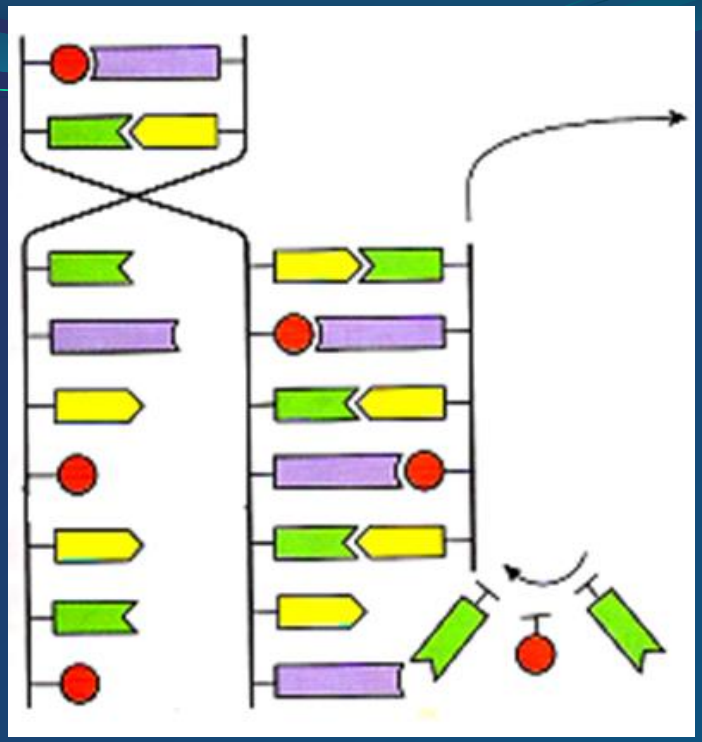
TRANSLATION



tRNA carries amino acid to ribosome

Amino acids linked up to form protein molecule

TRANSCRIPTION TO RNA



- One DNA strand acts as the template, or pattern, for the construction of mRNA in the nucleus.

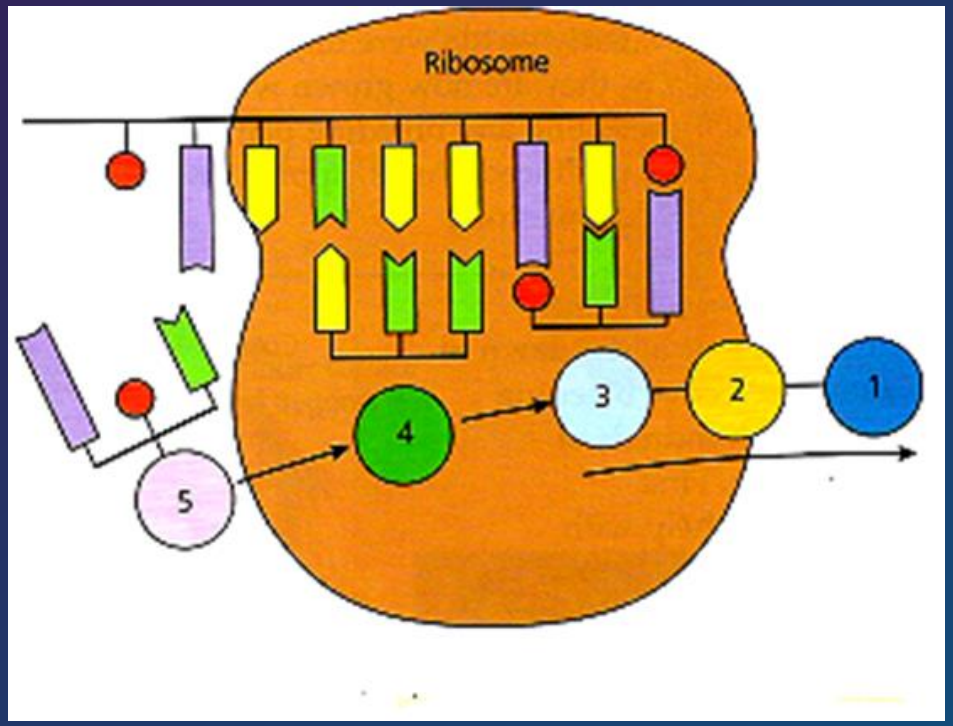
- In this process, called transcription, free-floating RNA nucleotides travelling in the cell nucleus pair with complementary bases on the DNA template strand.

- RNA nucleotides use the base uracil (U) instead of thymine (T).

DNA	RNA
T – A	U – A
G – C	G - C

- Transported out from the DNA of nucleus into the cytoplasm

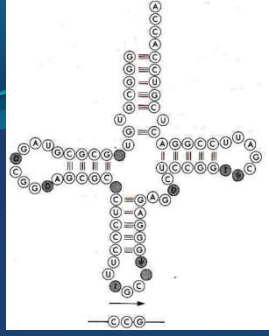
mRNA ATTACHED TO THE RIBOSOME



Once mRNA is completely formed, the mRNA strand leaves the cell nucleus to enter the cytoplasm, where it attaches to a cellular organelle called a ribosome. Protein synthesis occurs in the ribosomes

tRNA bind to amino acids

The single-stranded chain is folded in a *'clover-leaf'*



•Scattered throughout the cytoplasm are different types of transfer RNA (tRNA), each capable of attaching to one of the 20 different amino acids that are used to build a protein.

• One end of a tRNA molecule attaches to a specific amino acid as determined by the anticodon at the other end of the tRNA.

• An anticodon is a three-base sequence that recognizes a particular mRNA codon

Protein synthesis in the cell