

GENETICS



WHAT IS DNA?

- Deoxyribonucleic Acid
- *-Genetic material found in the nucleus
- Make-up genes, which are found on chromosomes (instructions)

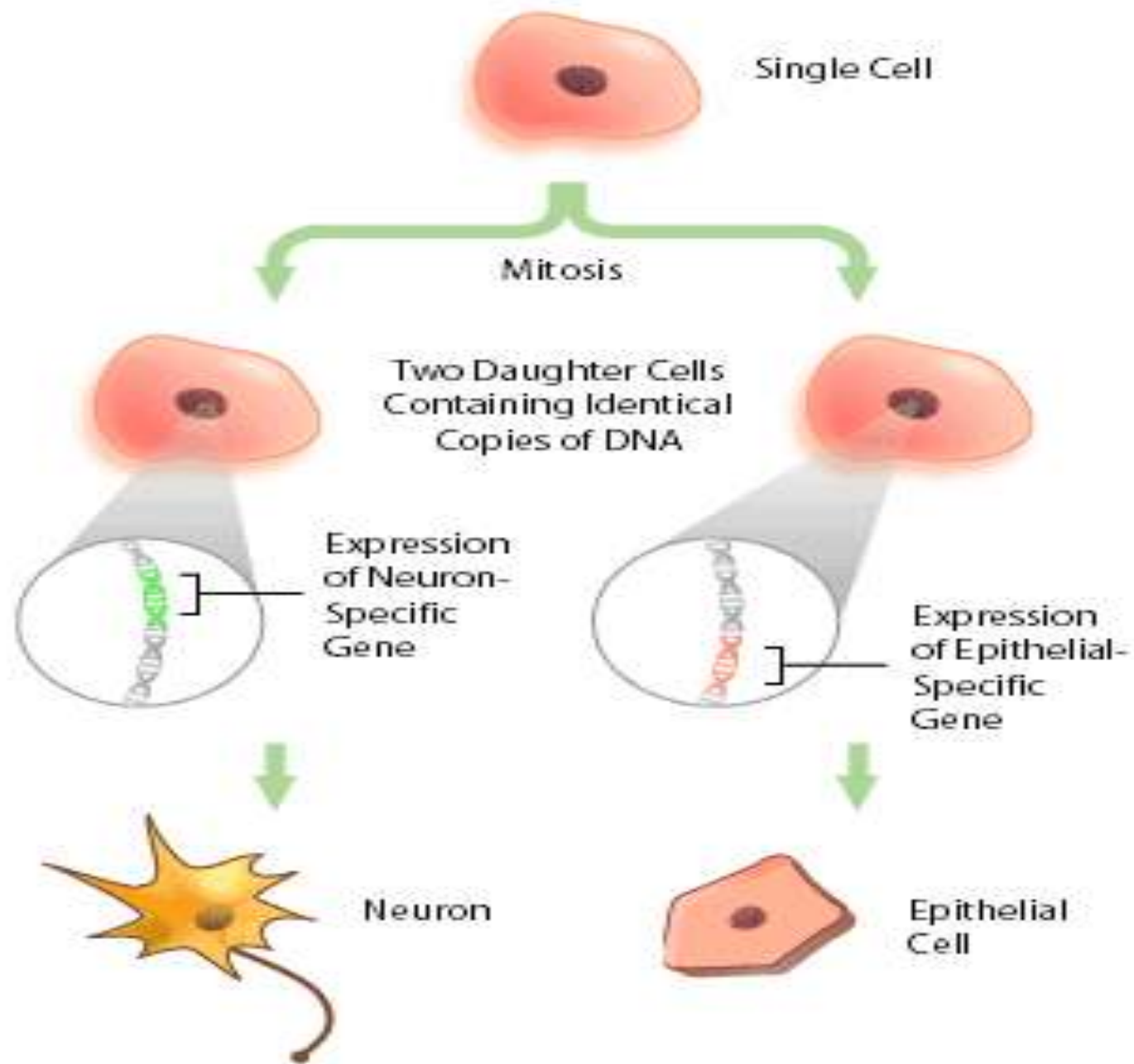
**If every nucleus of EVERY cell contains the same DNA, Why do various cells carry out different functions?

Differentiation

(creates different types of cells by turning the gene expression "on" or "off")

- Ex:
- Muscle cell- contract/relax
 - Nerve cell-transmit impulses
 - Skin cell-Form a protective layer





What are genes?

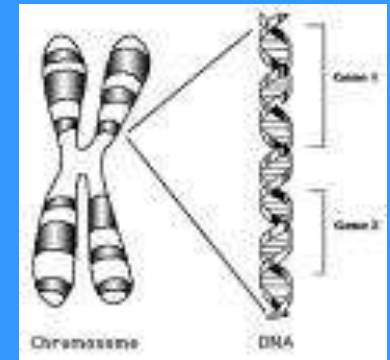
- Genetic instructions received from EACH parent

Where are genes located?

- 1000's on EACH chromosome

What are traits?

- characteristics the offspring will possess (hair color, skin color, eye color, height)

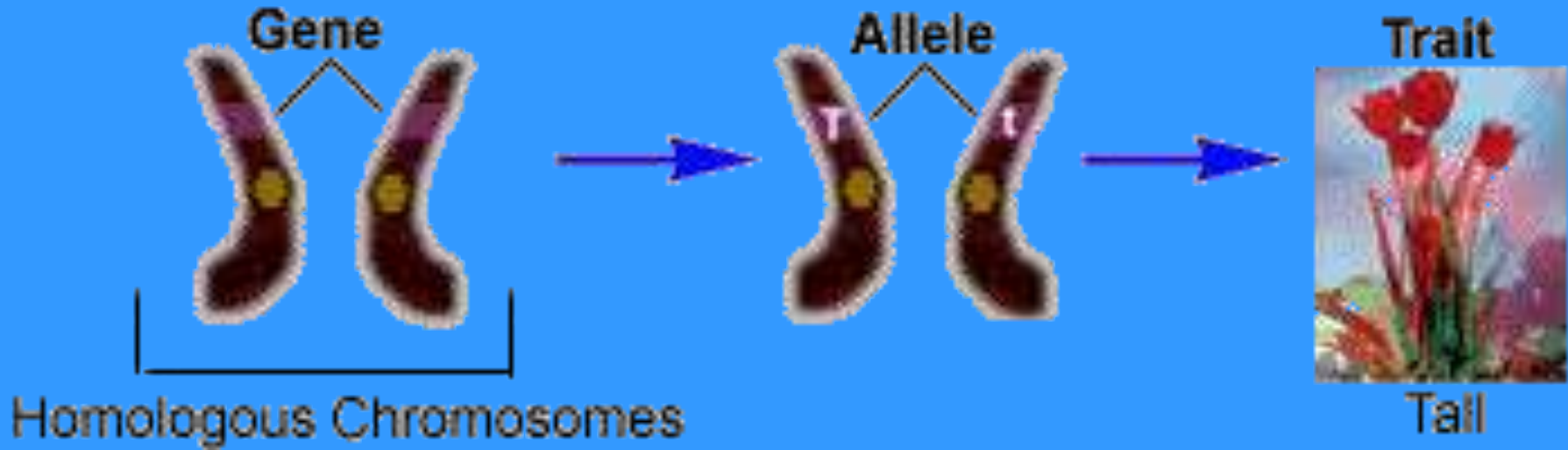


Do siblings have exact traits?

- No (except identical twins)

Why?

- Crossing-over and recombination during meiosis creating variation



How do traits become expressed?

-Combination of alleles (form of gene) determines the trait expressed

Dominant Gene- Stronger gene causing trait to be expressed (Represented by capital letter)

Recessive Gene- Weaker gene that is covered by dominant gene. Must have BOTH alleles for trait to be expressed (represented by lower case letter)

When BOTH alleles are the same for a specific trait, the trait is said to be *HOMOZYGOUS* (pure)

When the two alleles are different for a specific trait, the trait is said to be *HETEROZYGOUS* (hybrid)

Genotype - The genetic makeup of an organism (Tt)

Phenotype - The physical trait an organism expresses
(Tall)

All of the following
Are found in the
Nucleus of a cell:

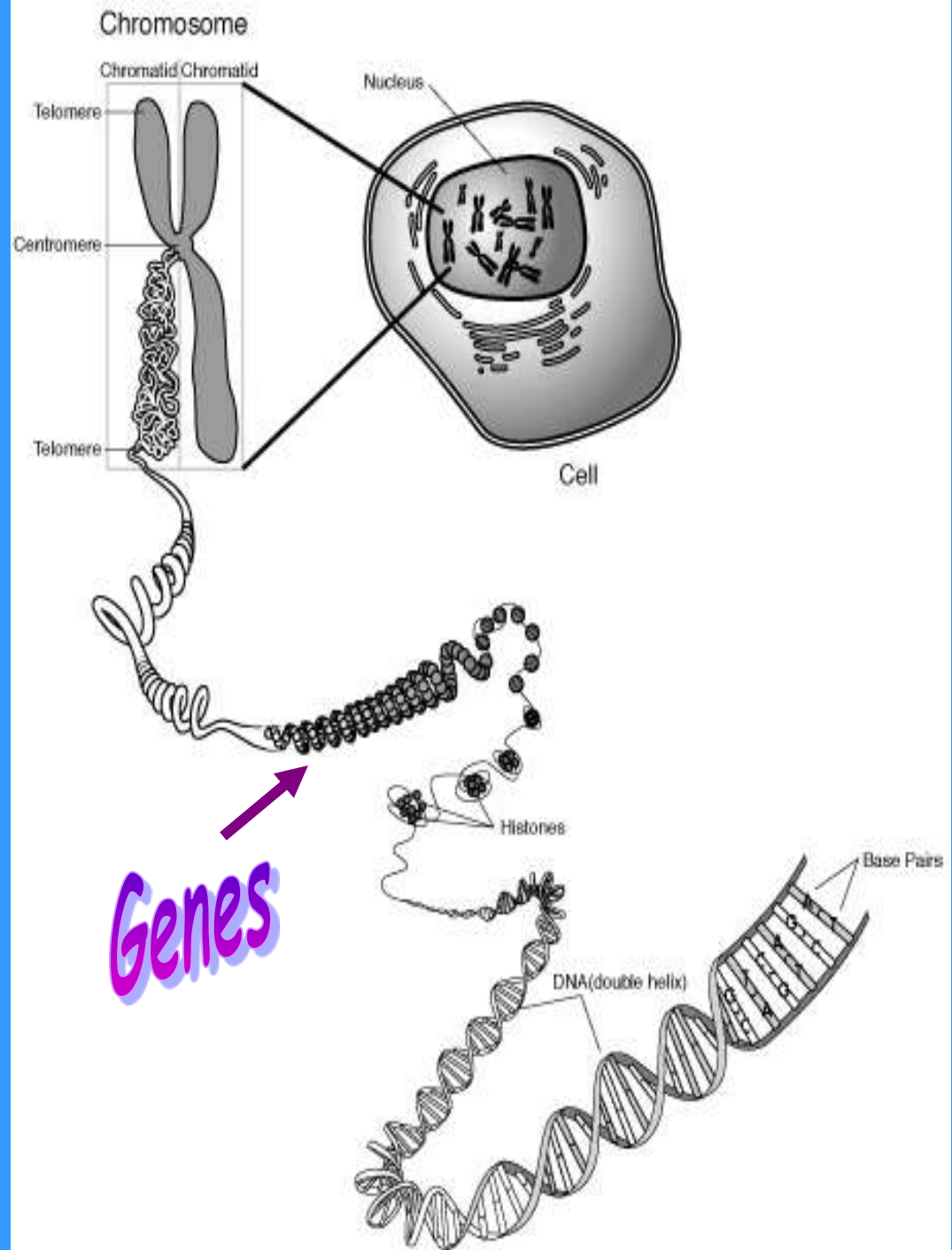
Chromosomes (largest)



Genes

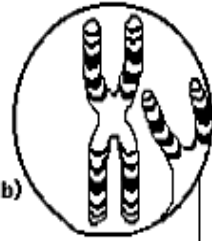
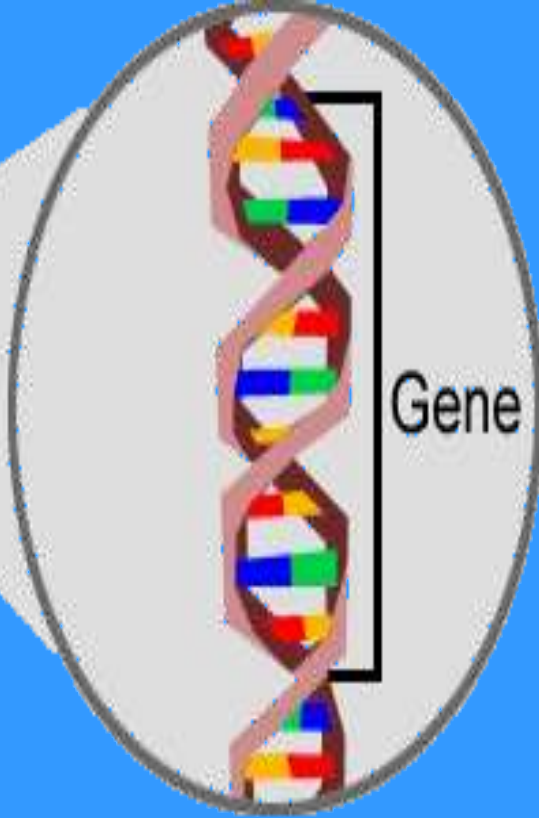


DNA (smallest)



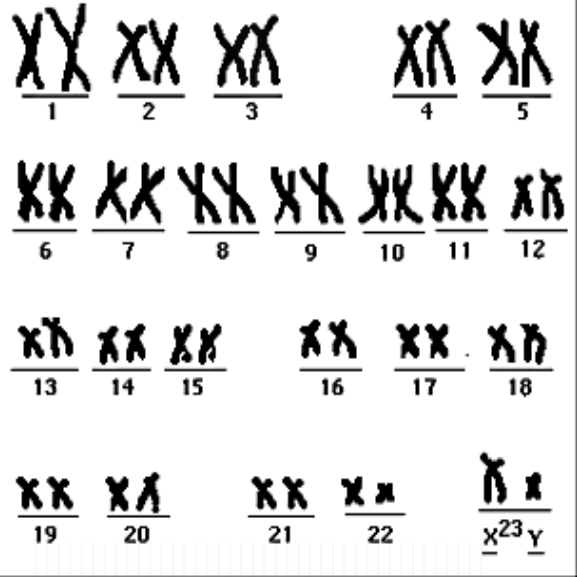


Chromosome



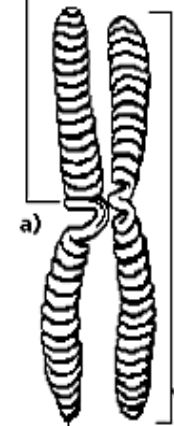
b)

HUMAN CHROMOSOMES



c)

Centromere



a)

Telomere

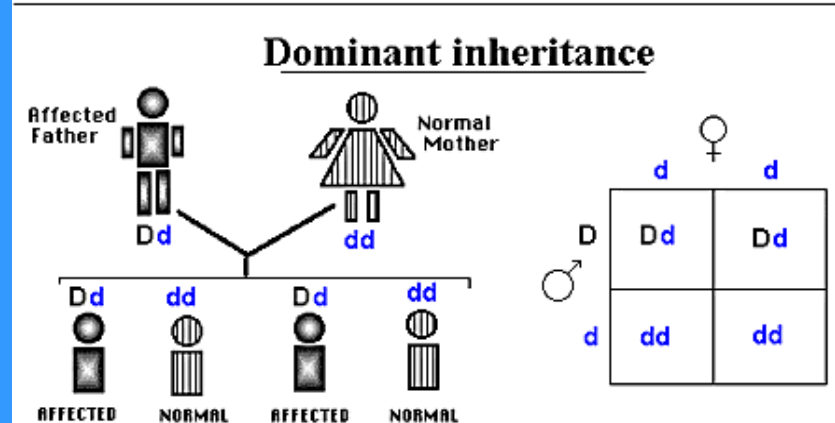
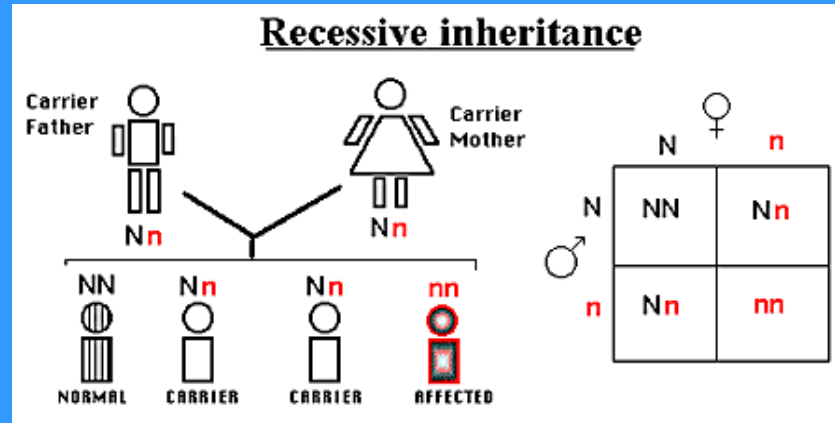
Chromatid

What is heredity?

- passing on of genetic information from one Generation to the next through reproduction

What is an inherited trait?

- Trait passed from one generation to the next



Components of DNA

What is DNA composed of?

-NUCLEOTIDES(3 components each):

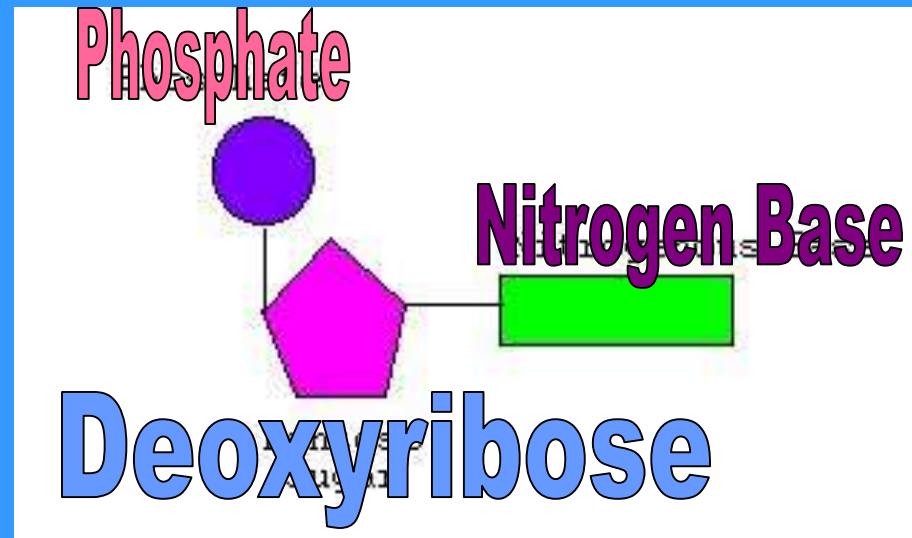
1. Sugar (Deoxyribose)
2. Phosphate Group
3. Nitrogenous Base

A nucleotide is a single strand of DNA

There are 4 different Nitrogenous bases:

-Adenine
-Thymine

-Guanine
-Cytosine



What does DNA look like?

-Twisted Ladder or **DOUBLE HELIX**

(Phosphate groups and deoxyribose form the Backbone of the chain → Nitrogenous bases

Form the steps) → 2 nucleotides wrapped around each Other!

****Each base on one side of the helix *MUST* pair up with a base on the other side:**

Adenine → Thymine (A-T)

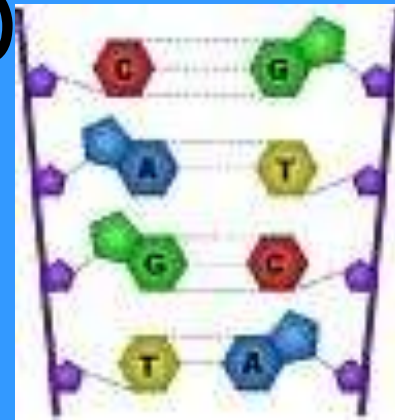
Thymine → Adenine (T-A)

Cytosine → Guanine (C-G)

Guanine → Cytosine (G-C)



"Double Helix Model"-2 coiled Strands twisted together

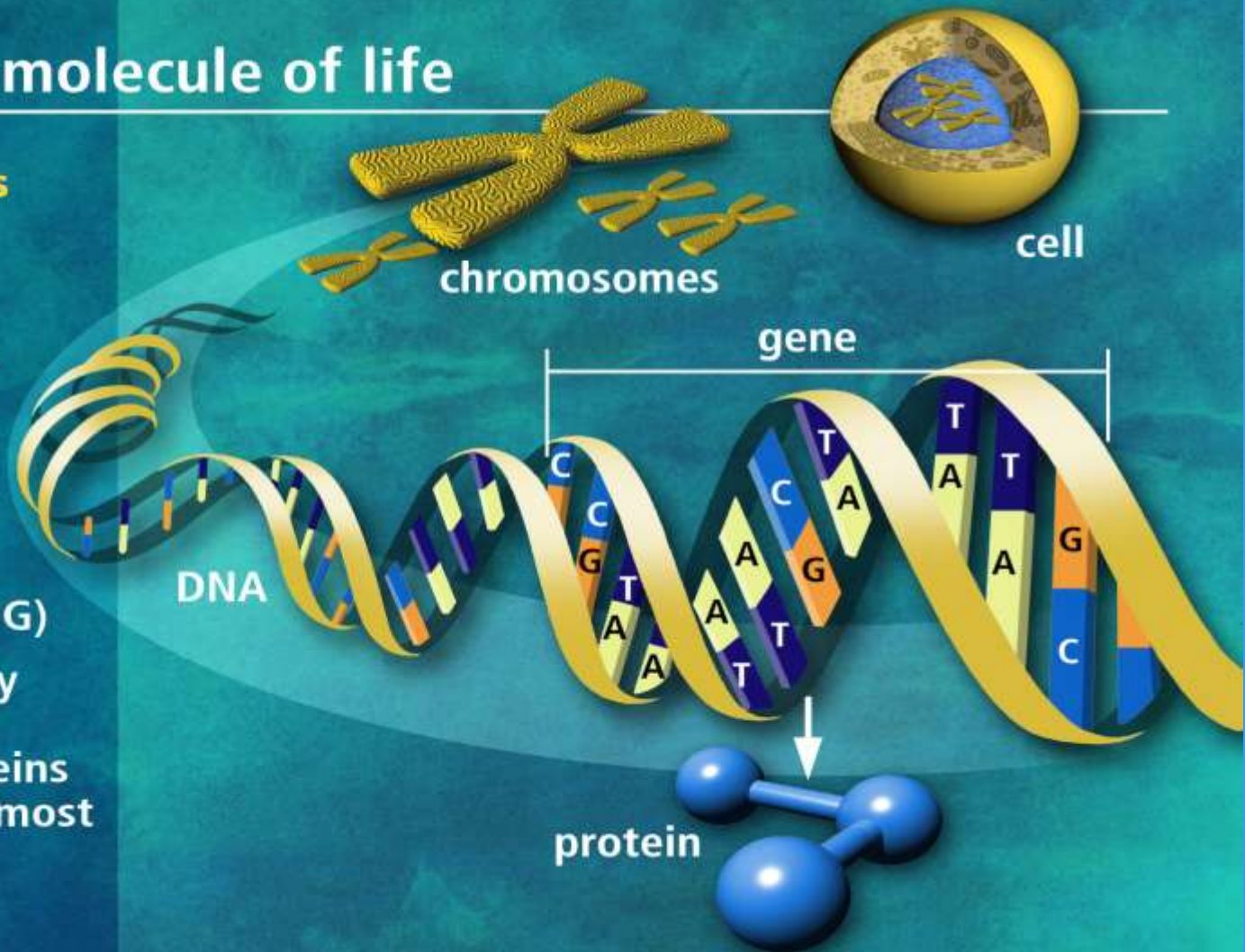


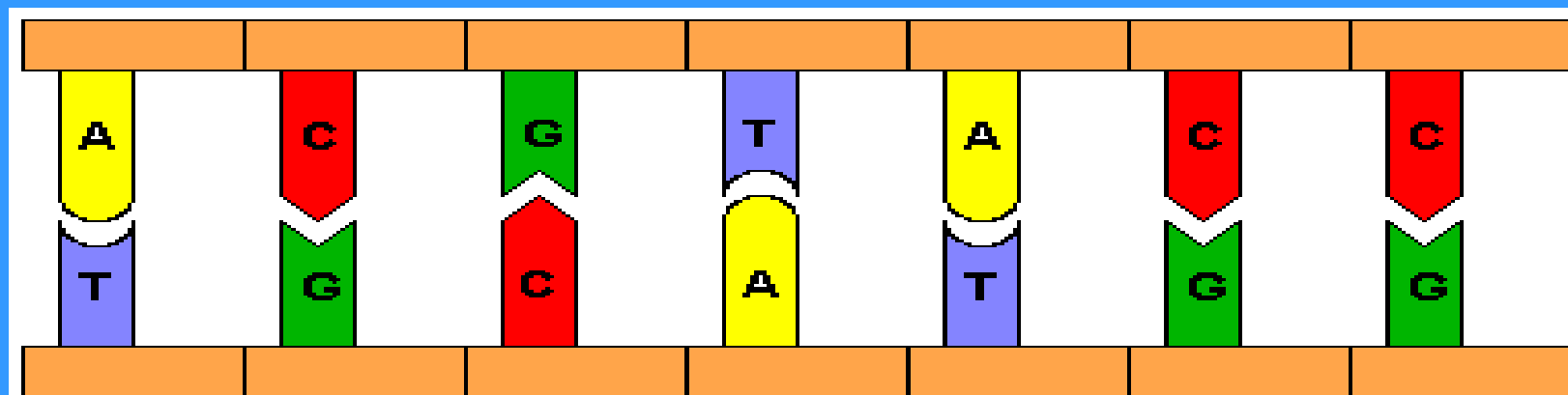
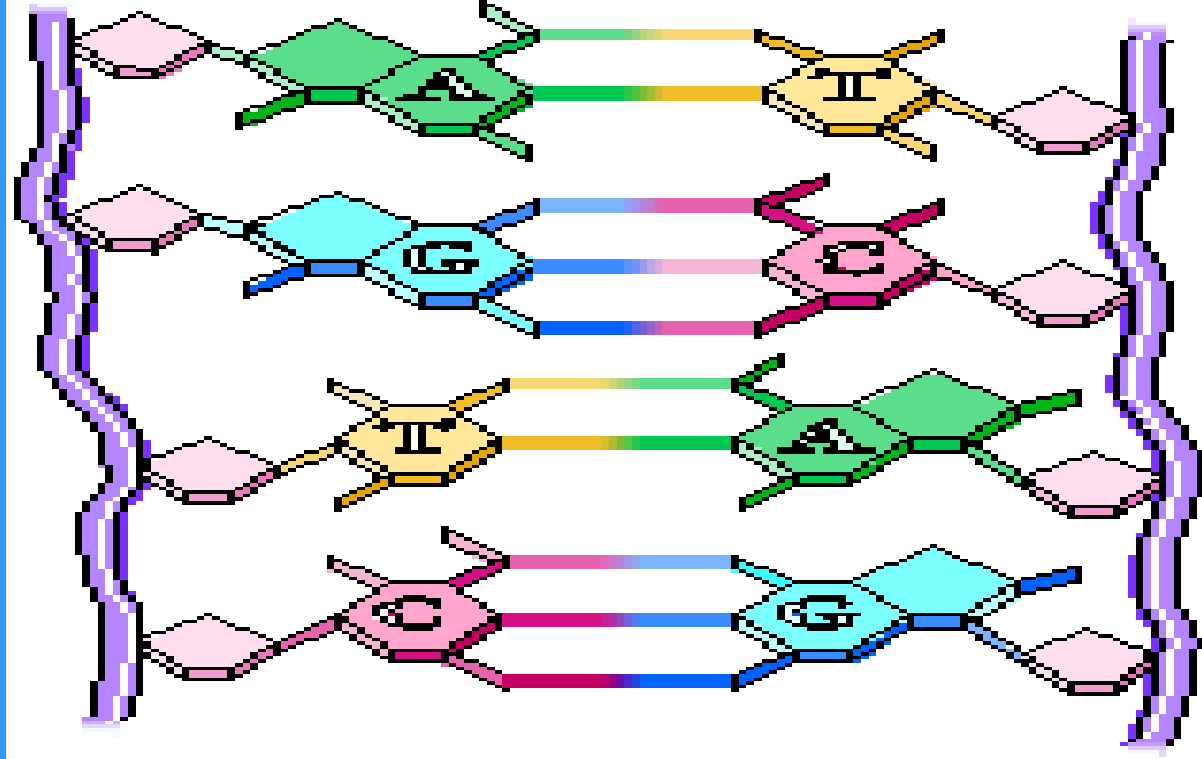
DNA the molecule of life

Trillions of cells

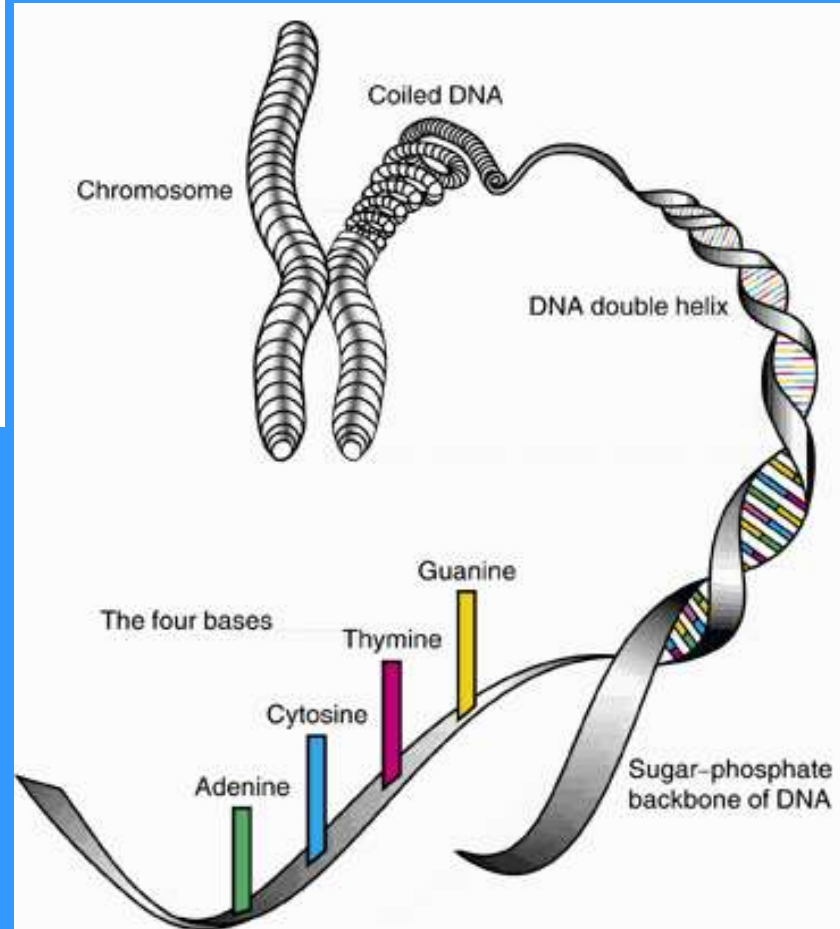
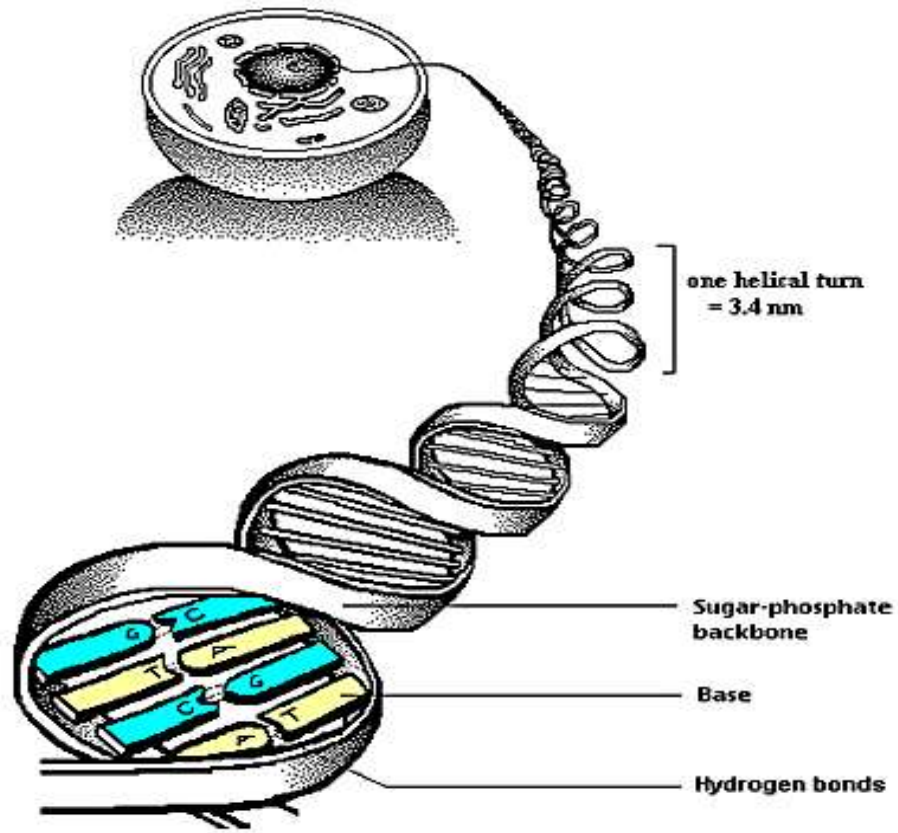
Each cell:

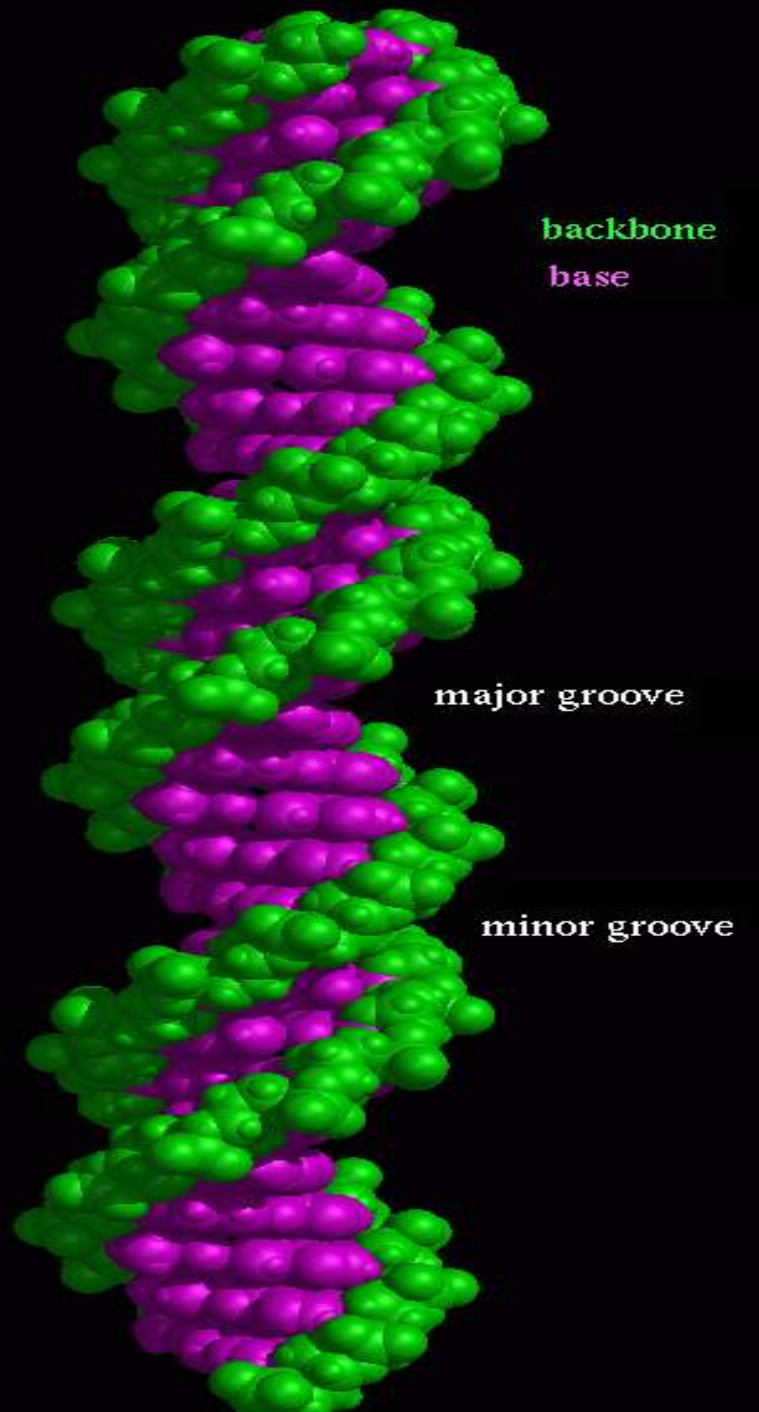
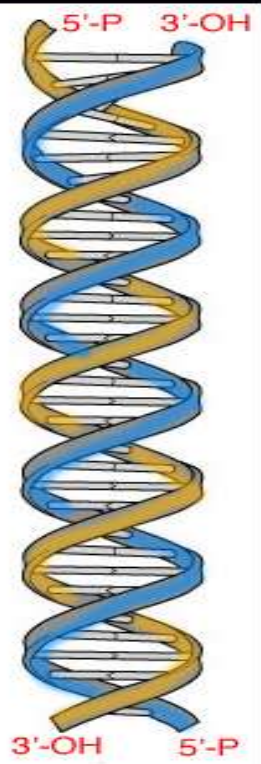
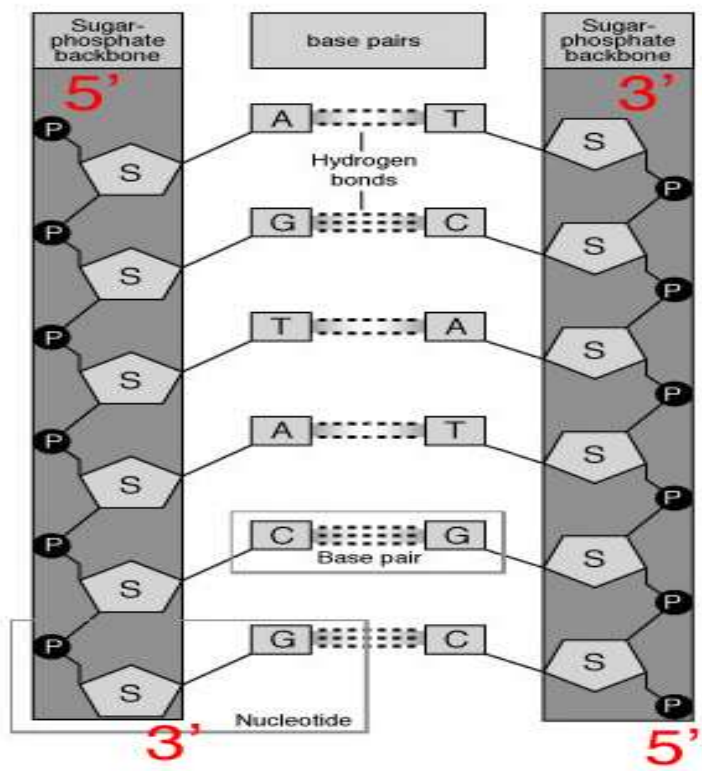
- 46 human chromosomes
- 2 meters of DNA
- 3 billion DNA subunits (the bases: A, T, C, G)
- Approximately 30,000 genes code for proteins that perform most life functions





THE STRUCTURE OF DNA

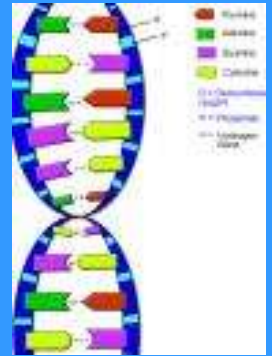




*****From one sequence of nucleotides we can determine the sequence on the other side**

How are these bases held together?

-Weak Hydrogen Bonds



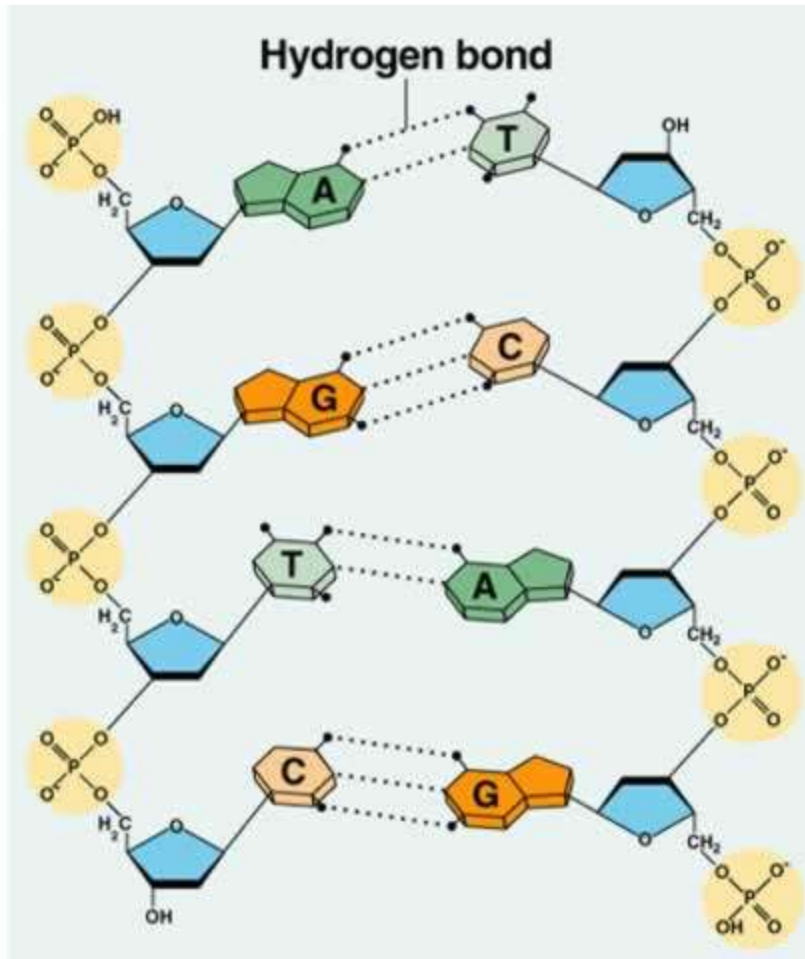
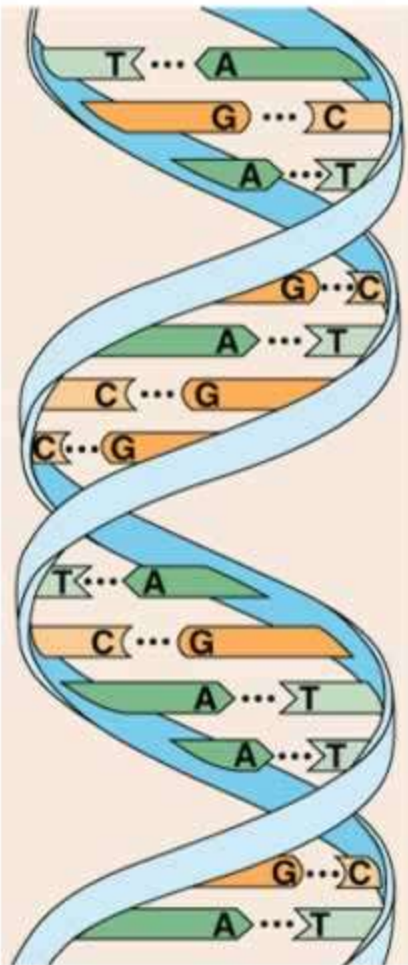
Each sequence of nucleotides forms the unique Genetic information of an organism

Ex: CAT not the same as ACT

A-T-T-G-A-C not the same as T-C-C-A-A-A



Double Helix Ladder



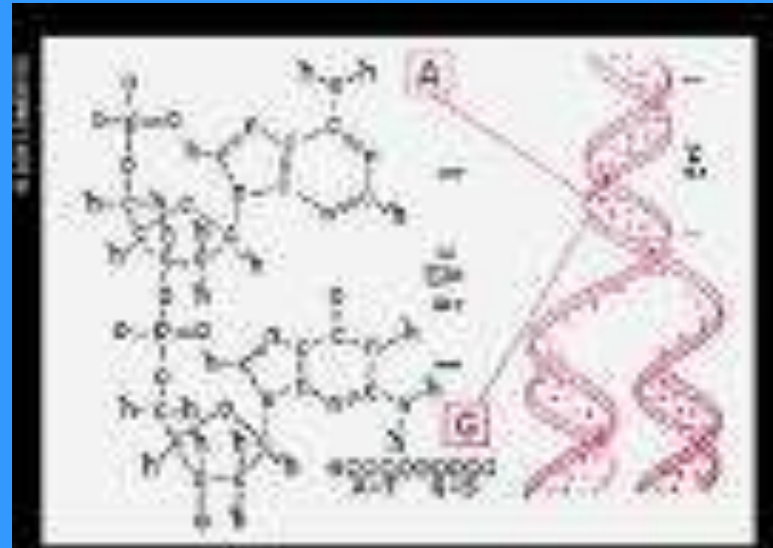
DNA Replication

How long is DNA?

- Each cell contains more than 2 meters (6 ft) of DNA!!

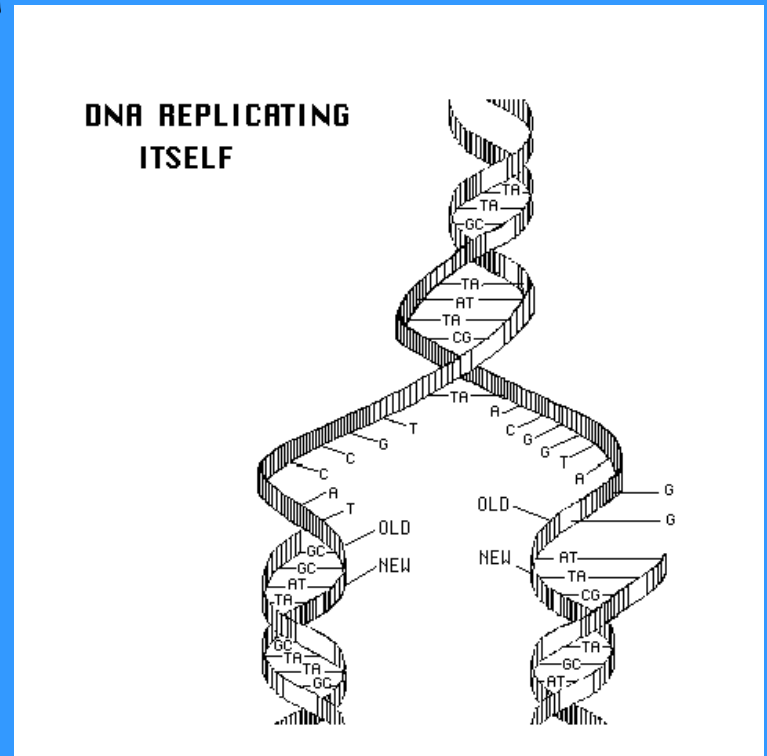
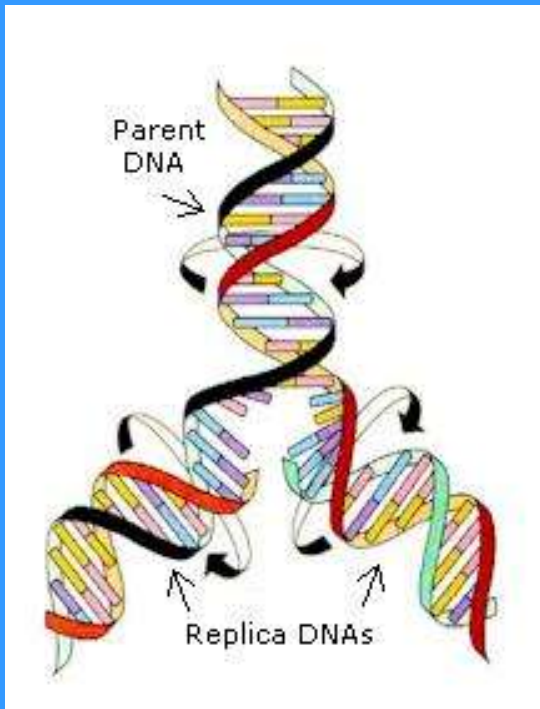
How does this fit into a tiny chromosome?

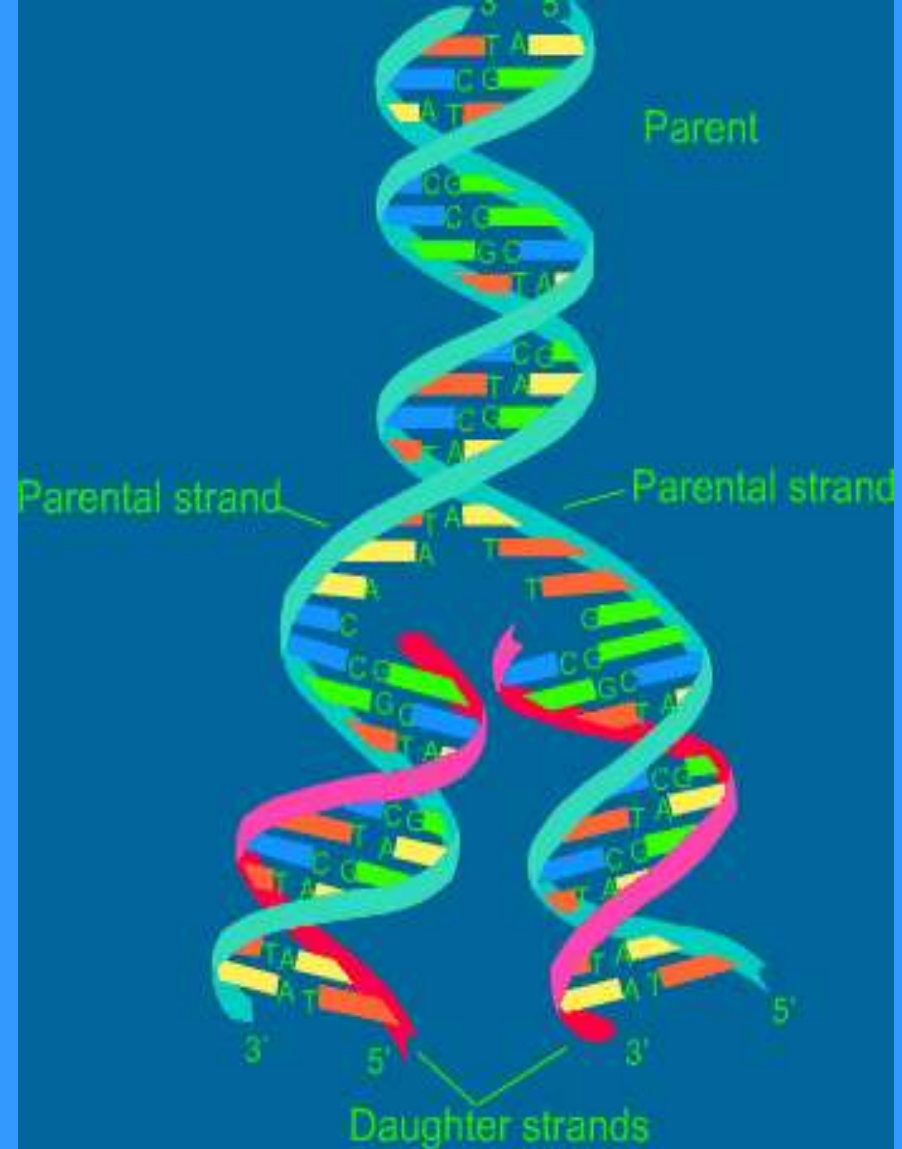
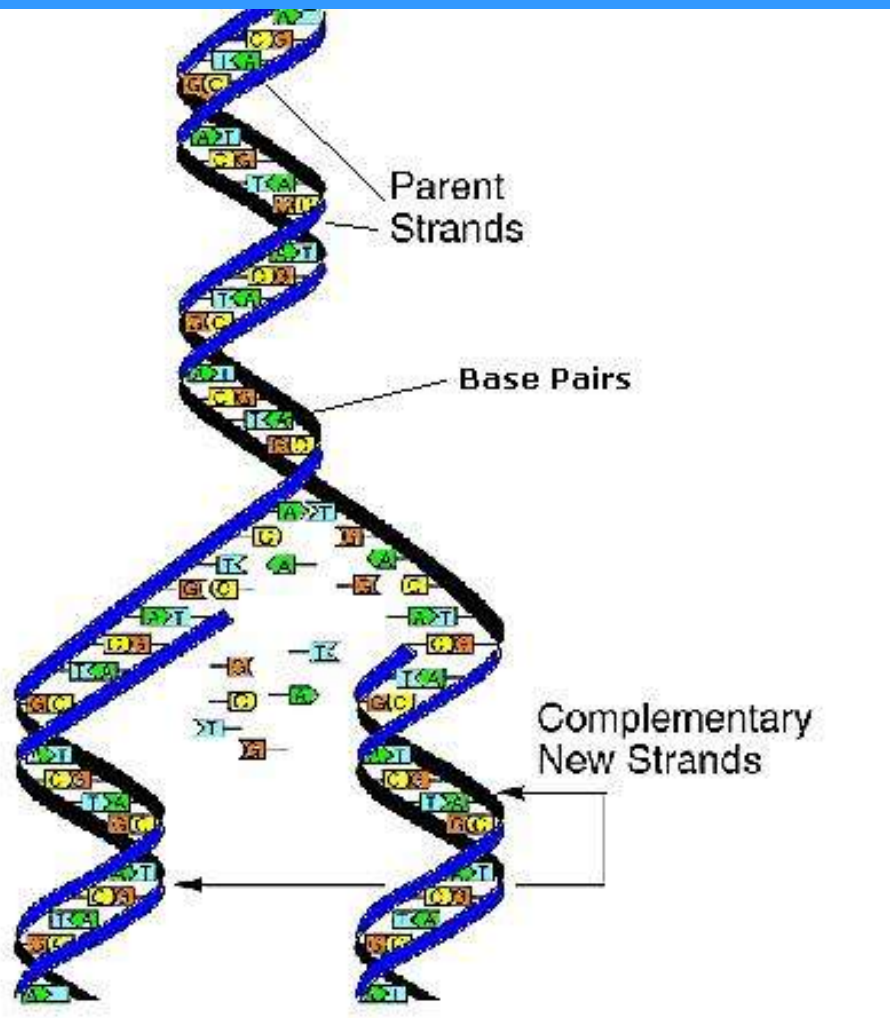
- The long **DOUBLE HELIX** gets wrapped tightly around protein molecules to form bundles



How does DNA Replication occur?

1. Helix unwinds with help of enzymes
2. Double strands unzip
3. Hydrogen bonds break → base pairs separate
4. With the help of enzymes, free floating nucleotides in the cell are matched up with the original DNA strand

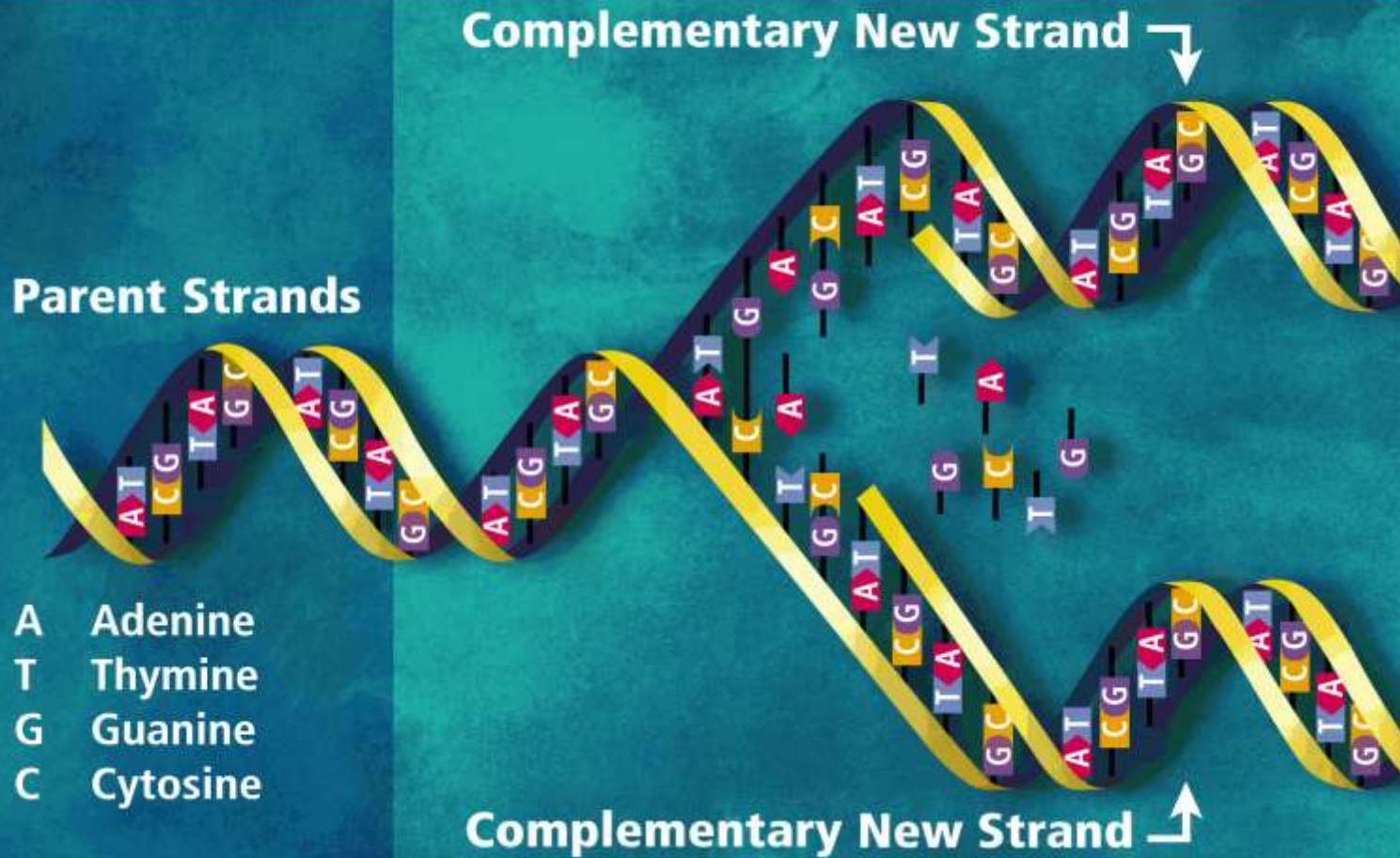




When does DNA replicate itself?

- At the beginning of cell division (mitosis/meiosis)

DNA Replication Prior to Cell Division



The Genetic Code

What is a protein?

-A protein is made up of long chains of amino acids (there are 20 different amino acids) each with their own properties and structures.

Protein Ex: enzymes, hormones, cell receptors, antibodies

What determines how proteins are made?

-The order of amino acids (Each protein molecule has a unique sequence of amino acids)

What determines the function of a protein?

-the shape (****proteins are shape specific*)

genome

cell

chromosomes

genes

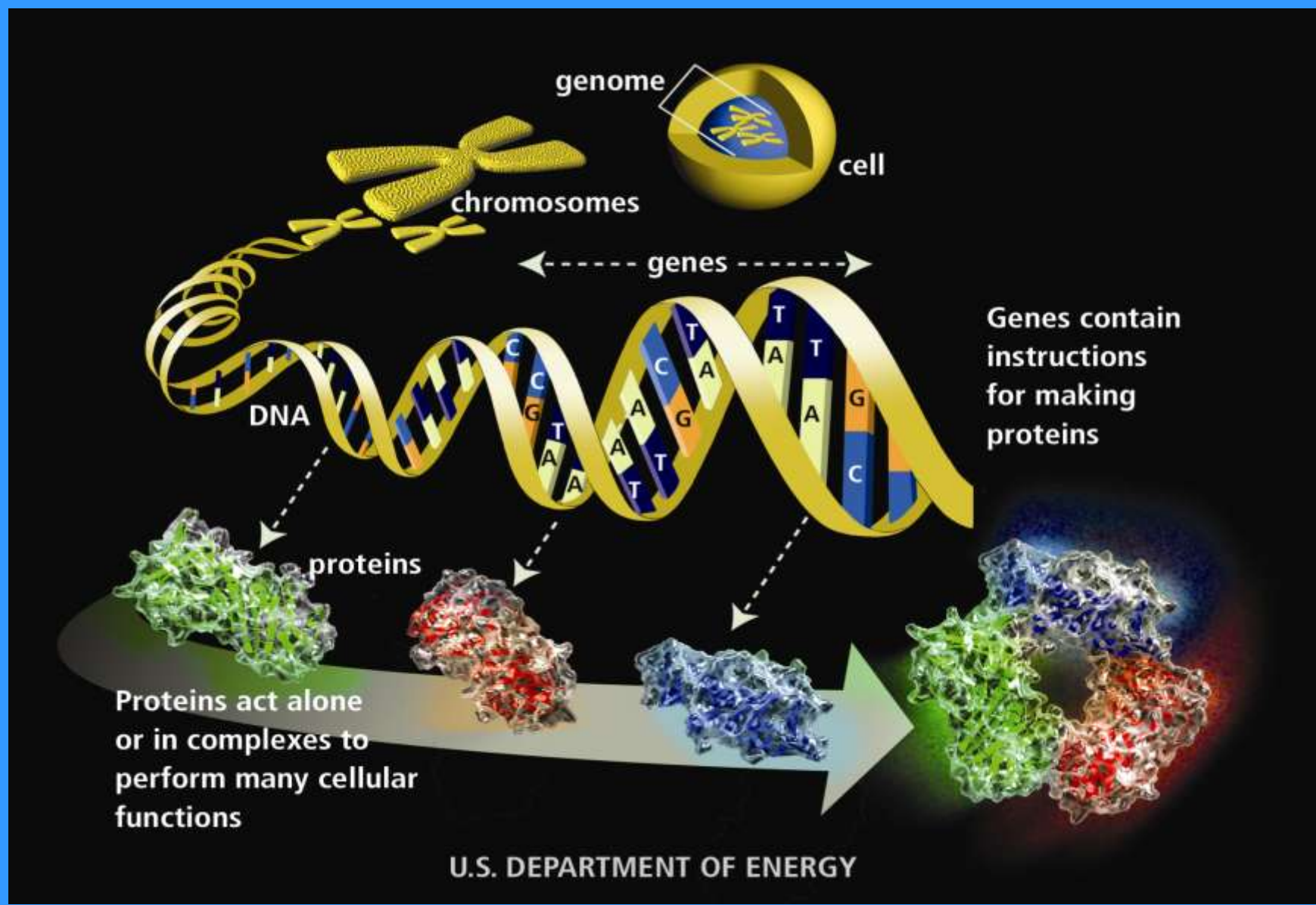
DNA

proteins

Genes contain instructions for making proteins

Proteins act alone or in complexes to perform many cellular functions

U.S. DEPARTMENT OF ENERGY



What determines the order of amino acids ?

- The DNA sequence

Where are proteins made?

- Ribosomes

What controls protein synthesis?

- DNA sequences
- A sequence of 3 bases (codon)
represents 1 single amino acid

****Amino Acids-the building blocks of proteins*



What is RNA?

-Ribonucleic Acid

3 Types of RNA:

1. **mRNA** (messenger RNA)- Brings information from DNA → Ribosome
2. **tRNA** (transfer RNA)- Transports amino acids to ribosome
3. **rRNA** (ribosomal RNA)- Assembles amino acids

What is protein synthesis?

-The process of using amino acids to make a protein from a DNA template (pattern)

How is a protein made?

-making a protein involves 2 steps:

Step #1:

Transcription- making RNA from a DNA template
(Happens in the nucleus)

****This is going from DNA language to RNA language*

DNA template

C

G

T

A

RNA Transcription

G

C

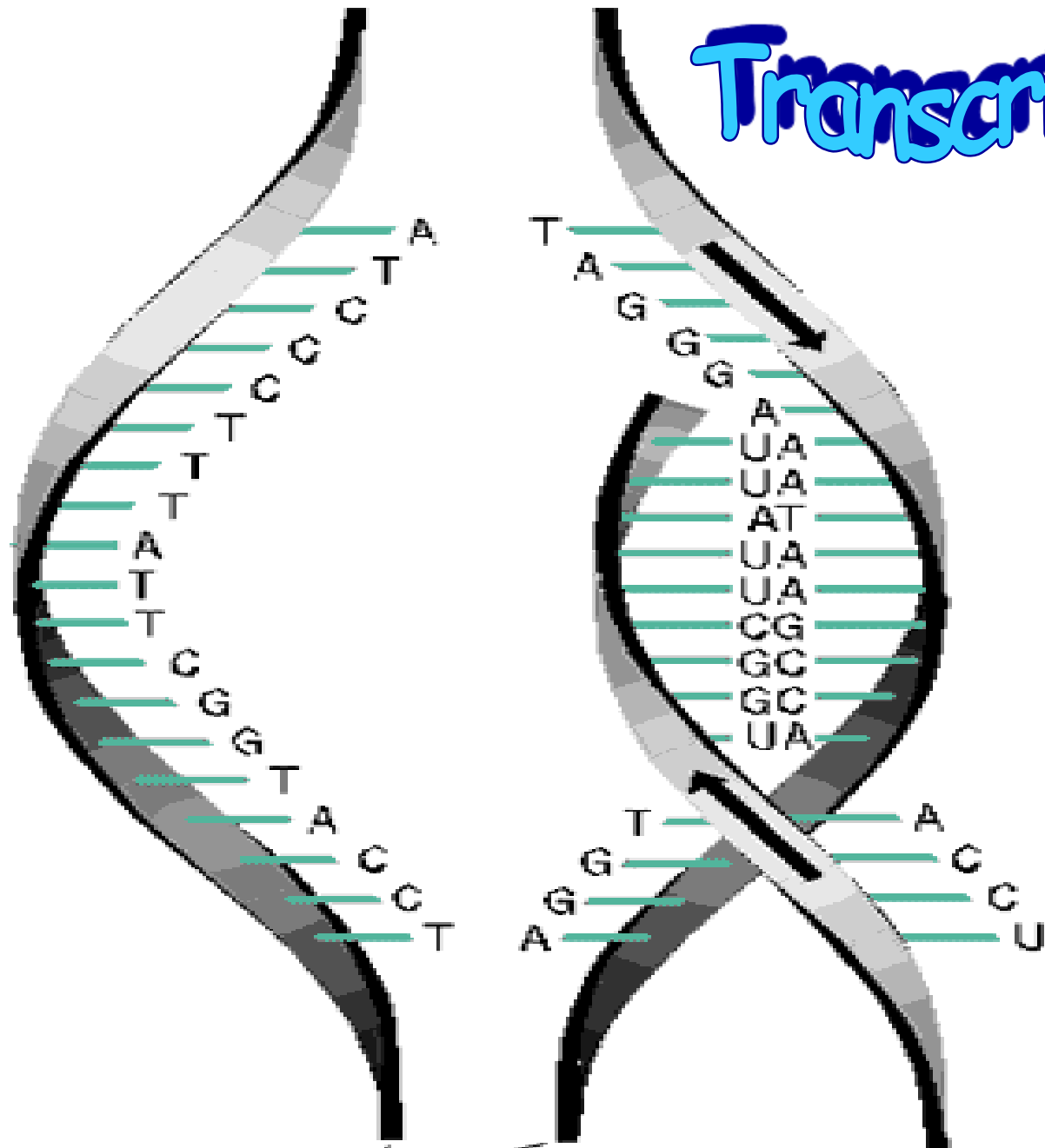
A

U

**** (there is no T in RNA language)*

****n RNA language, Uracil (U) replaces Thymine (T) and pairs with Adenine (A - U)*

Transcription



Step #2:

Translation- Using RNA language to build an amino acid sequence

(Happens in the ribosome)

****This is using an amino acid sequence to build a protein*

RNA Codon

Amino Acid

GCA

Ala

UAC

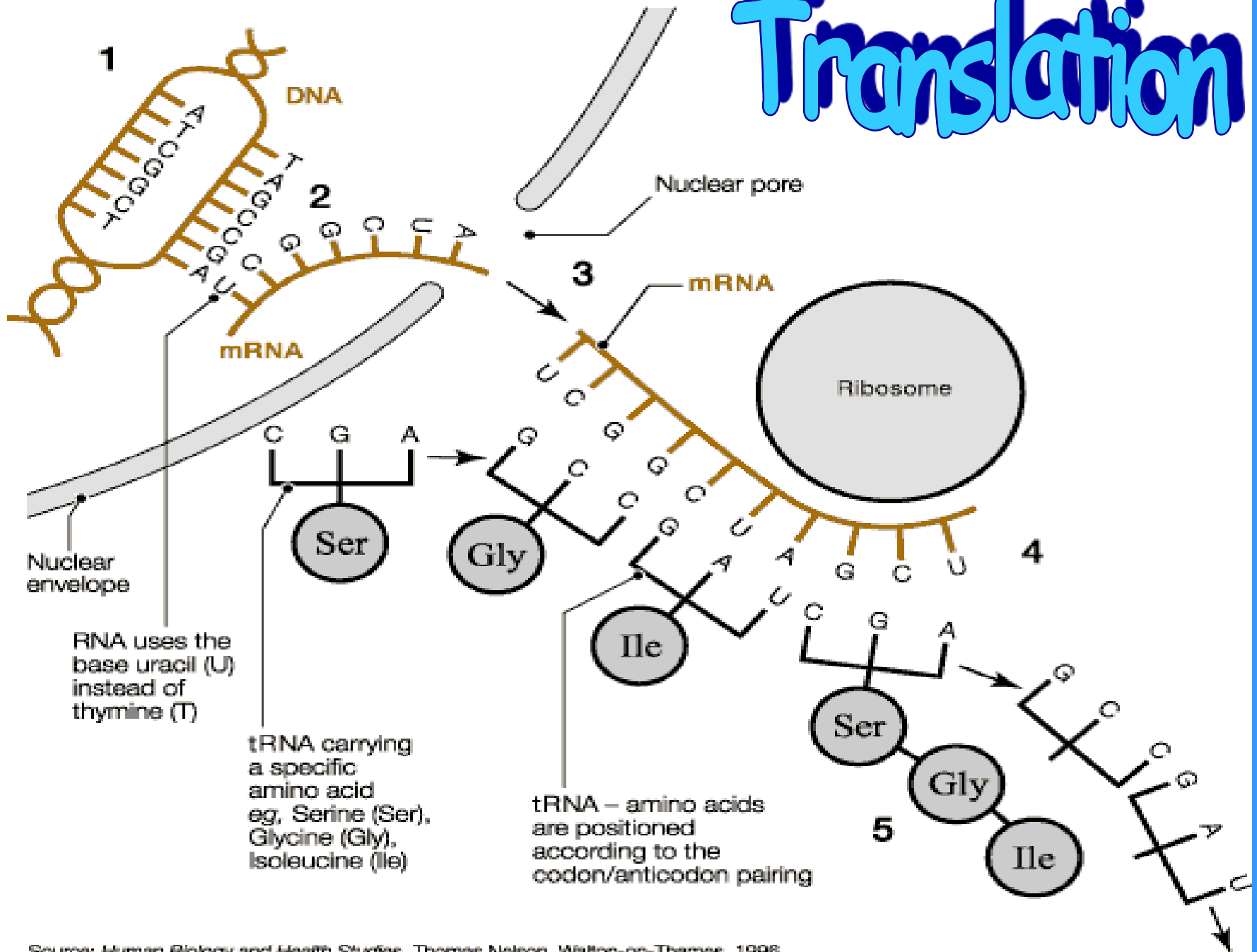
Tyr

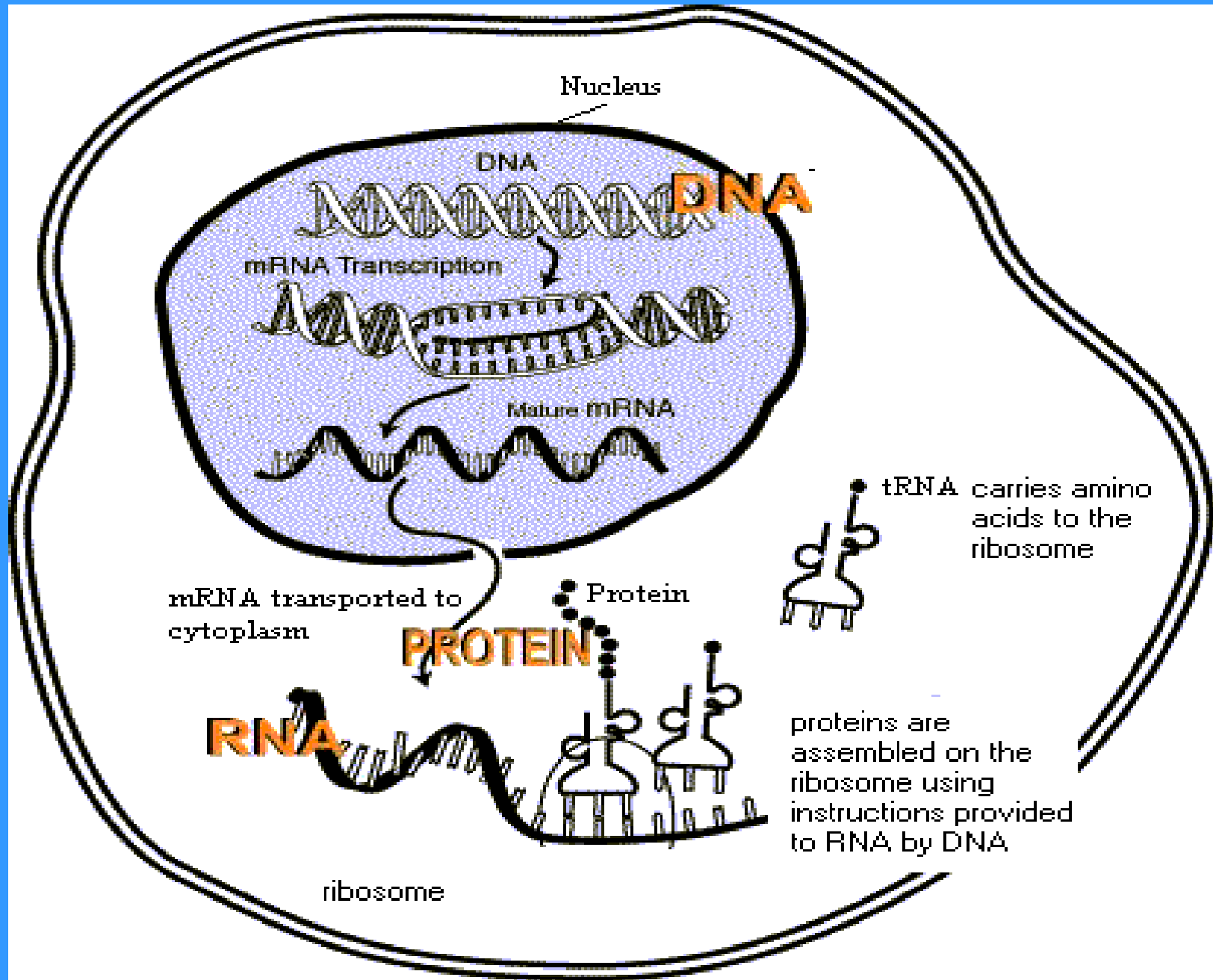
AGU

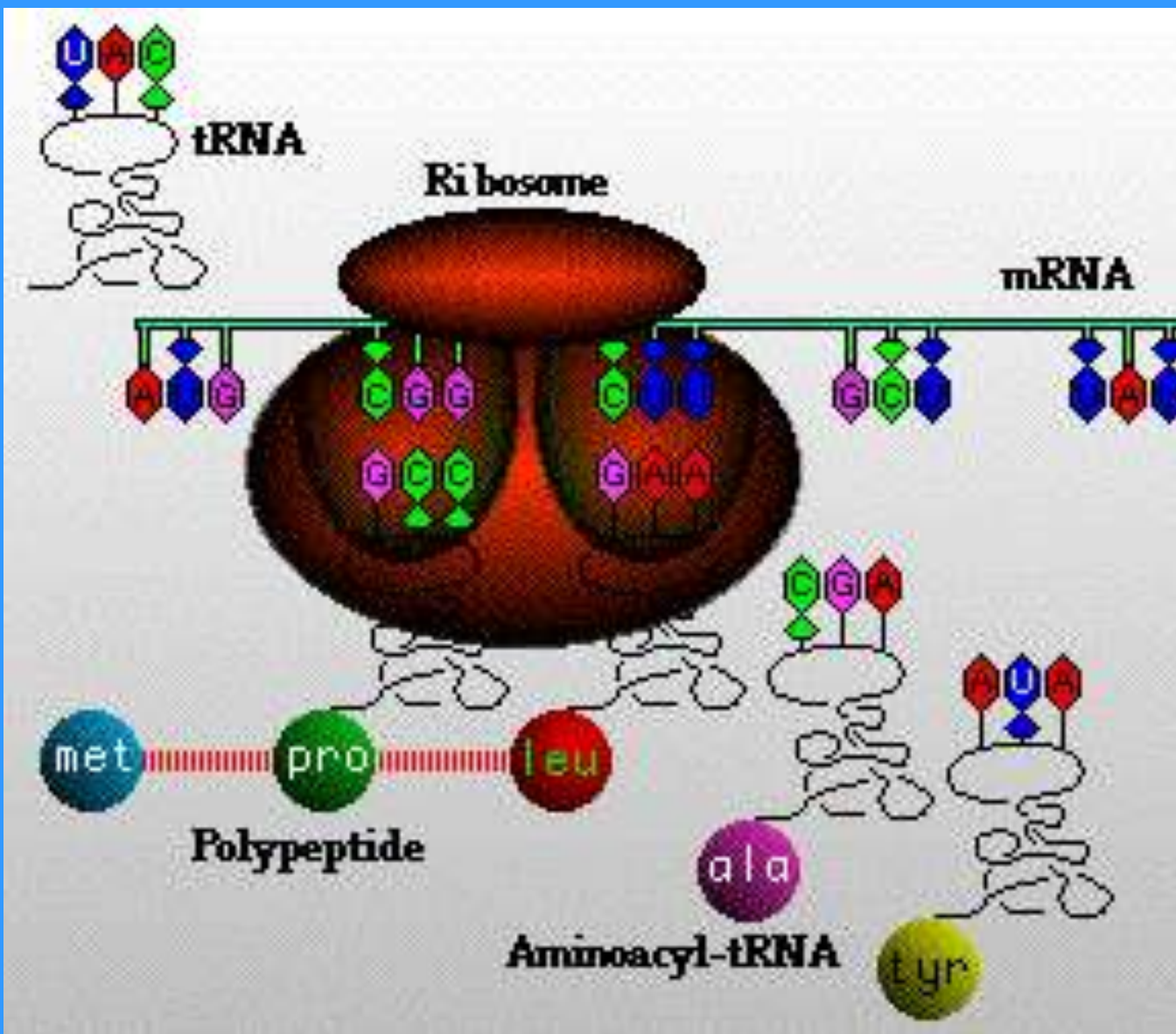
Ser

		SECOND LETTER				
		U	C	A	G	
FIRST (5') LETTER	U	UUU } Phe	UCU } Ser	UAU } Tyr	UGU } Cys	U
		UUC } Leu	UCC } Ser	UAC } Tyr	UGC } Cys	C
		UUA } Leu	UCA } Ser	UAA } Ochre (terminator)	UGA } Opal (terminator)	A
		UUG } Leu	UCG } Ser	UAG } Amber (terminator)	UGG } Trp	G
	C	CUU } Leu	CCU } Pro	CAU } His	CGU } Arg	U
		CUC } Leu	CCC } Pro	CAC } His	CGC } Arg	C
		CUA } Leu	CCA } Pro	CAA } Gln	CGA } Arg	A
		CUG } Leu	CCG } Pro	CAG } Gln	CGG } Arg	G
	A	AUU } Ileu	ACU } Thr	AAU } Asn	AGU } Ser	U
		AUC } Ileu	ACC } Thr	AAC } Asn	AGC } Ser	C
		AUA } Met (initiator)	ACA } Thr	AAA } Lys	AGA } Arg	A
		AUG } Met (initiator)	ACG } Thr	AAG } Lys	AGG } Arg	G
	G	GUU } Val	GCU } Ala	GAU } Asp	GGU } Gly	U
		GUC } Val	GCC } Ala	GAC } Asp	GGC } Gly	C
		GUA } Val	GCA } Ala	GAA } Glu	GGA } Gly	A
		GUG } (initiator)	GCG } Ala	GAG } Glu	GGG } Gly	G
						THIRD (3') LETTER

Translation







Let's Practice!

Original DNA Strand:

ATA CGA TCG CAC

(Transcription) mRNA strand:

UAU GCU AGC GUG

****Remember, mRNA does NOT contain the base Thymine (T), so Adenine (A) gets paired with Uracil (U)**

-Each mRNA **codon** (3 bases) represents a **SPECIFIC** amino acid

THE GENETIC CODE

		SECOND LETTER				
		U	C	A	G	
FIRST (5') LETTER	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA } <i>Ochre</i> (terminator) UAG } <i>Amber</i> (terminator)	UGU } Cys UGC } UGA } <i>Opal</i> terminator UGG } Trp	U C A G
	C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } CGC } Arg CGA } CGG }	U C A G
	A	AUU } AUC } Ileu AUA } AUG } Met (initiator)	ACU } ACC } Thr ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G
	G	GUU } GUC } Val GUA } GUG } (initiator)	GCU } GCC } Ala GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } GGC } Gly GGA } GGG }	U C A G

THIRD (3') LETTER

mRNA Strand:

UAU GCU AGC GUG

Amino acid sequence:

Tyr Ala Ser Start

How do the organelles of a cell work together to carry out Protein Synthesis?

