

DNA, Transcription, & Translation

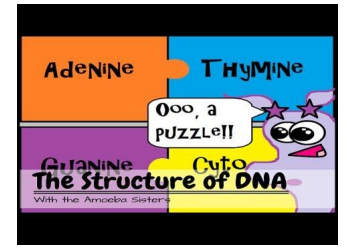
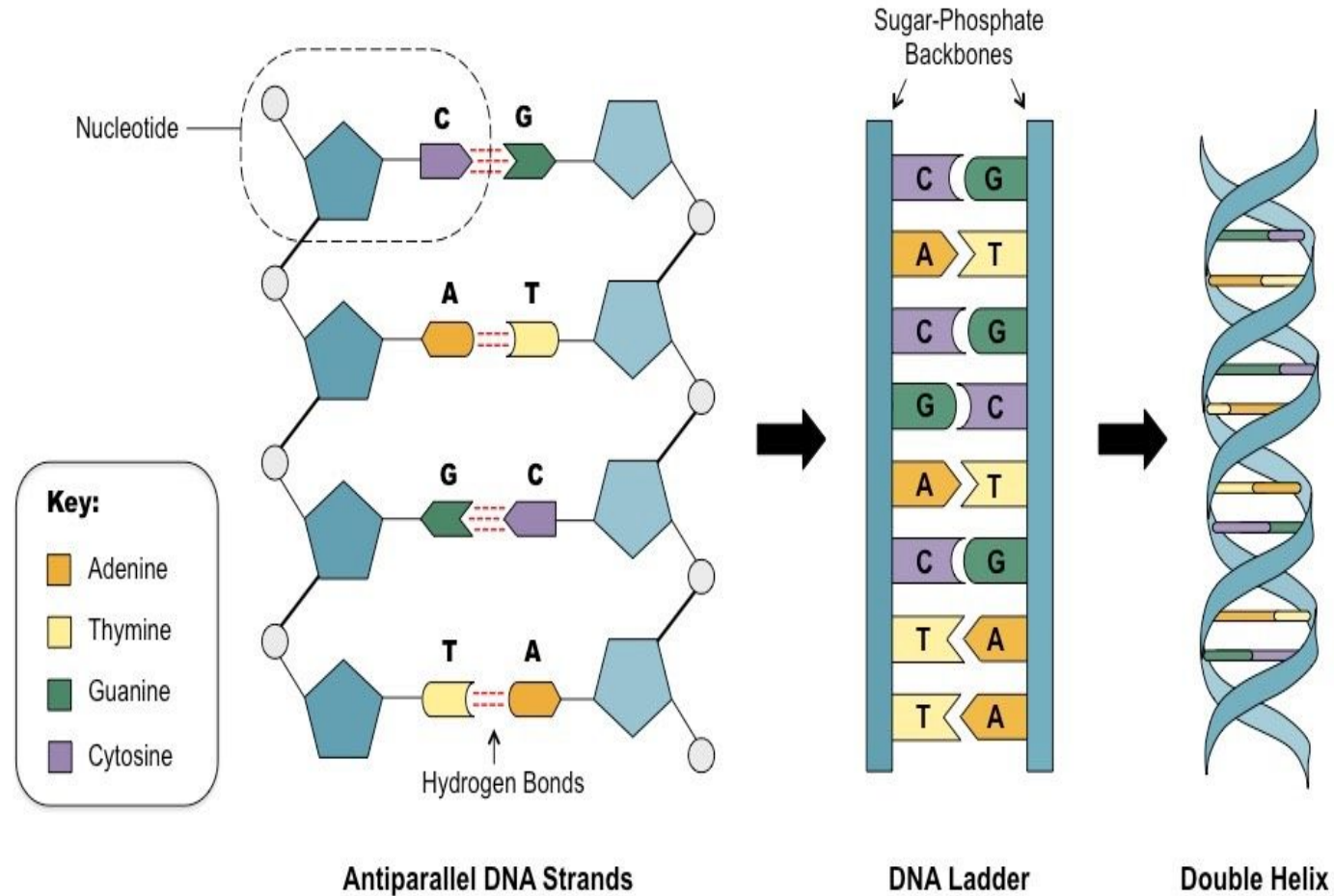
Unit 4

Vocabulary

- **Anticodon**- Group of three bases on a tRNA molecule that are complementary to an mRNA codon
- **Cancer**- A disease in which some body cells grow and divide uncontrollably, damaging the parts of the body around them.
- **Chemical bond**- The force that holds two atoms together
- **Codon**- Three nucleotide sequence on messenger RNA that codes for a single amino acid
- **Complementary base pairs**- A-T, G-C
- **Gene**- A segment of DNA on a chromosome that codes for a specific trait
- **Genetic**- Relating to genes or heredity
- **Mutation**- Change in a DNA sequence that affects genetic information
- **Nucleotide**- Monomer of nucleic acids made up of a 5-carbon sugar, a phosphate group, and a nitrogenous base
- **Replication**- Process of copying DNA prior to cell division
- **Template strand**- The DNA strand that provides the template for ordering the sequence of nucleotides in an mRNA transcript.
- **Transcription**- Synthesis of an RNA molecule from a DNA template
- **Translation**- Process by which mRNA is decoded and a protein is produced

DNA Function & Structure

- Stores & transmits genetic information
- Replicates during interphase of the cell cycle
- Structurally:
 - made up of nucleotides. Nucleotides are composed of a sugar (deoxyribose), a phosphate, and a nitrogenous base (Adenine, Thymine, Cytosine, and Guanine)
 - Sugar-phosphate backbone is held together by covalent bonds.
 - Two strands are held together by weak hydrogen bonds between complementary base pairs that make it twist into a 'double helix'.
 - Complementary base pairs are Adenine is always paired with Thymine & Cytosine is always paired with Guanine.



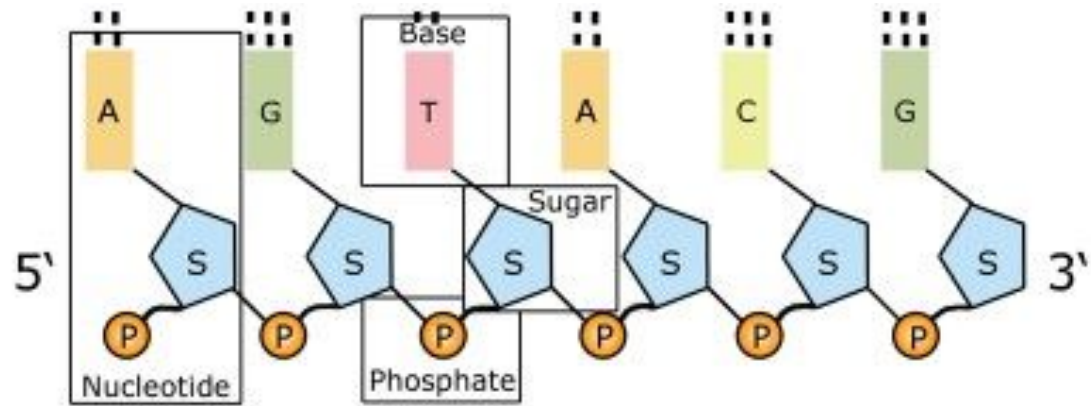
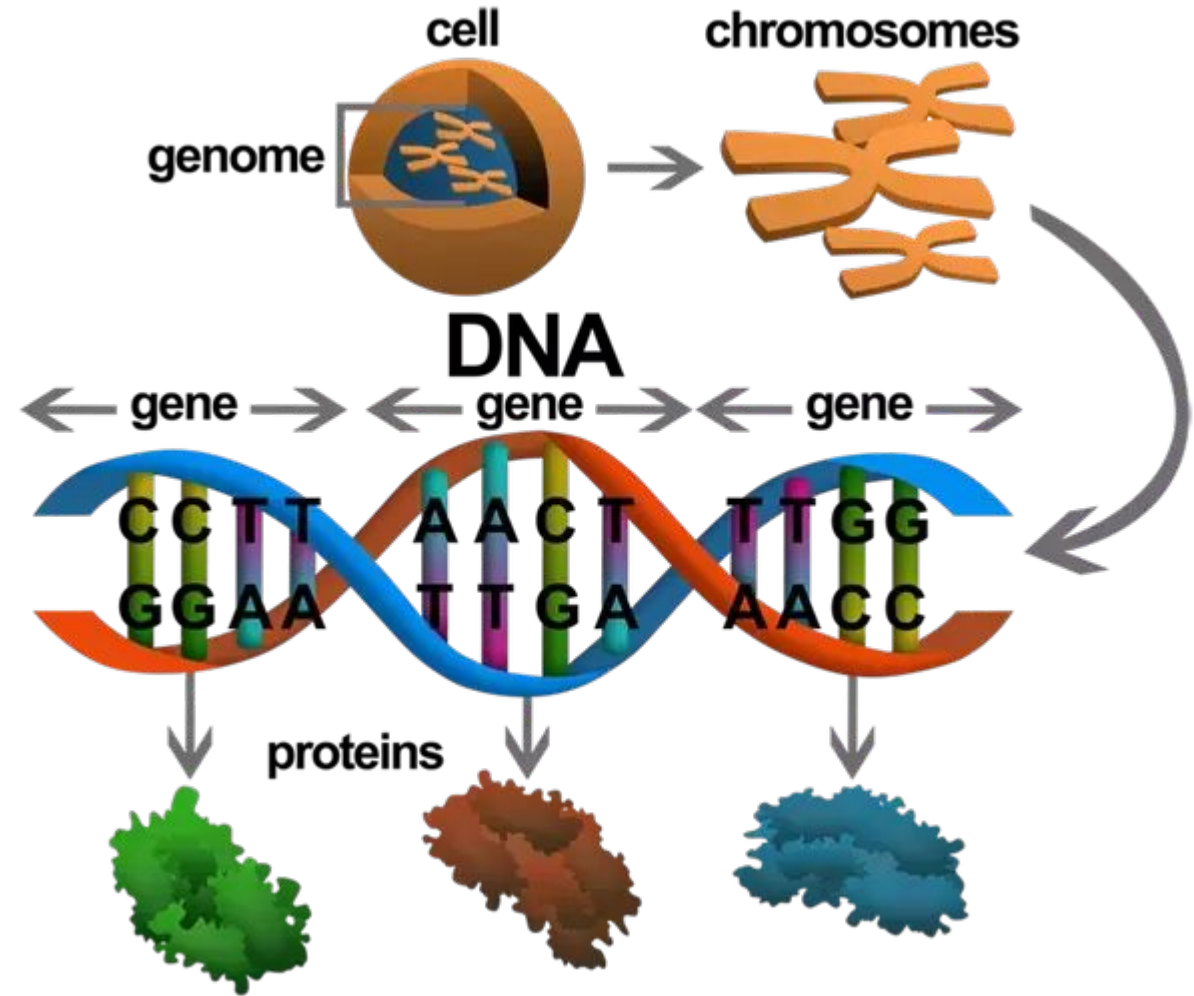
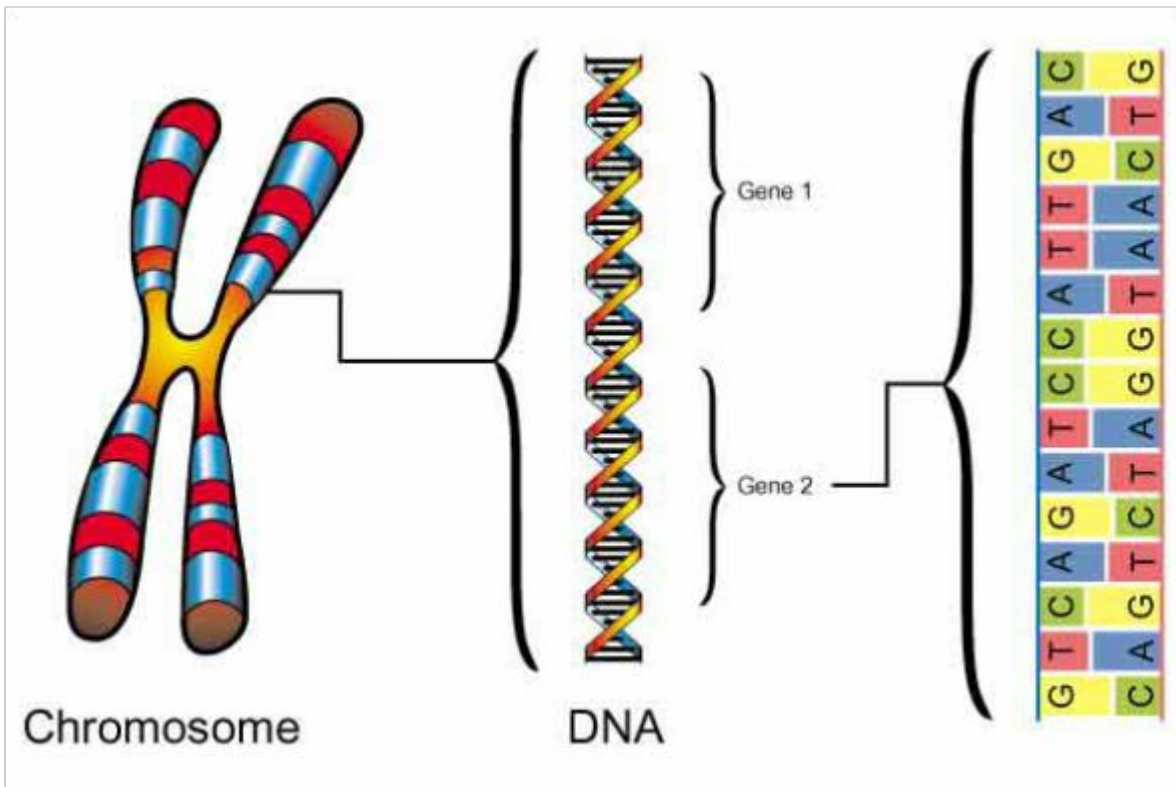


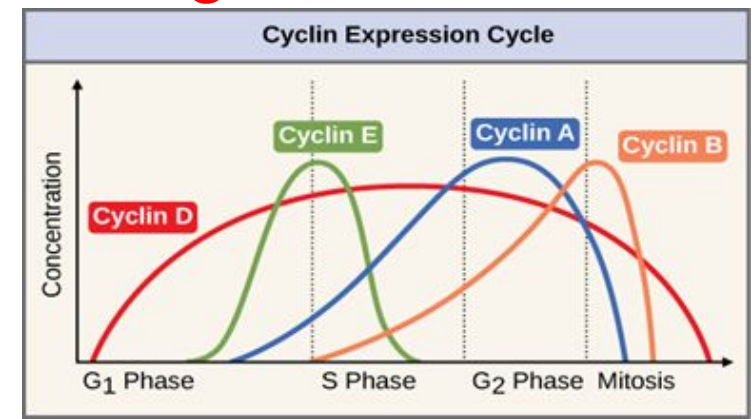
Image adapted from: National Human Genome Research Institute.



DNA is a double helix that is made up of several genes.
A gene is a heritable segment of DNA that determines a trait or characteristic.

Cyclins

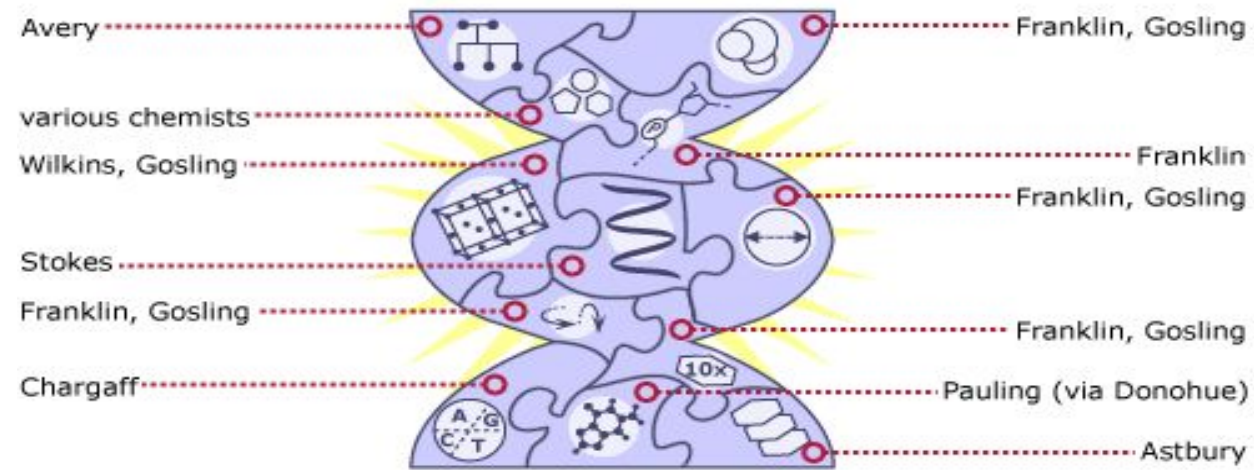
- Cyclins are a group of proteins that ensure each cell only moves on to the next stage of the cell cycle when it is appropriate.
- Unless cyclins reach a threshold concentration, the cell does not progress to the next stage. Only happens when new cells are needed.
- Mutations in these can cause uncontrolled cell division resulting in tumors (cancer) and can occur in any tissue or organ.



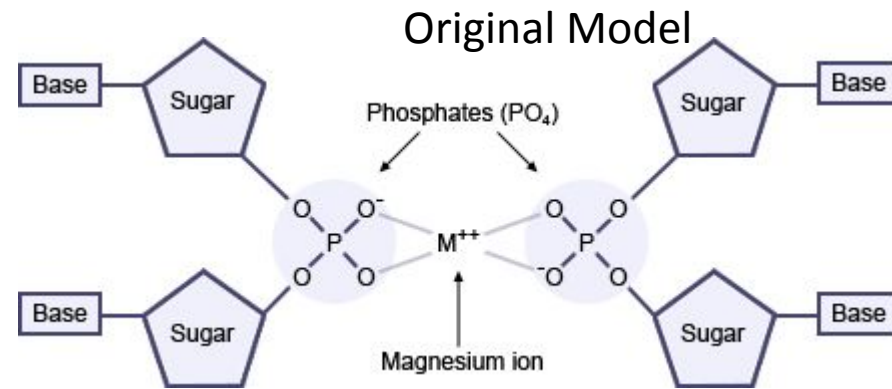
Watson & Crick:

Credited for the “discovery” of DNA structure

Watson and Crick figured out how all the evidence fit together ...



... but the evidence came from many different members of the scientific community.

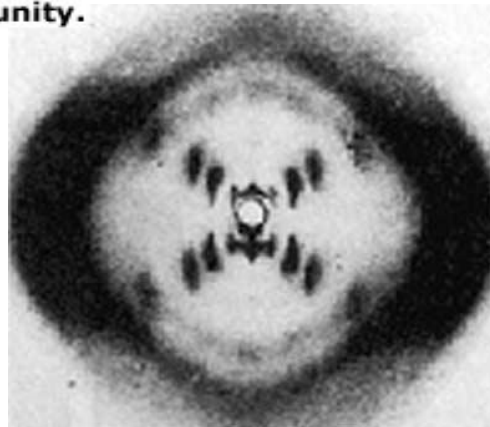


Supposed to mention that they used creativity, logic and critical thinking, but come on



"The results suggest a helical structure (which must be very closely packed) containing probably 2, 3 or 4 coaxial nucleic acid chains per helical unit and having the phosphate groups near the outside."

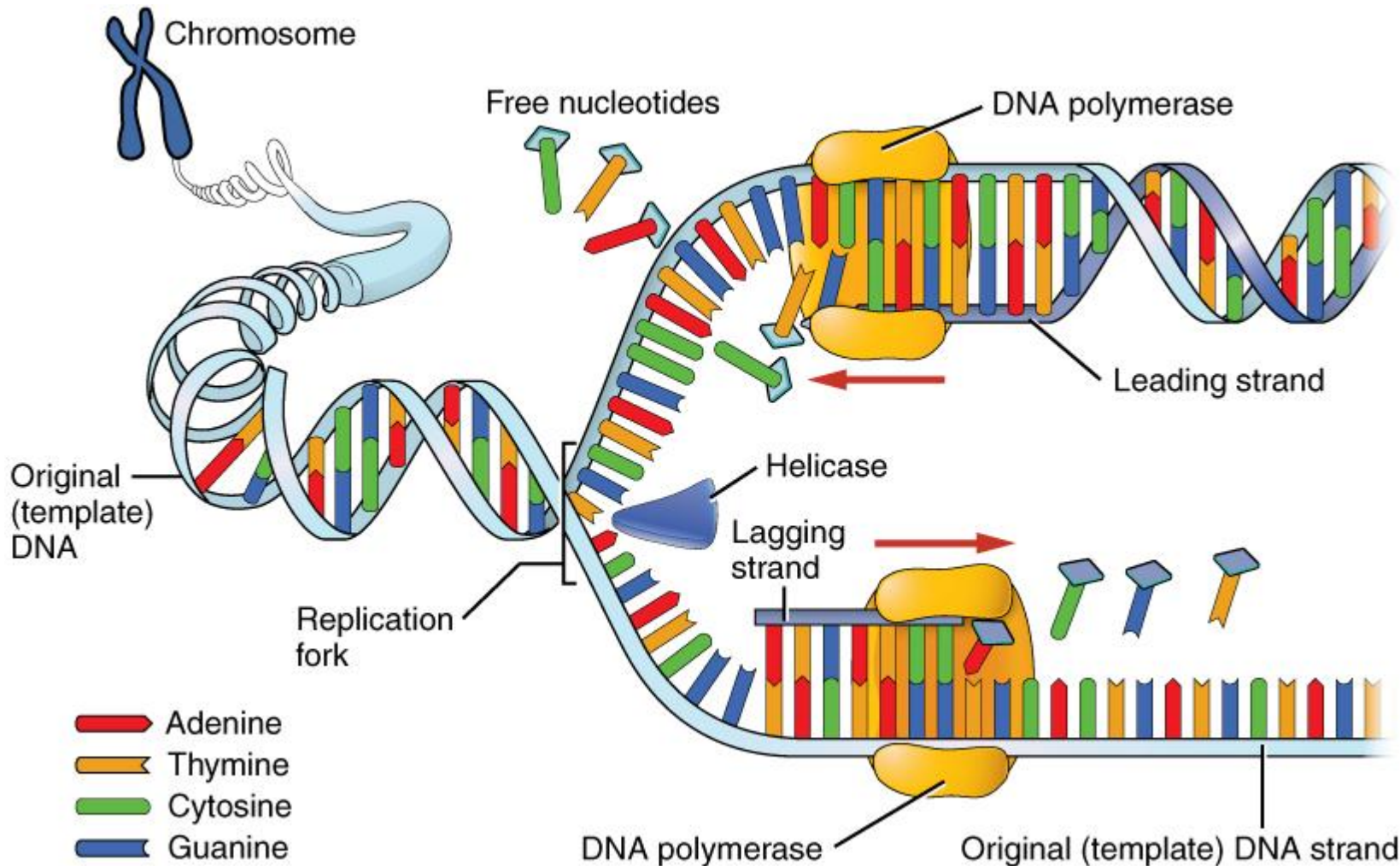
Rosalind Franklin



Franklin's diffracted X-ray helped identify the helical pattern



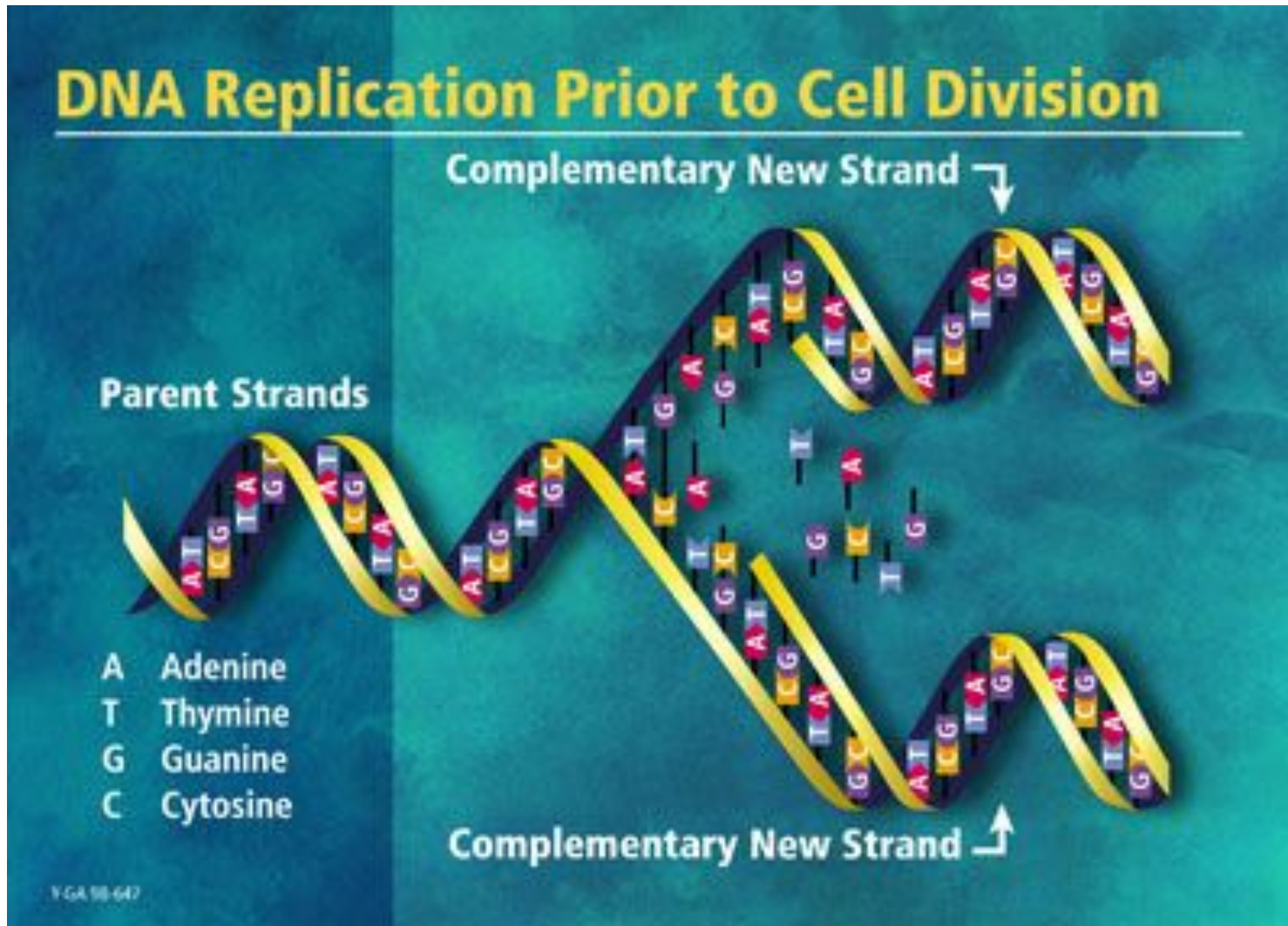
DNA Replication



DNA Helicase is an enzyme that separates the two strands of DNA by breaking the hydrogen bonds between the bases of the two strands.

New nucleotides are paired with each strand by DNA Polymerase.

DNA Replication

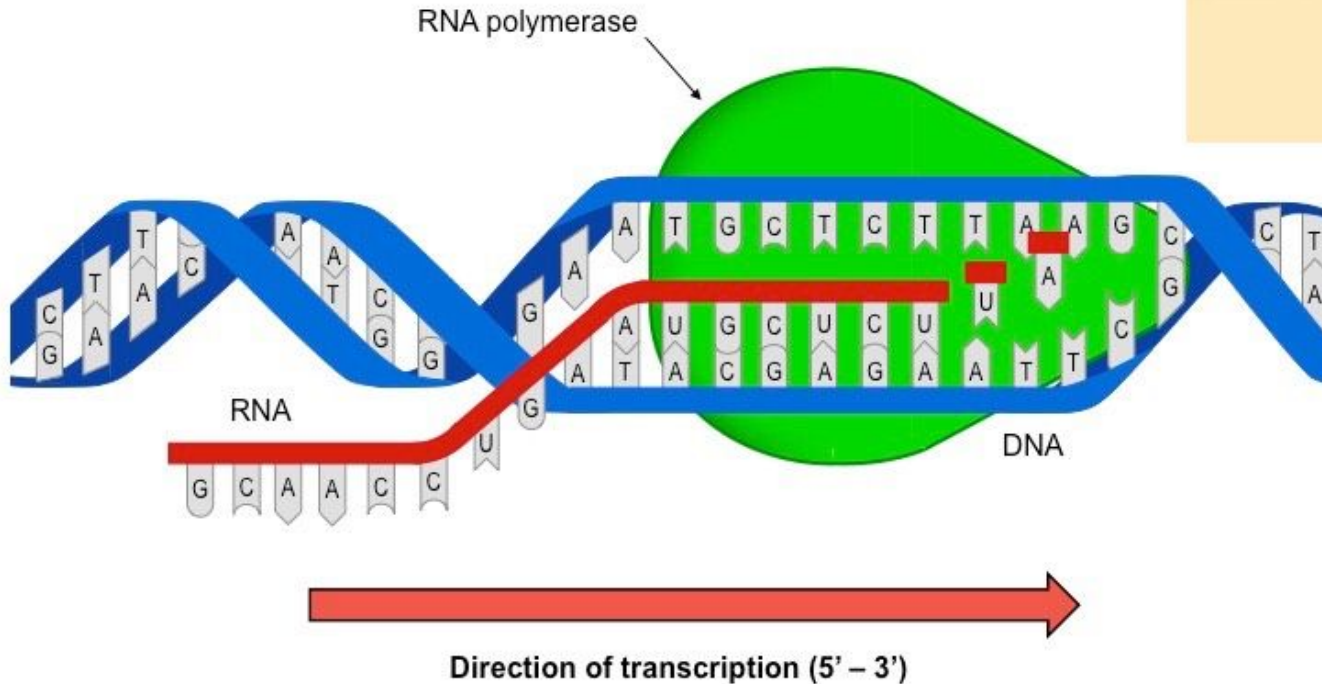
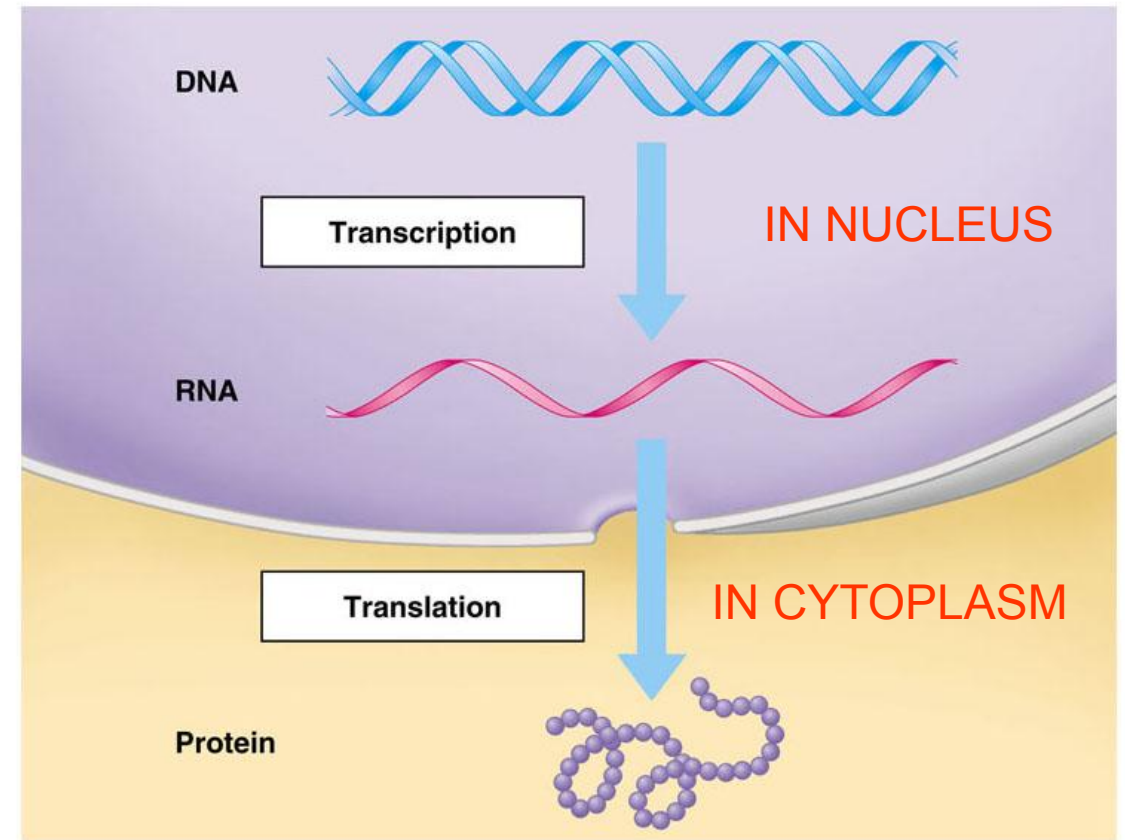


Each of the strands serves as a template for free-floating complementary nucleotides to attach to and make a new strand.

Because one strand of each new DNA molecule is from the original and the other strand is new, the process is called **Semi-Conservative**

Transcription

DNA to RNA



RNA Polymerase is an enzyme that unwinds and temporarily separates the DNA in the nucleus and adds RNA nucleotides to produce a strand of mRNA that is complementary to the DNA strand

DNA

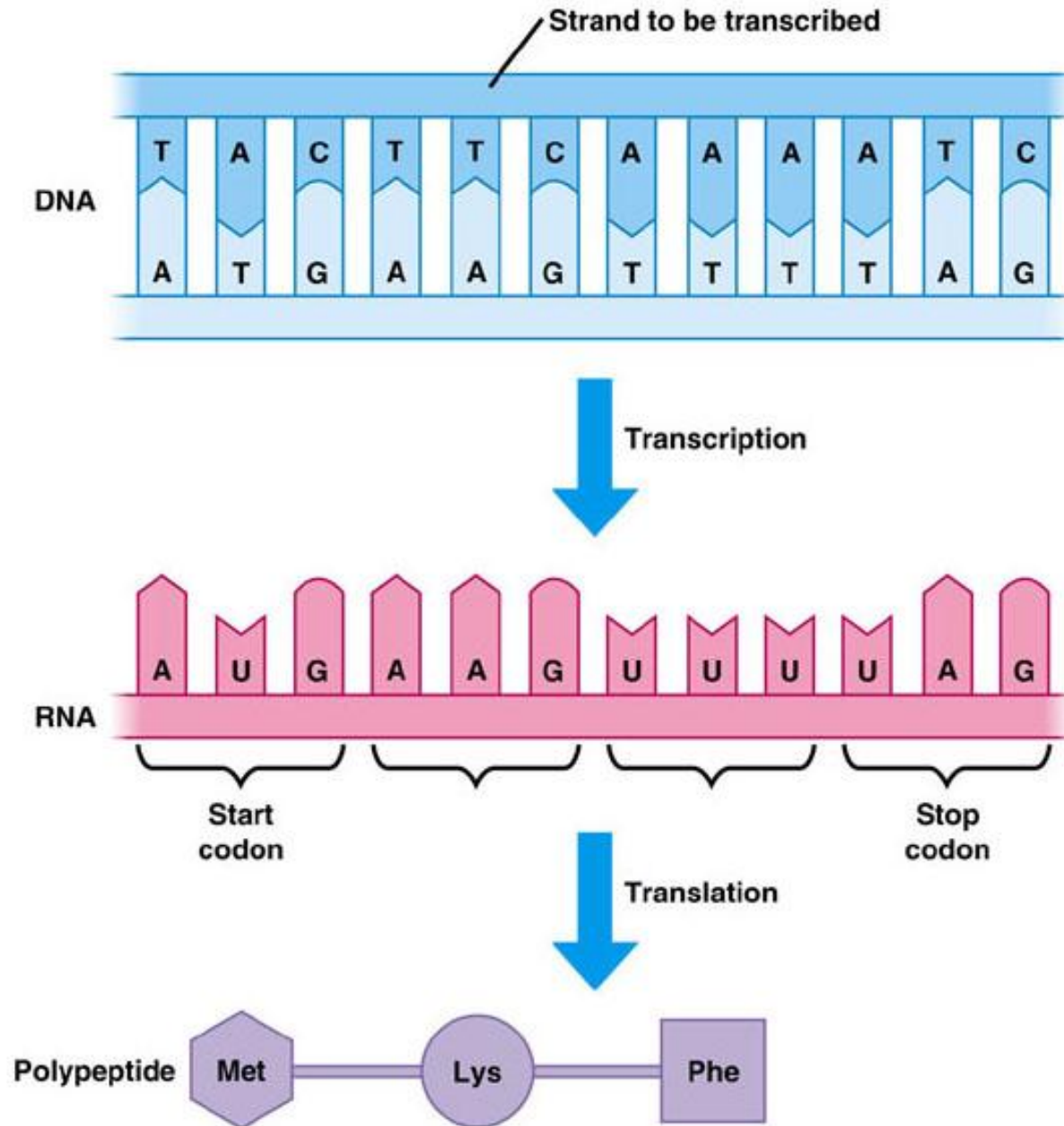
RNA

- Has Thymine
- Sugar is Deoxyribose
- Double stranded
- Helical
- Only in nucleus

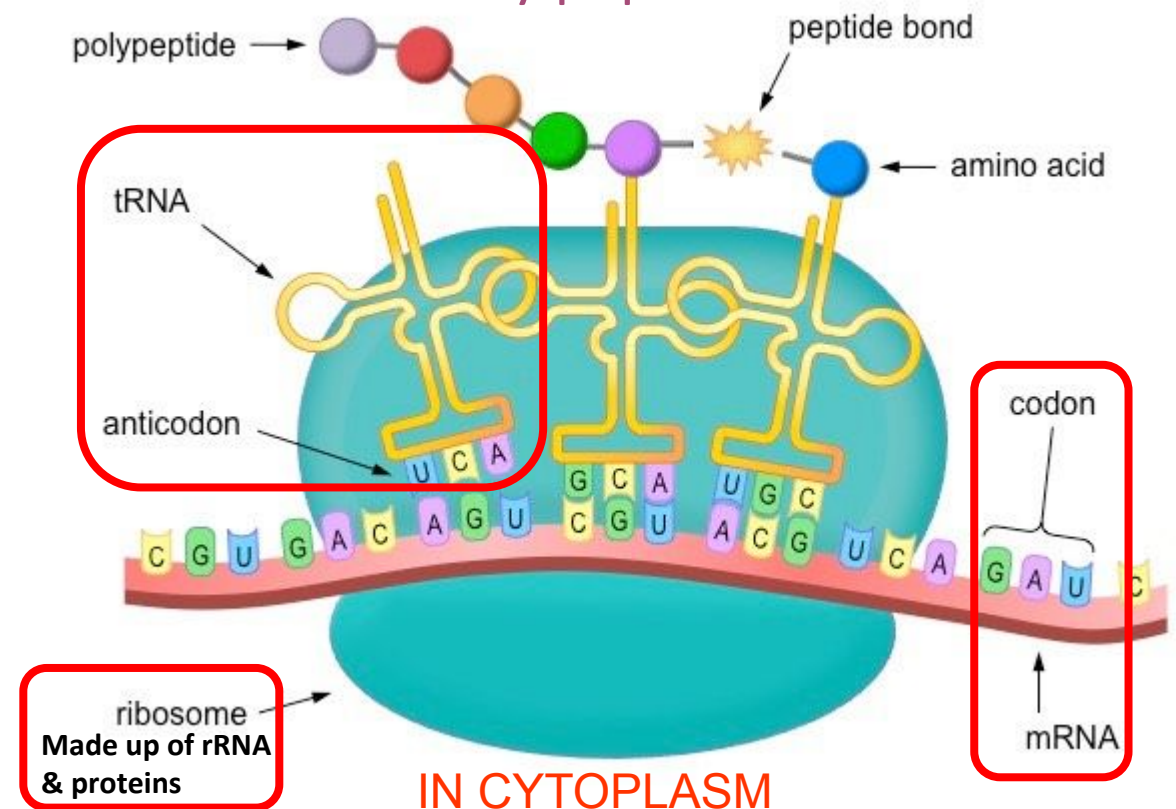
- Has cytosine, guanine, and adenine
- Made up of nucleotides

- Has Uracil
- Sugar is Ribose
- Single stranded
- Not helical
- In nucleus & cytoplasm

Translation: the synthesis of polypeptides/ proteins on ribosomes from mRNA



3 mRNA nucleotides are a codon. Each codon equals one amino acid. tRNA has an anticodon that compliments the codon. The tRNA brings the specific amino acid. Amino acids are attached to each other by peptide bonds.

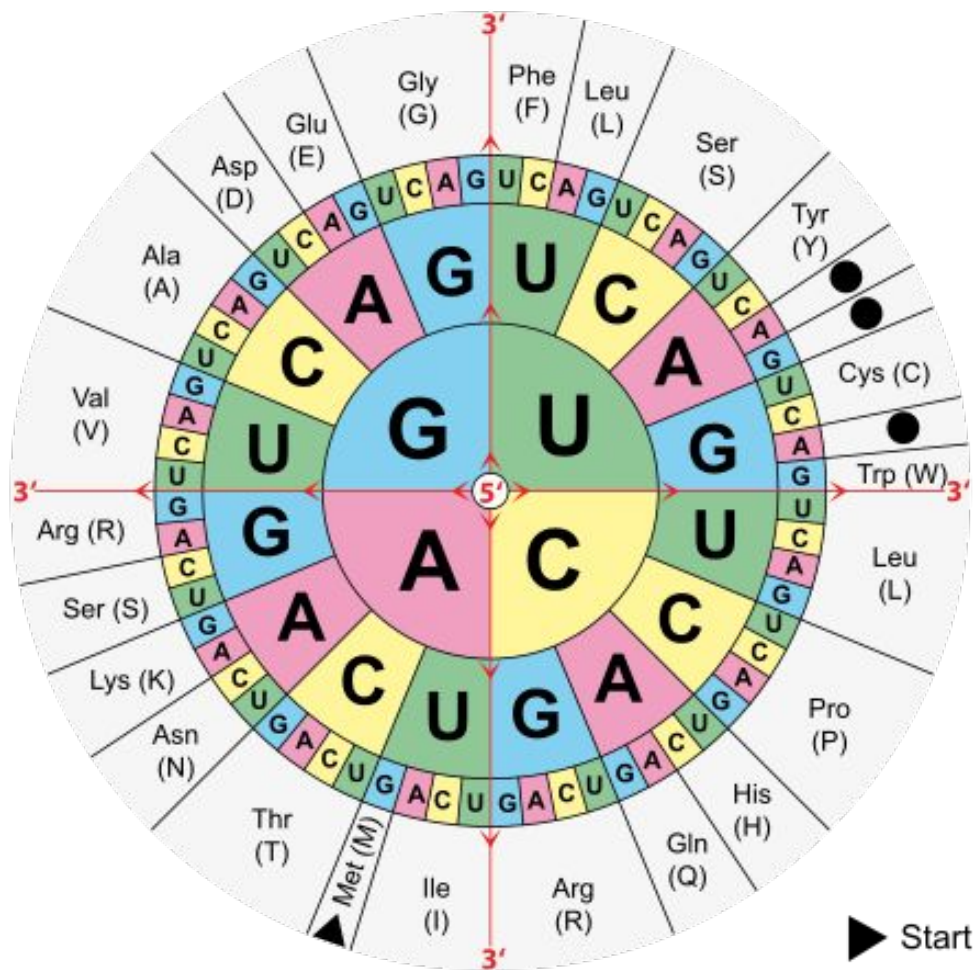


The Genetic Code is made up of codons composed of triplet bases.

The genetic code is Universal. It is found in all organisms.

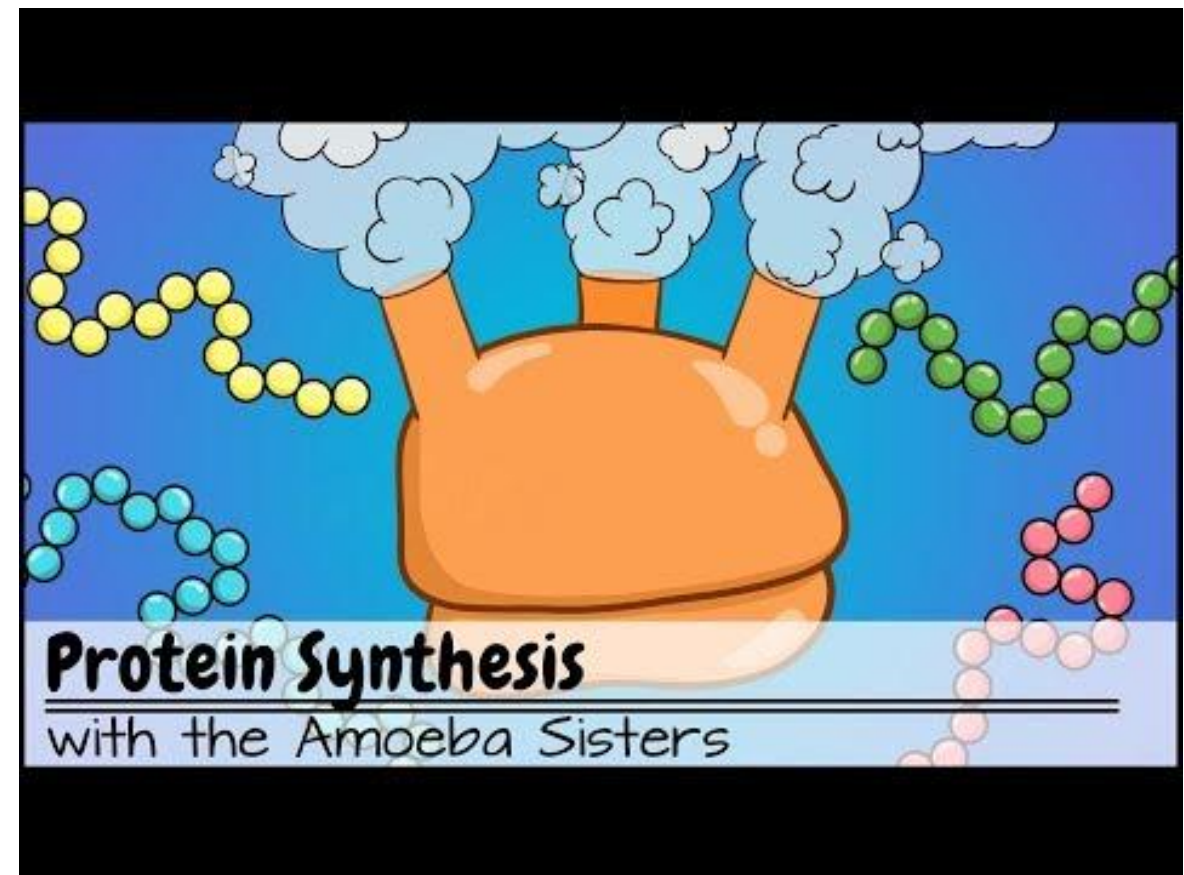
		Second base					
		U	C	A	G		
First base	U	UUU] Phe	UCU]	UAU] Tyr	UGU] Cys	U	Third base
		UUC]	UCC] Ser	UAC]	UGC]	C	
		UUA] Leu	UCA]	UAA Stop	UGA Stop	A	
		UUG]	UCG]	UAG Stop	UGG Trp	G	
	C	CUU]	CCU]	CAU] His	CGU]	U	
		CUC] Leu	CCC] Pro	CAC]	CGC] Arg	C	
		CUA]	CCA]	CAA] Gln	CGA]	A	
		CUG]	CCG]	CAG]	CGG]	G	
	A	AUU]	ACU]	AAU] Asn	AGU] Ser	U	
		AUC] Ile	ACC] Thr	AAC]	AGC]	C	
		AUA]	ACA]	AAA] Lys	AGA] Arg	A	
		AUG Met or start	ACG]	AAG]	AGG]	G	
	G	GUU]	GCU]	GAU] Asp	GGU]	U	
		GUC] Val	GCC] Ala	GAC]	GGC] Gly	C	
		GUA]	GCA]	GAA] Glu	GGA]	A	
		GUG]	GCG]	GAG]	GGG]	G	

TACCTCTTGGGATAGCACATT
AUGGAGAACCCUAUCGUGUAA
MET Glu Asn Pro Ile Val



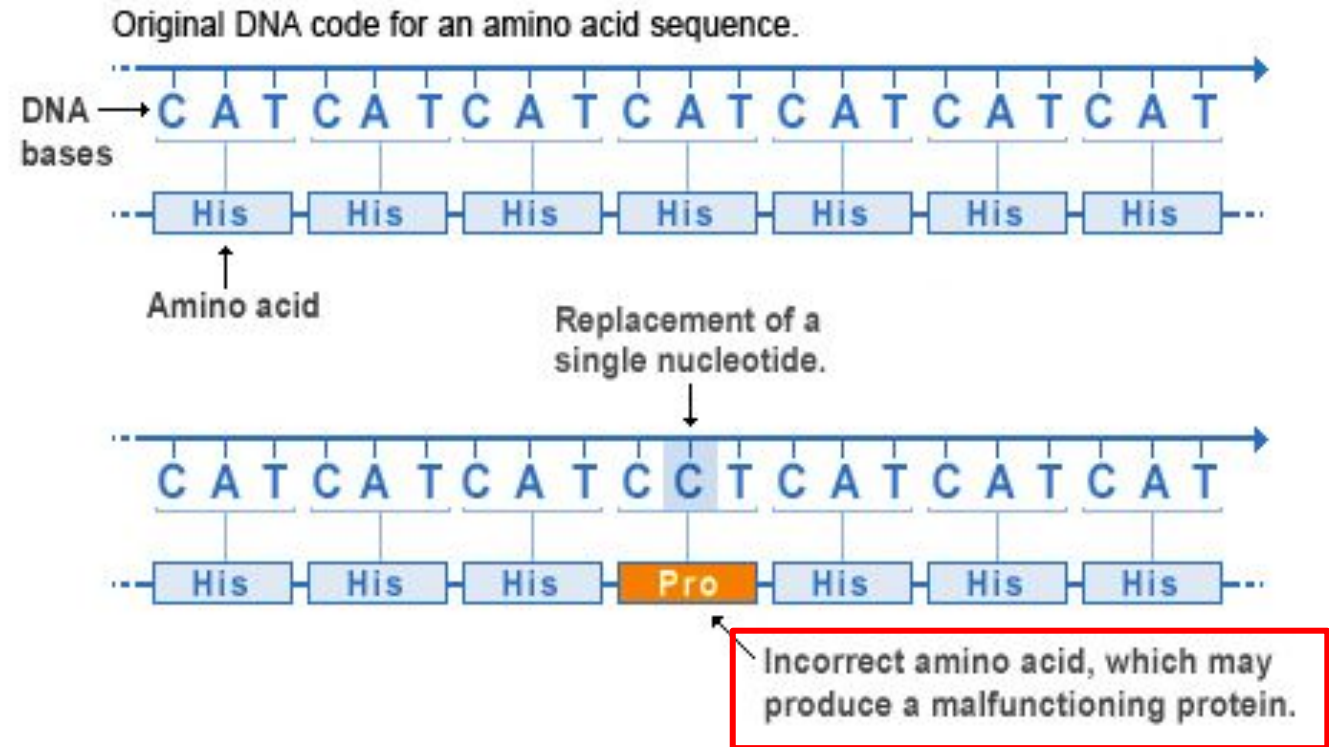
		Second Base					
		U	C	A	G		
First Base	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA } STOP UAG }	UGU } Cys UGC } UGA } STOP UGG } Trp	U C A G	Third Base
	C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } CGC } Arg CGA } CGG }	U C A G	
	A	AUU } AUC } Ile AUA } AUG } Met or Start	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 }	GCU } GCC } Ala GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } GGC } Gly GGA } GGG }	U C A G	

Transcription and Translation

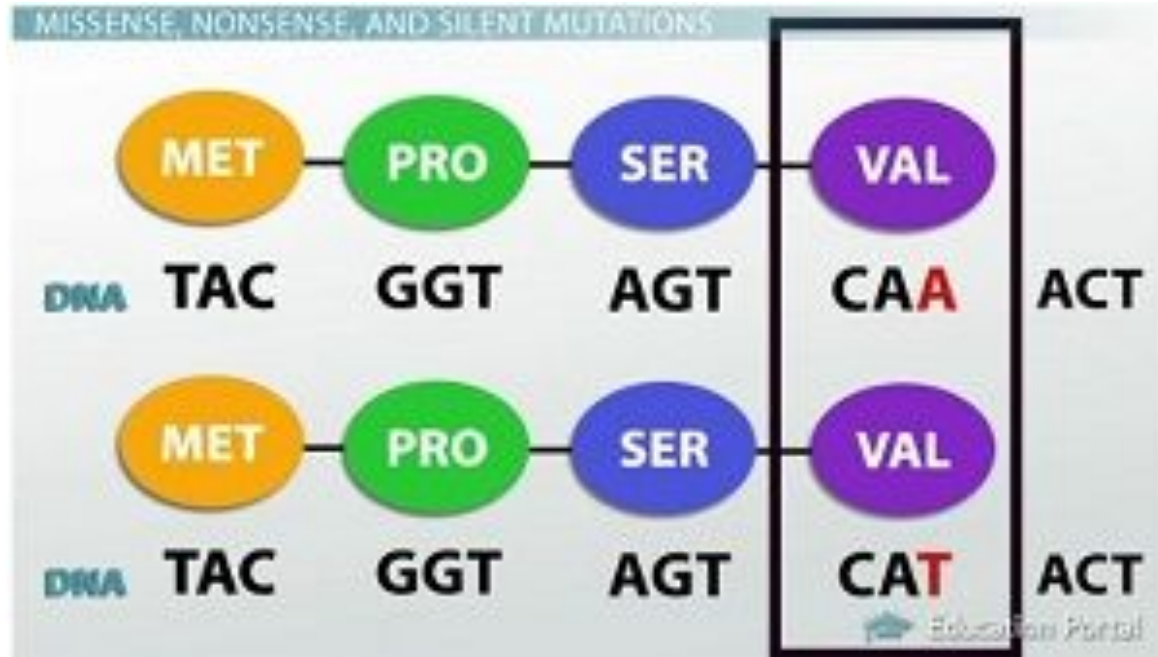


Gene Mutation

Point mutation- when one nucleotide (monomer of nucleic acids such as DNA) is replaced with a different nucleotide.



Gene Mutation



A silent mutation occurs when a nucleotide is changed, but the change results in the same amino acid inserted into the polypeptide made from that sequence of DNA.

Chromosomal Mutations that may occur during crossing-over & meiosis

