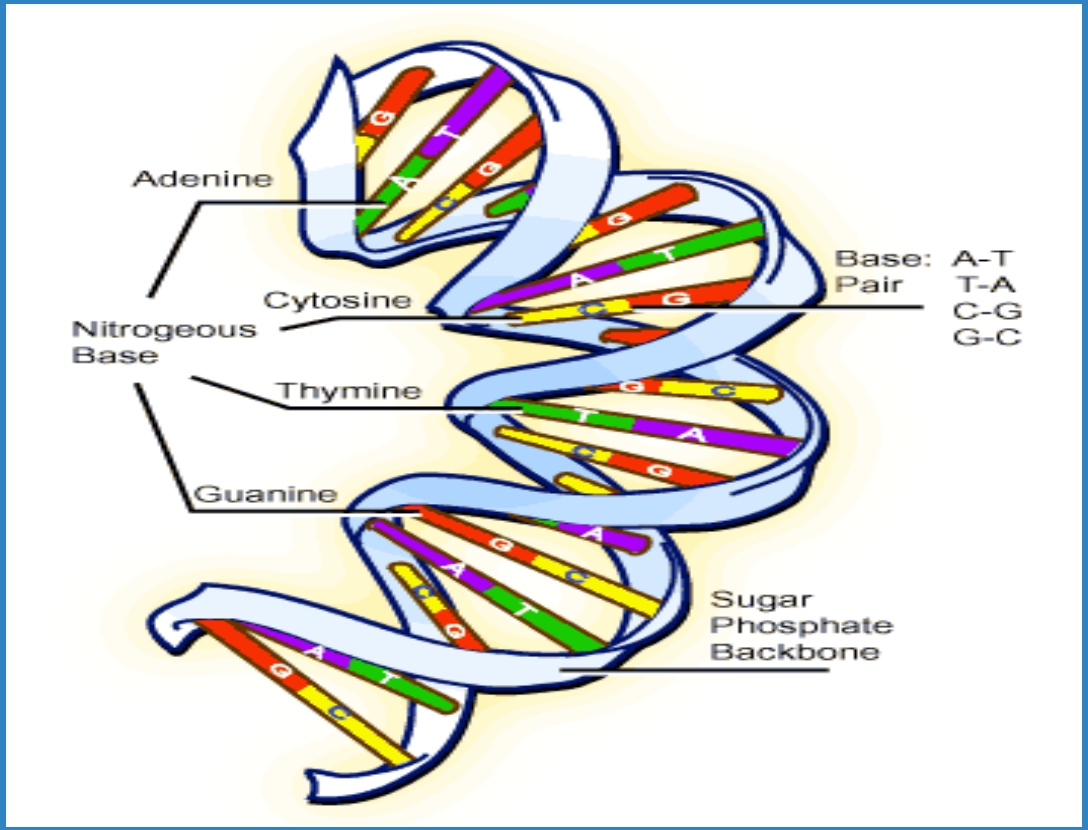
Review DNA and RNA

1) DNA and RNA are important organic compounds found in cells, called nucleic acids
2) Both DNA and RNA molecules contain the following chemical elements: carbon, hydrogen, oxygen, nitrogen and phosphorus

What is DNA???

DNA = Deoxyribonucleic acid

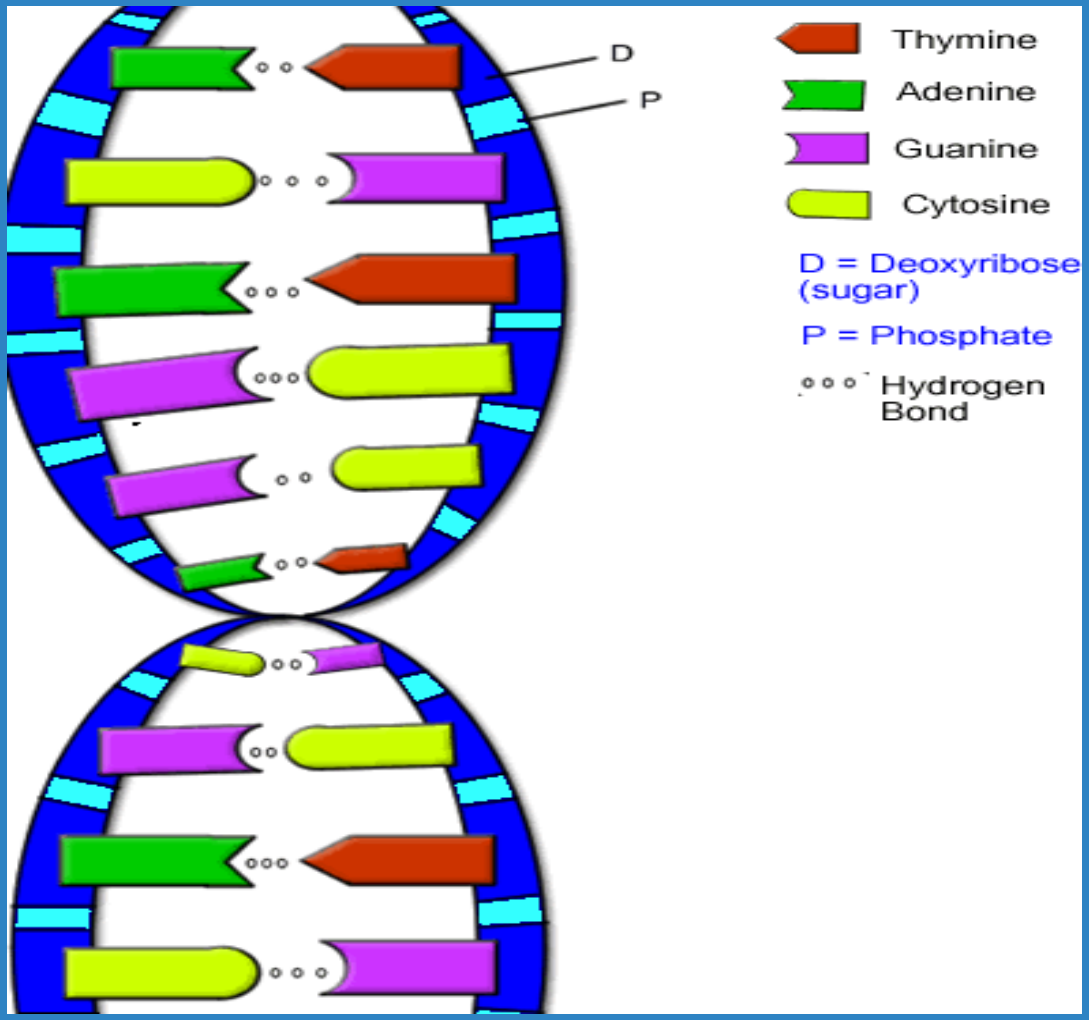
IT is a molecule that contains the code for an organism's growth and function



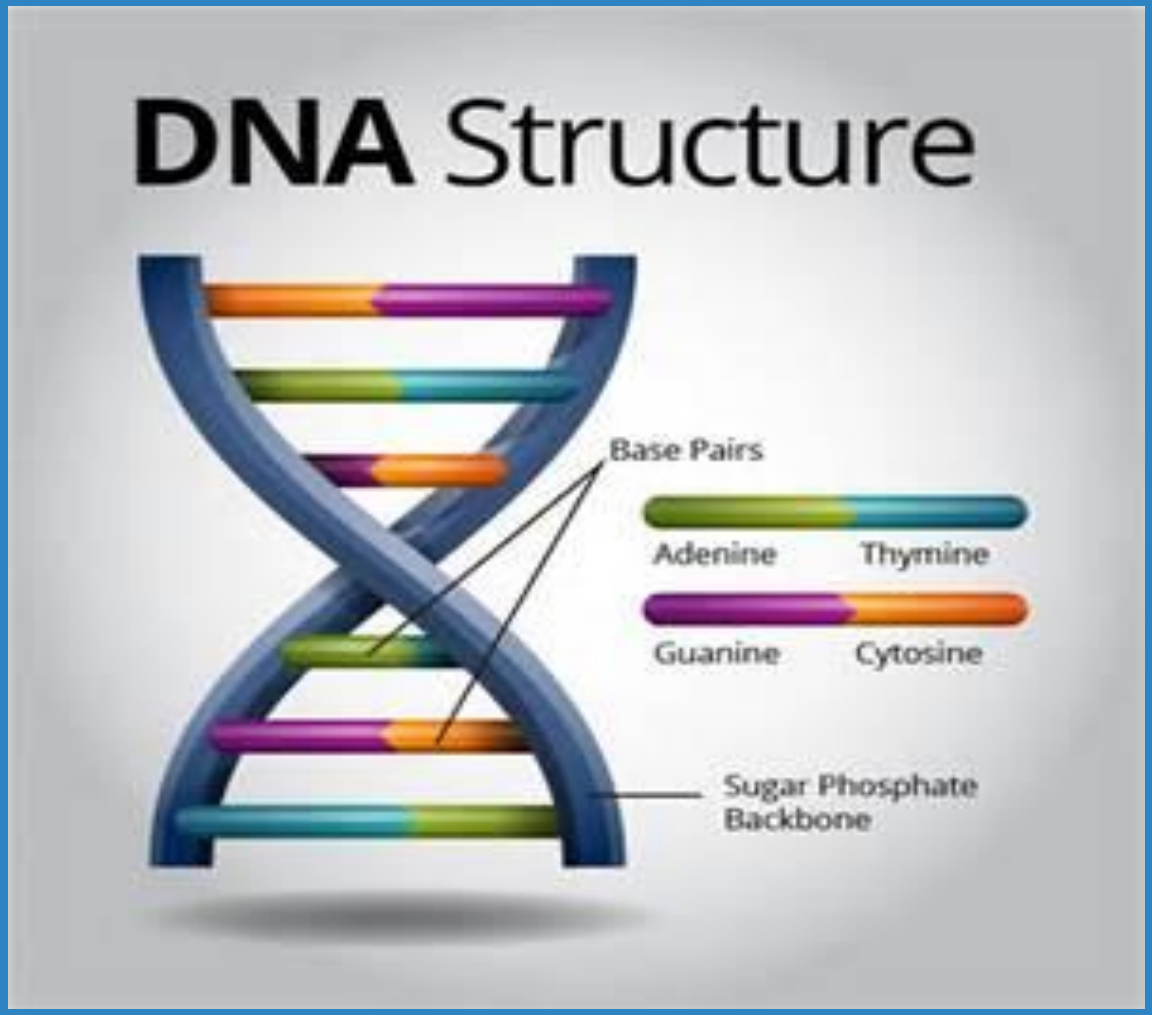
DNA molecule - shape of a twisted ladder:
Interior: sequence of nitrogen bases and
Exterior: molecules of sugar phosphate

The sugar present in the Dna is called Deoxyribose

Phosphate: PO_4



Nitrogen Bases come in pairs Here is how they match:



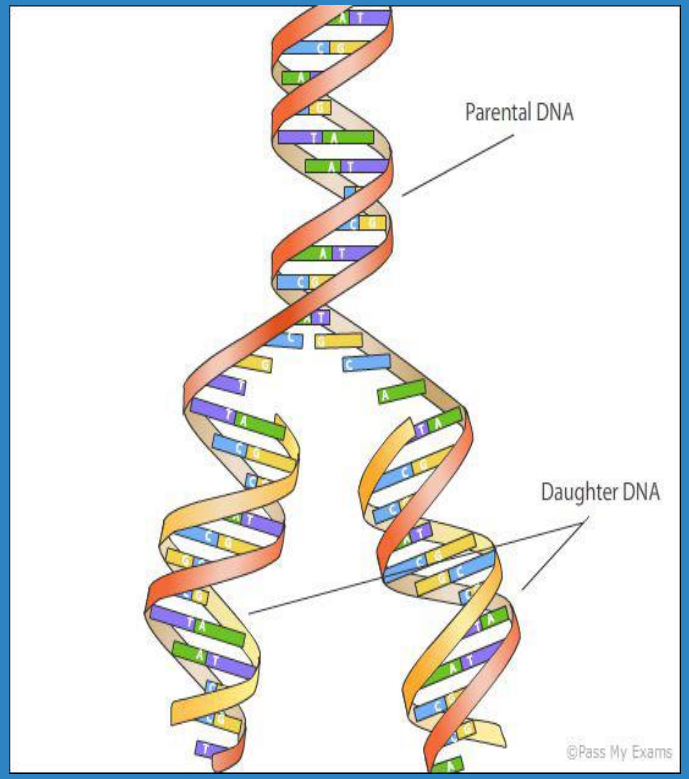
DNA REPLICATION:

The DNA replication is the process during which the molecule of DNA copies itself, generating two new identical molecules.

Replication happens before cell division, because when the cell splits in two, each new copy of the original DNA will go to one of the new cells.

DNA replication:

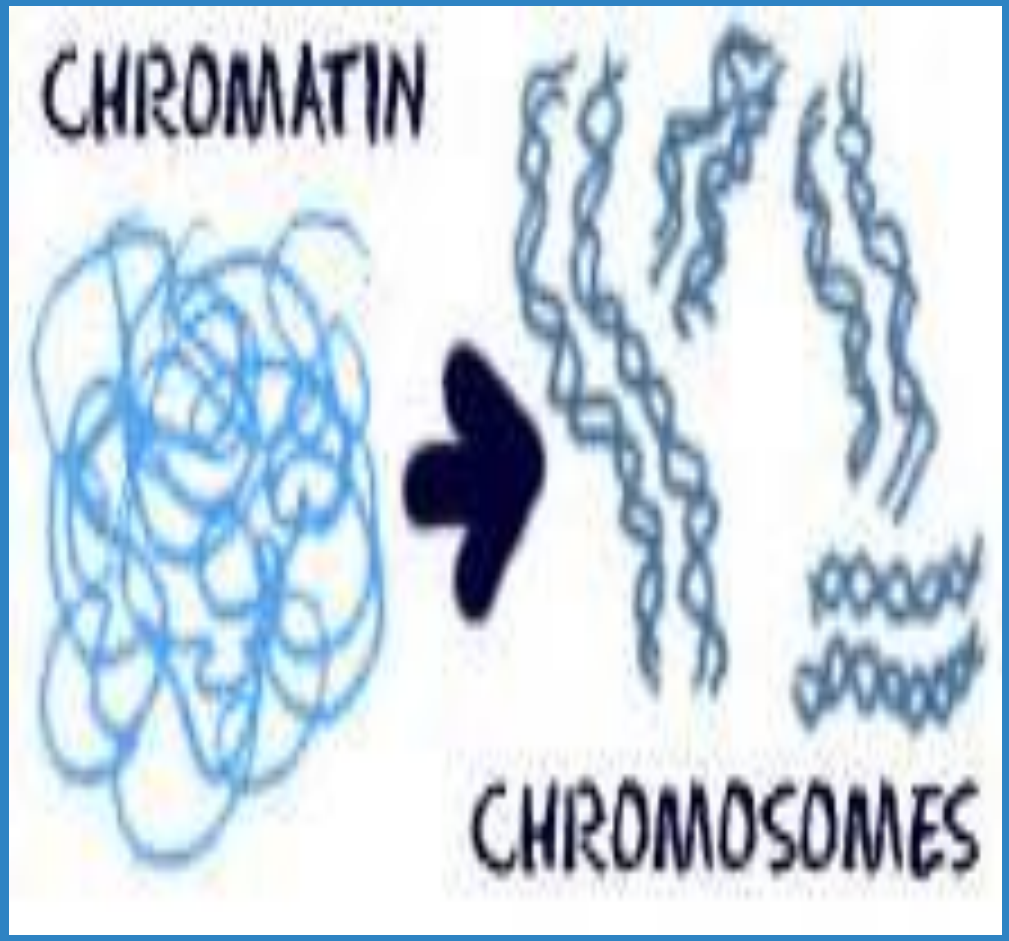
1)Molecules unwind and separate
2) new nitrogen bases present in the nucleus join the original ones
3) two new identical DNA molecules are formed



**Different forms of DNA:

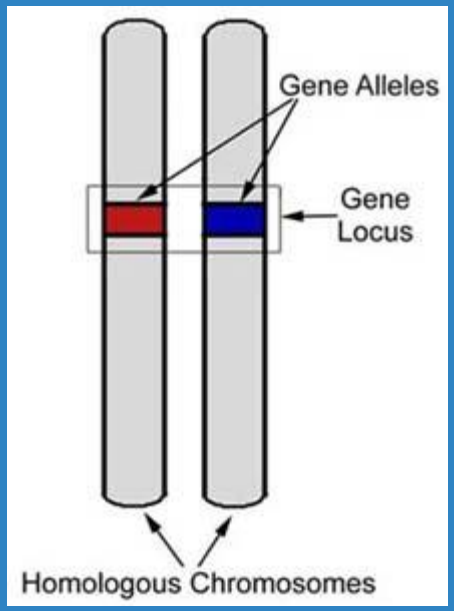
DNA comes in the form of Chromatin, in the nucleus

Before cell division, the chromatin will condense forming chromosomes. Chromosomes will replicate before cell division



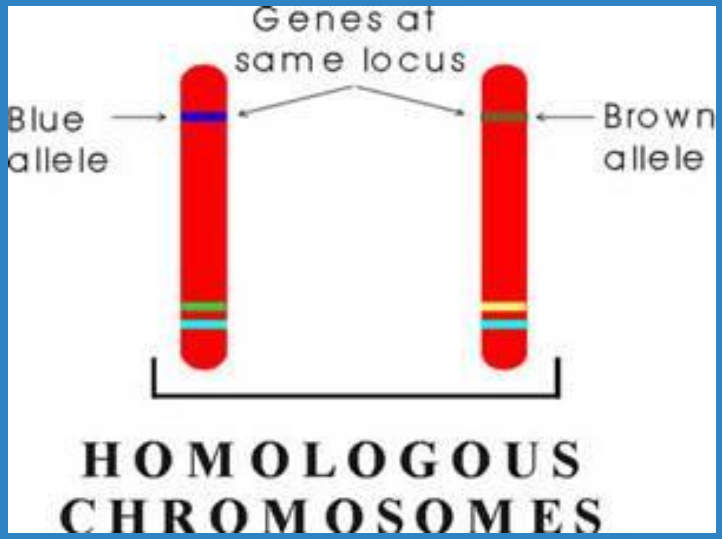
What are genes?
Genes are sections of DNA that code for a certain trait.

Locus is the location of a gene in a chromosome

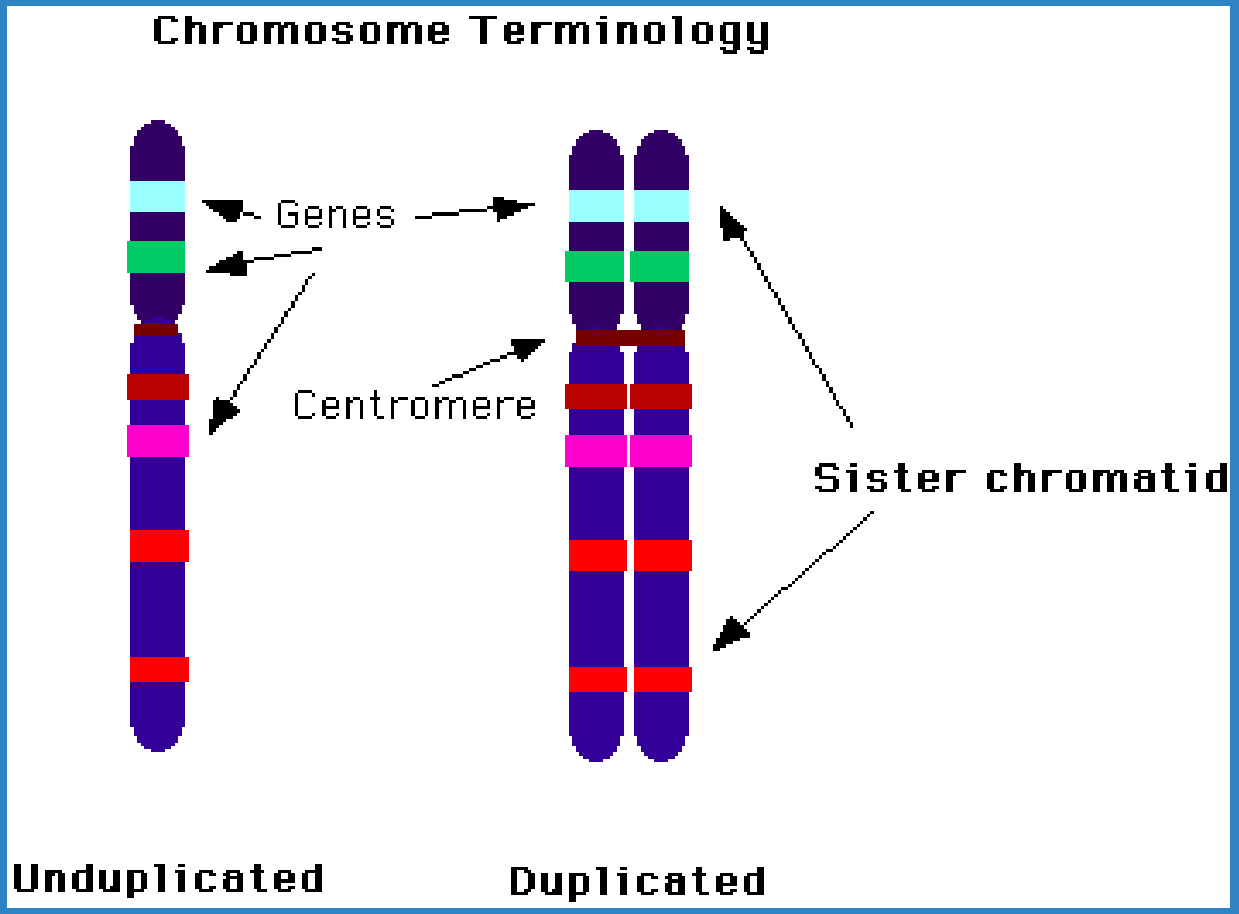


*Genes have different forms called alleles
Each allele code for a variation of the trait.
Ex:

There is a gene for eye color
The gene for eye color has alleles for brown, blue, green eyes, etc.
(the alleles are
located in the same locus)

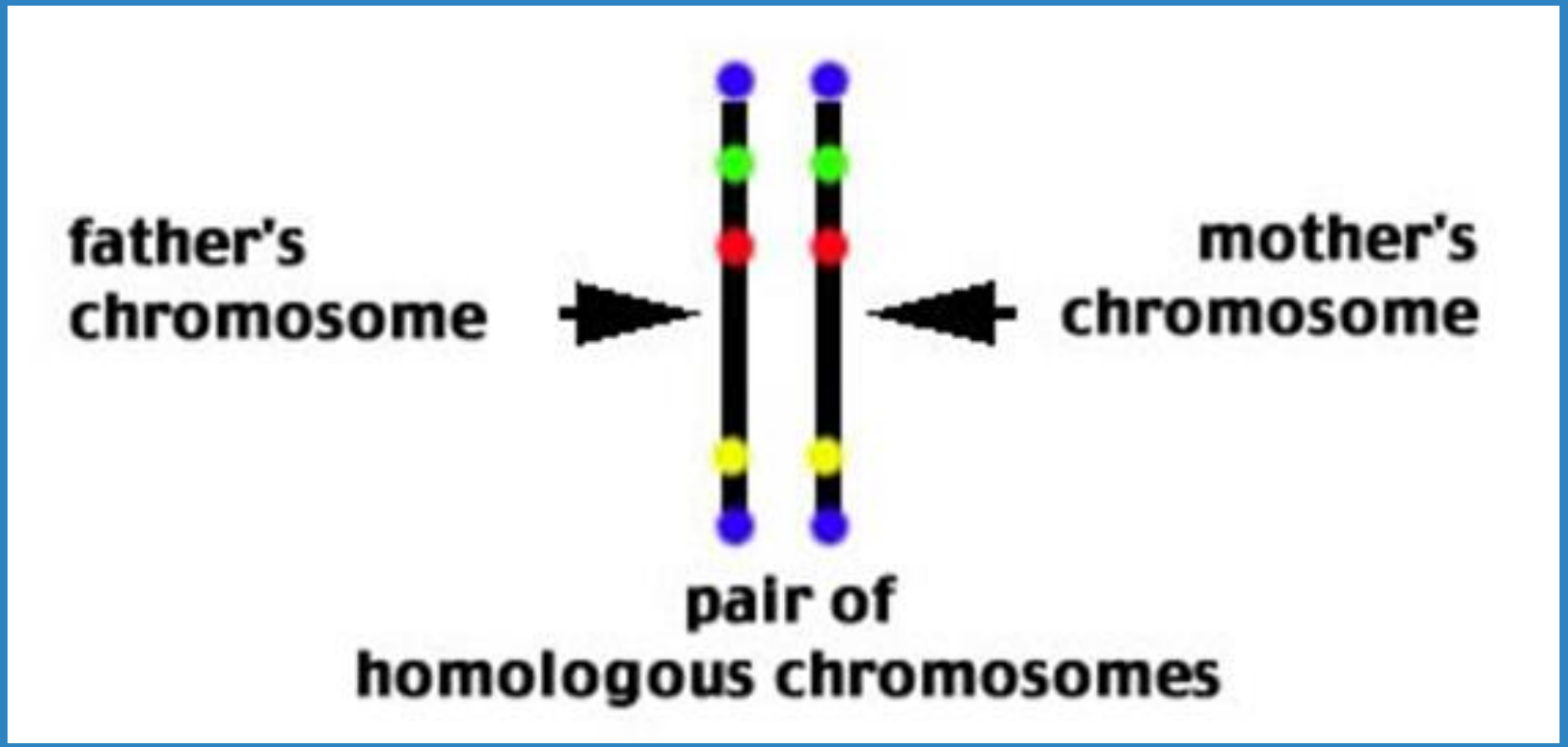


**Chromosomes are sequences of genes



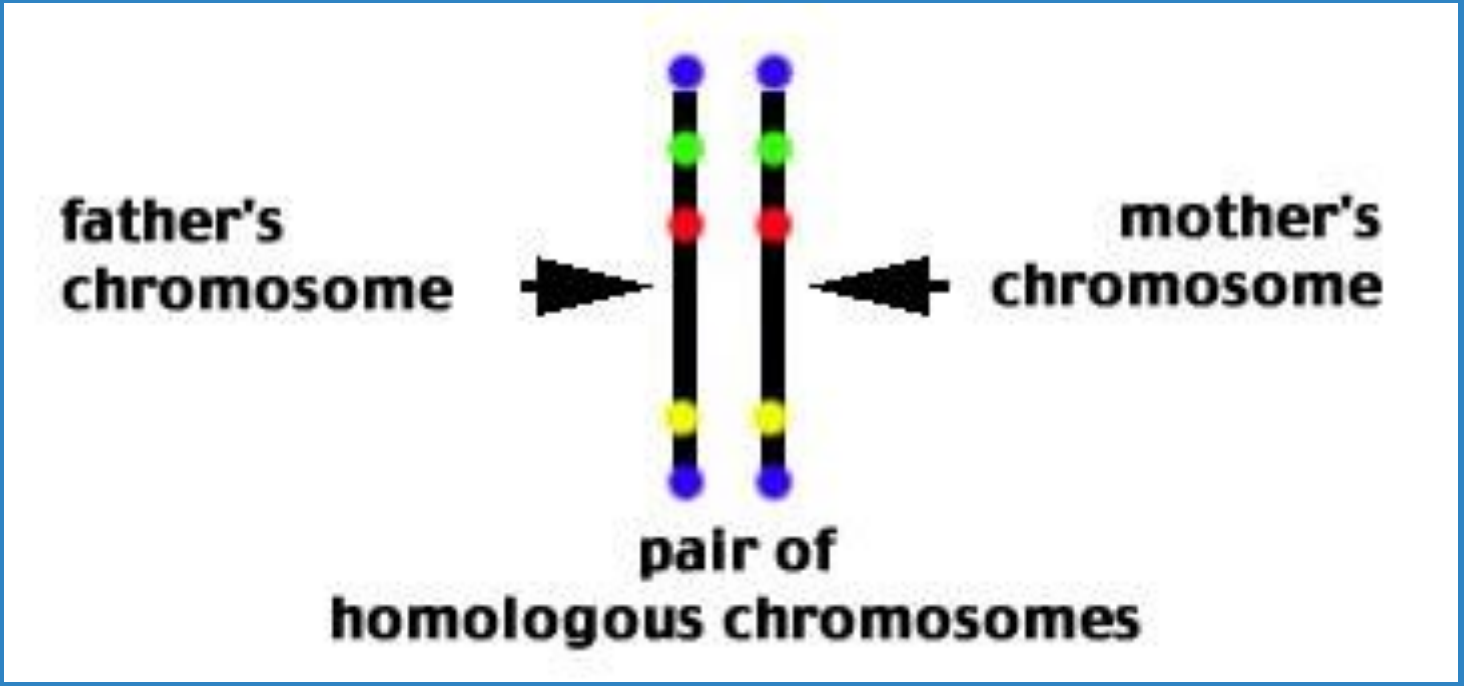
After replication the chromosome has two sister chromatids that are identical

Humans have 46 chromosomes in each cell.
23 come from one parent and 23 from the other parent
The chromosomes are organized in 23 pairs



*Chromosomes in the same pair are called Homologous

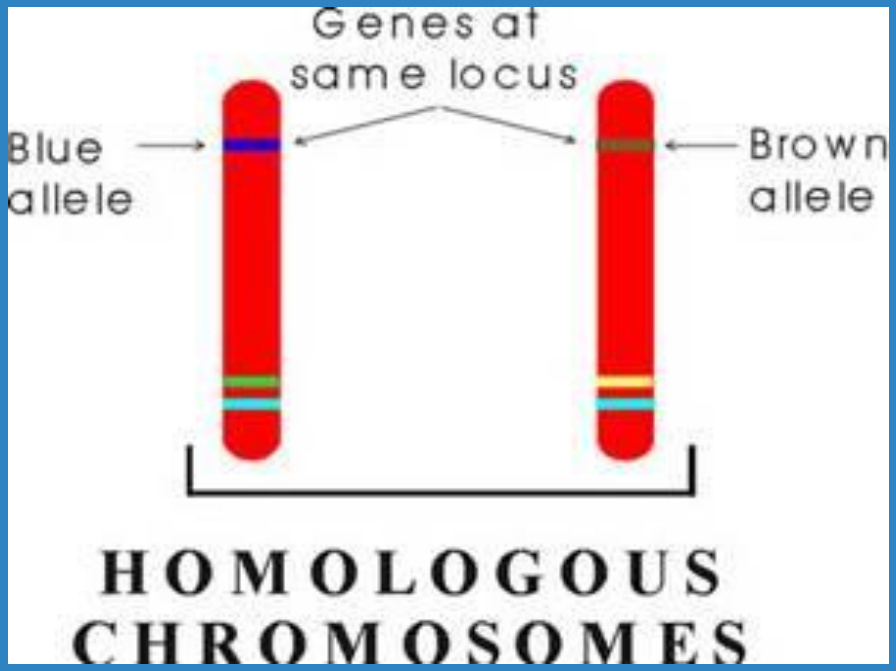
*Homologous chromosomes have the same sequence of genes, but can have different alleles



*Homologous chromosomes have the same sequence of genes, but might have different alleles

One comes from the father

One comes from the mother



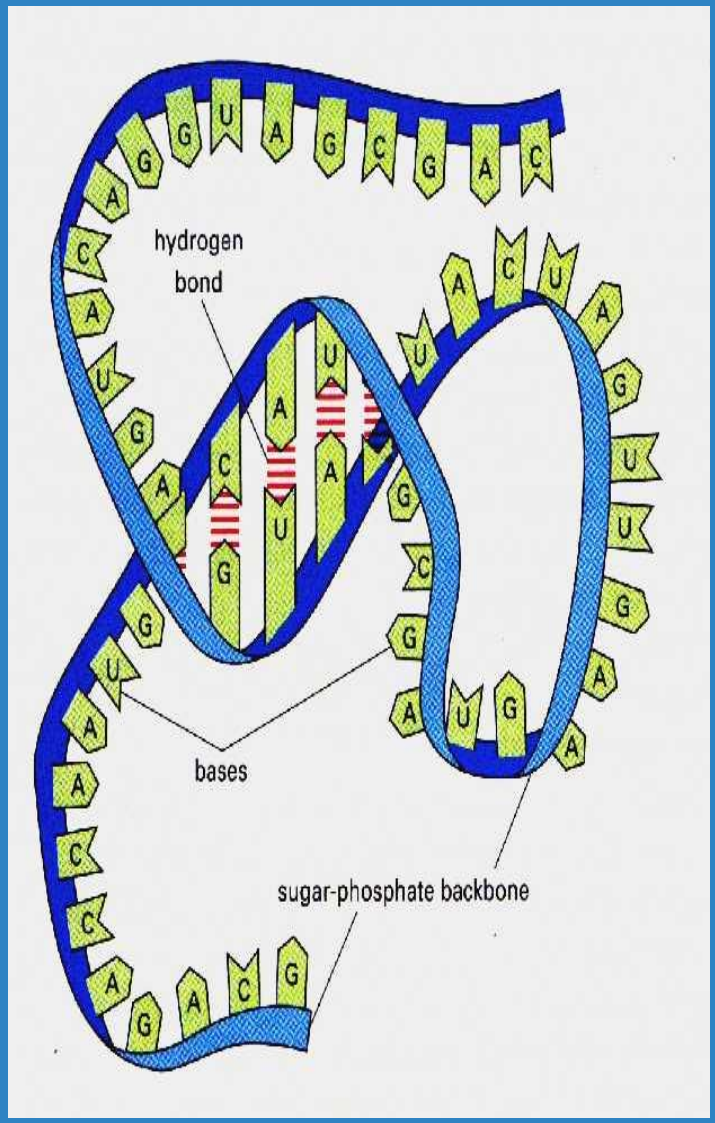
The 2nd type of Nucleic Acid: RNA

RNA stands for Ribonucleic Acid

-RNA has a different sugar on the backbone called ribose

-It is not a double strand molecule

-It does not have Thymine as one of the nitrogen bases



RNA

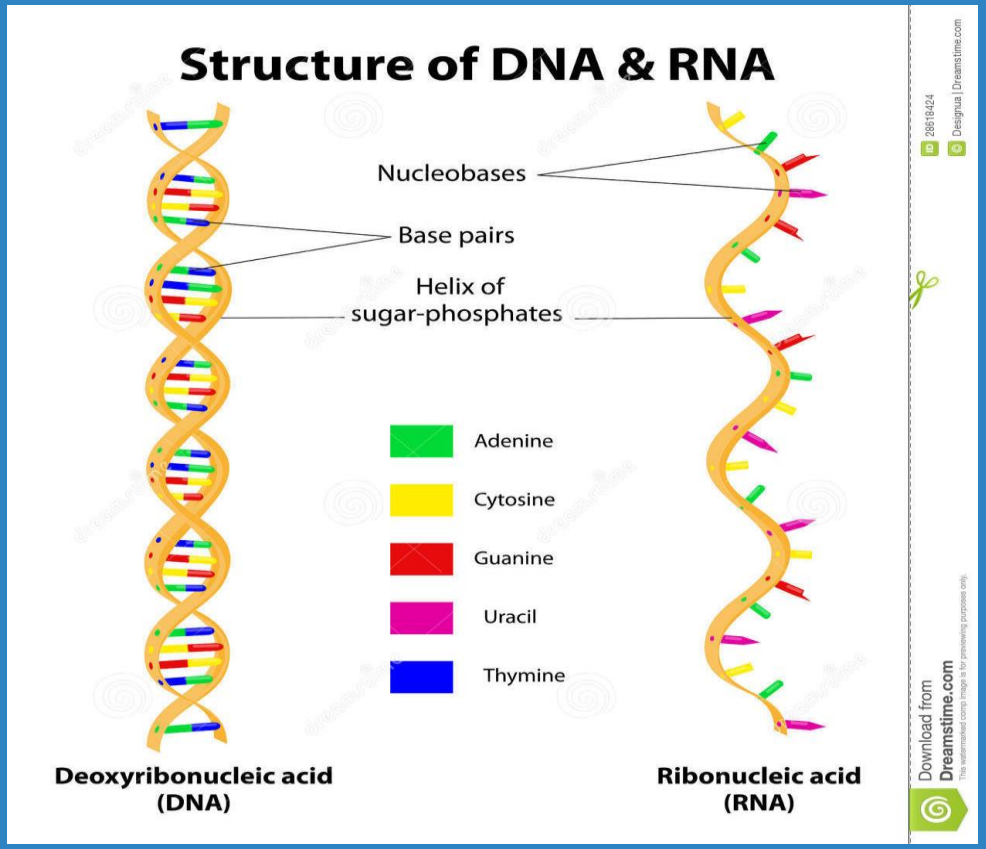
- RNA is made using the DNA as a model, just as proteins

- The sequence of nitrogen bases in the RNA depends on the sequence of nitrogen bases in the Dna, just like for the proteins

RNA – Uracil replaces Thymine

Bases pairing:

A with U
C with G



How are DNA, RNA and Proteins related?

The main concept of Molecular Biology states that DNA makes RNA and RNA makes proteins .

The process by which DNA is copied to RNA is called transcription.

The process by which RNA is used to produce proteins is called translation.

Nitrogen Bases matching during Transcription (DNA to RNA)

DNA MOLECULE BEING COPIED	RNA MOLECULE BEING FORMED
C	G
G	C
T	A
A	U

Functions of RNA – a cell has 3 types of RNA

1) Messenger RNA – The DNA molecule is copied in the nucleus generating a messenger RNA molecule (transcription process)
The messenger RNA takes the DNA code from the nucleus to the ribosomes in the cytoplasm for the synthesis of proteins

Functions of RNA – a cell has 3 types of RNA

2) Ribosomes are made of Ribosomal RNA – ribosomes is the cell organelle where the RNAs meet to synthetize proteins.

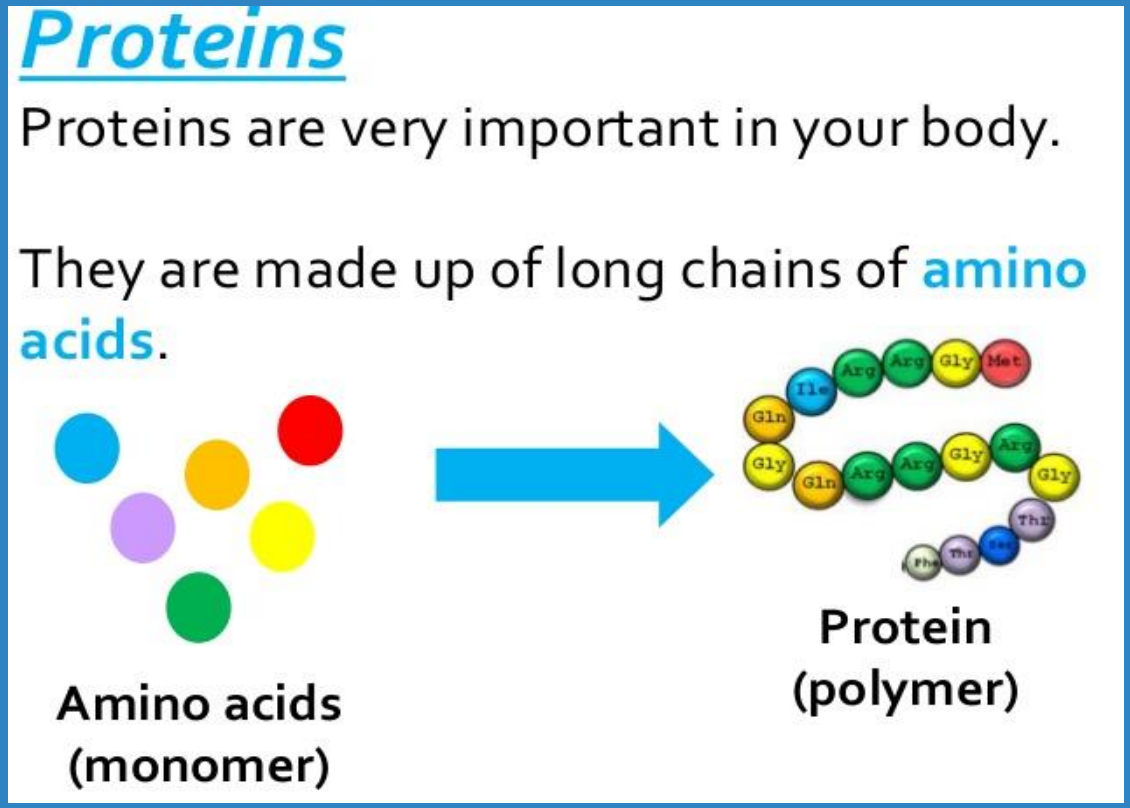
Functions of RNA – a cell has 3 types of RNA

3) Transfer RNA – is the RNA that brings to the ribosomes all the amino acids that will form the protein.

Sets of 3 nitrogen bases in the transfer RNA will code for one amino acid.

The sequence of nitrogen bases in the RNA transfer, matches the sequence of nitrogen bases in the RNA messenger

Proteins is a type of organic compound responsible for function (enzymes) and structure (structural proteins) in organisms



**Important about proteins

- Proteins are made in the ribosomes, located in the cytoplasm of the cell
- Proteins are made based on the sequence of Nitrogen Bases in the DNA
- A different order of Nitrogen bases will make a different protein

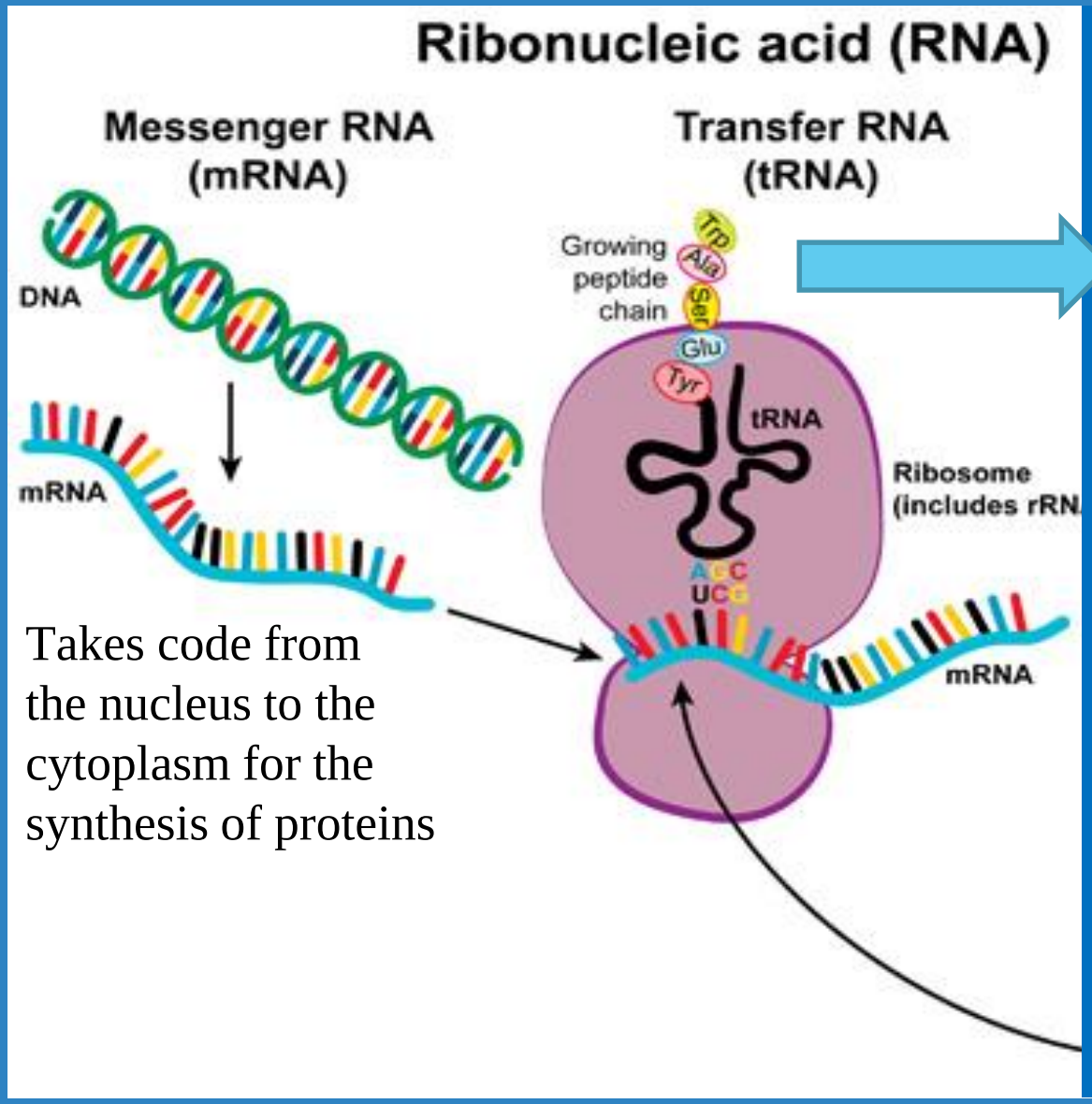
** Proteins are made with the help of the RNA, that will take the DNA code from the nucleus to the cytoplasm

Steps of Translation – protein synthesis

1) RNA messenger is synthetized in the nucleus (transcription)
2) RNA messenger leaves the nucleus of the cell and goes to the cytoplasm, carrying the code for the synthesis of a certain protein
3) RNA messenger enters in the ribosome
4) The RNA transfer will also enter in the ribosome, bringing the amino acids that match the sequence of nitrogen bases in the messenger RNA
5) The two types of RNA combine and the amino acids attach to each other forming the protein, which is a chain of amino acids.

See the picture on page 172 to understand better this process.

Translation - protein synthesis

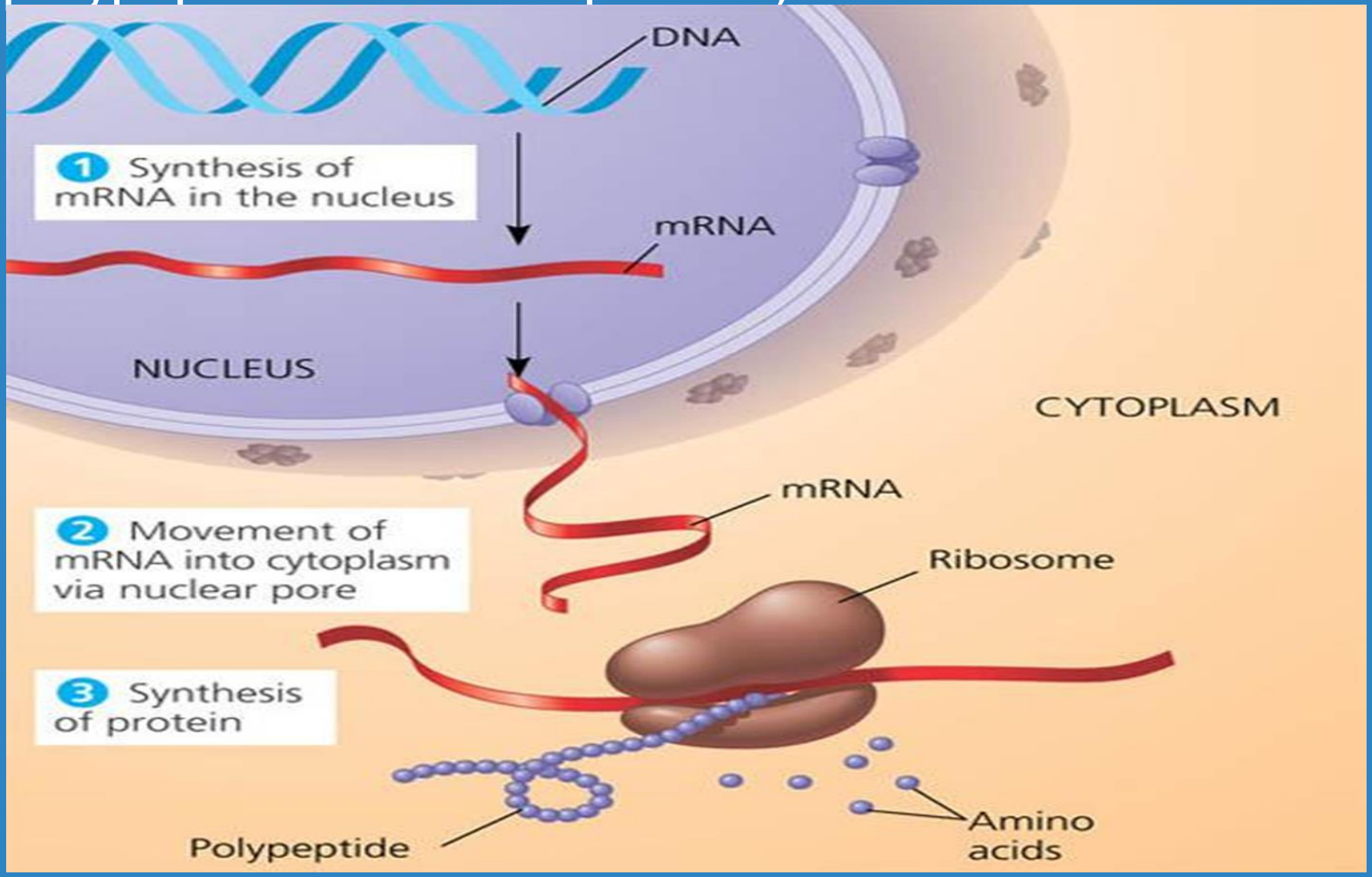


Takes code from the nucleus to the cytoplasm for the synthesis of proteins

Trp, Ala, Ser, Glu, Tyr are different amino acids that will form the protein

From the nucleus to the cytoplasm: protein synthesis

(polypeptide is a small protein)



Remember:

- **Cell Differentiation:**
  Cells have **different functions**
  Different cells will synthetize different proteins to execute that cell's function

- Cells will only produce the proteins needed by the cell.
- A cell will not waste energy producing something that is not needed.

Mutations are when the sequence of the nitrogen bases in the DNA changes, this happens due to mistakes during replication, exposure to radiation and certain chemical substances

Mutations - important information

1) Mutations can be bad, good or neutral.

1) Mutations are important when they result in a trait that will help the organisms of the species survive

1) When mutations occur in the sex cells or gametes,and they are helpful, they tend to become part of the species' genotype.

1) By being part of the genotype, this mutation will pass from one individual of the species to another, increasing the variability of genes in the gene pool of this species.

Trait Variability due to Mutations

- Gene A codes for trait A
- Gene A suffers a mutation and turns into Gene B
- Gene B will not code for trait A, but for a different trait
- This will generate variability in the population