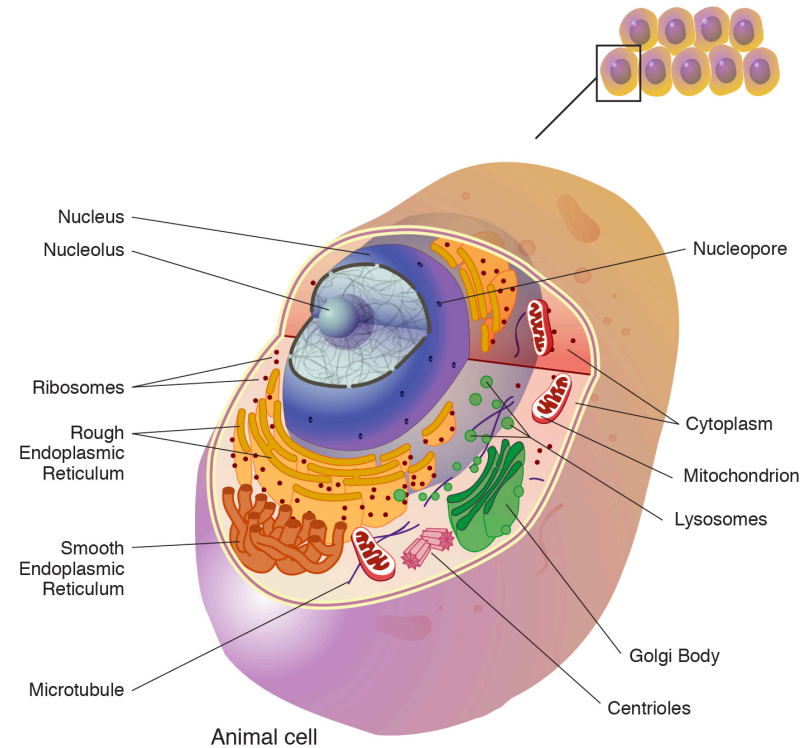


CMSC 423: Introduction to Biology and Bioinformatics

Part 1

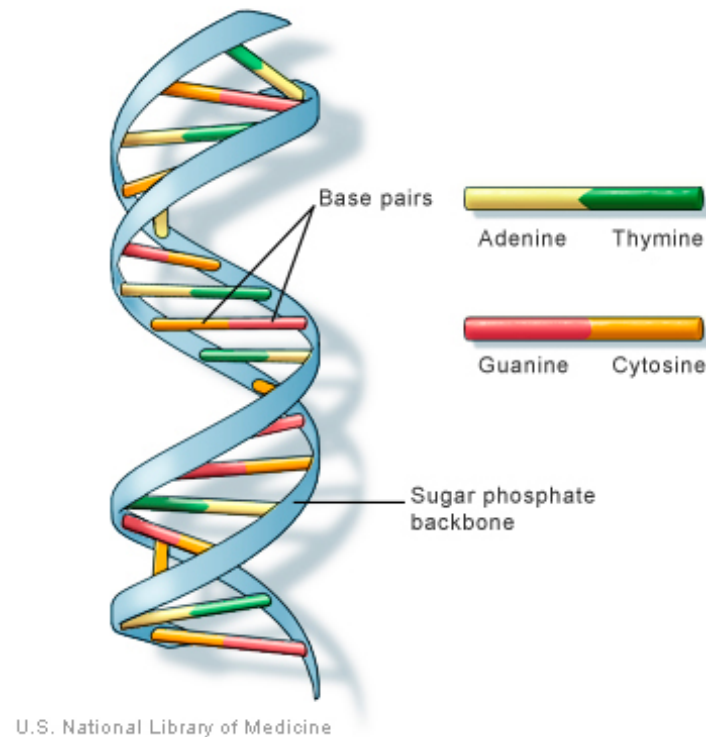
The Cell

- Basic unit of life of all known organisms
- Stores genetic material, including deoxyribonucleic acid (DNA) and RNA (ribonucleic acid)



<https://www.genome.gov/genetics-glossary/Cell>

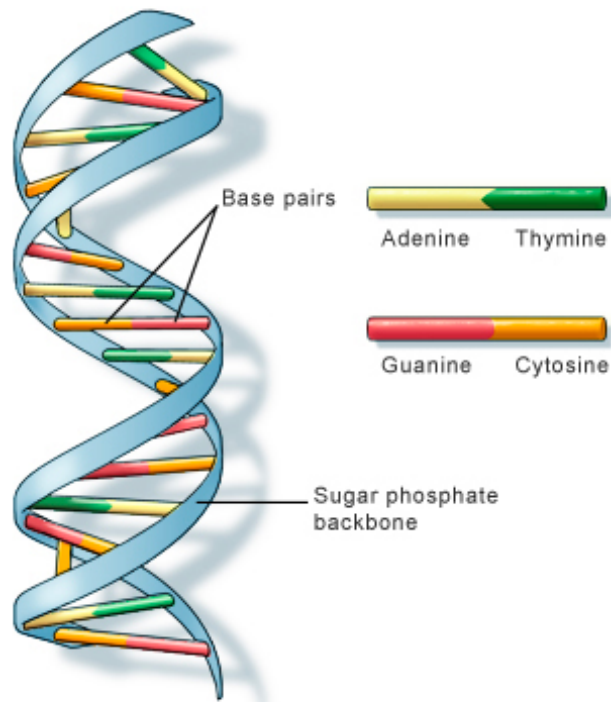
DNA- the code of life



- Stores genetic information
- Consists of four types of bases (A, T, C, G)
- Nucleotide=base + sugar + phosphate
- Purines (A, G) form base pairs with pyrimidines (T, C)
- Double helix

<https://ghr.nlm.nih.gov/primer/basics/dna>

DNA- the code of life



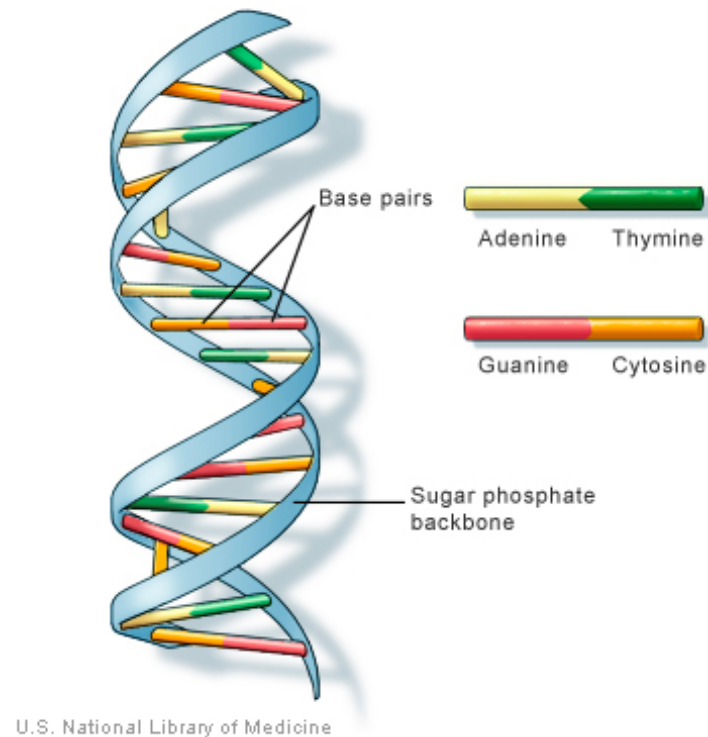
U.S. National Library of Medicine

- Each strand is the **reverse complement** of each other

ATATCAG

<https://ghr.nlm.nih.gov/primer/basics/dna>

DNA- the code of life



ATATCAG

TATAGTC (Complement)



CTGATAT (Reverse Complement)

<https://ghr.nlm.nih.gov/primer/basics/dna>



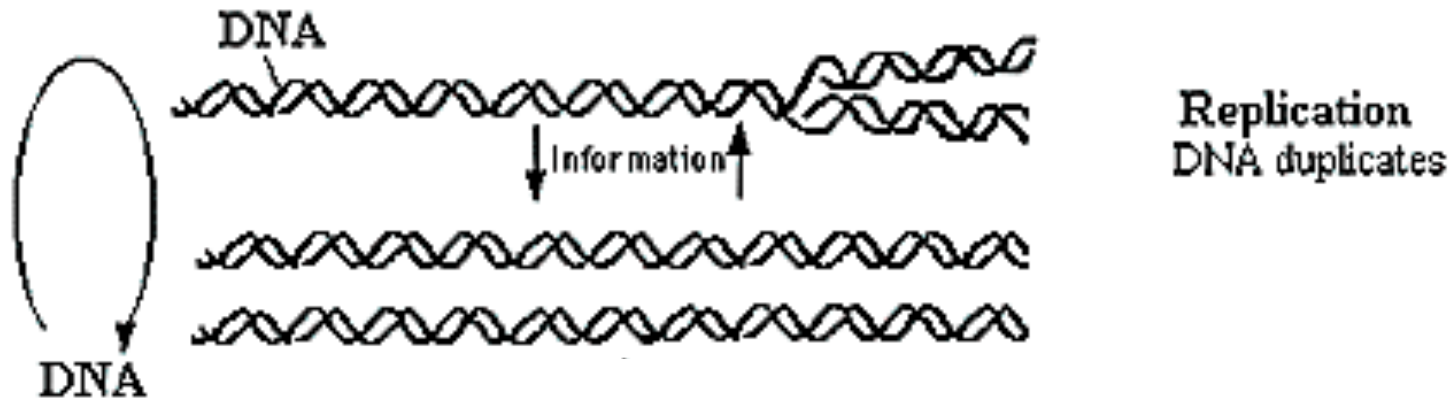
and Think

Why is DNA double stranded?



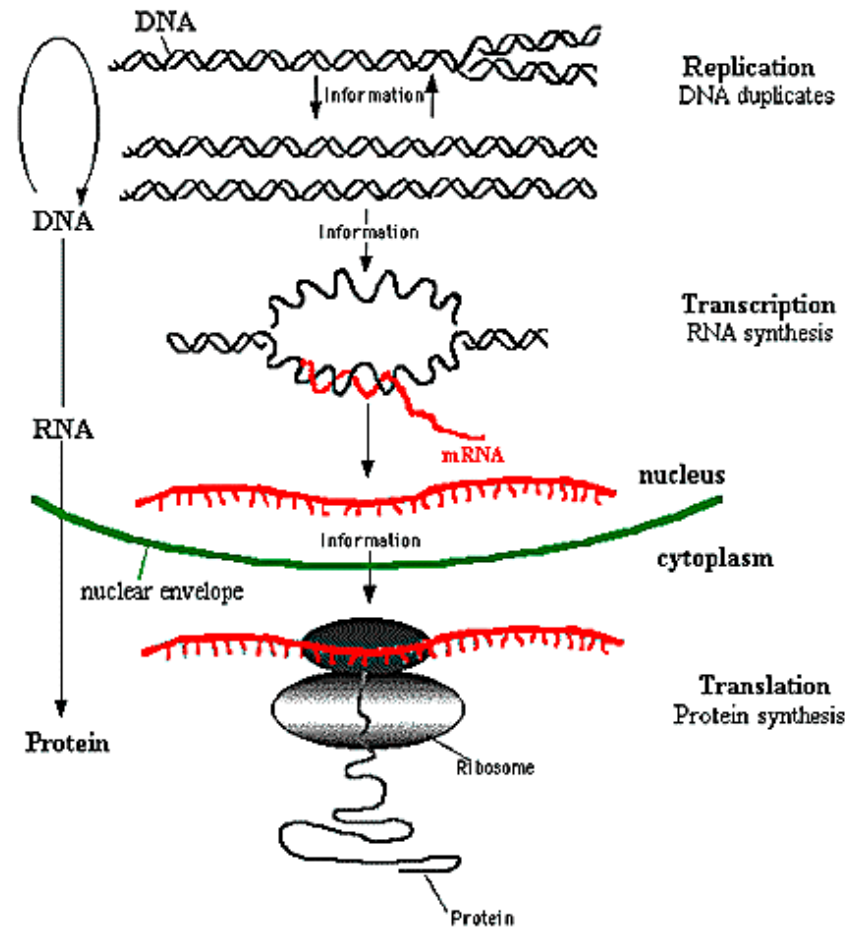
and Think

Why is DNA double stranded?

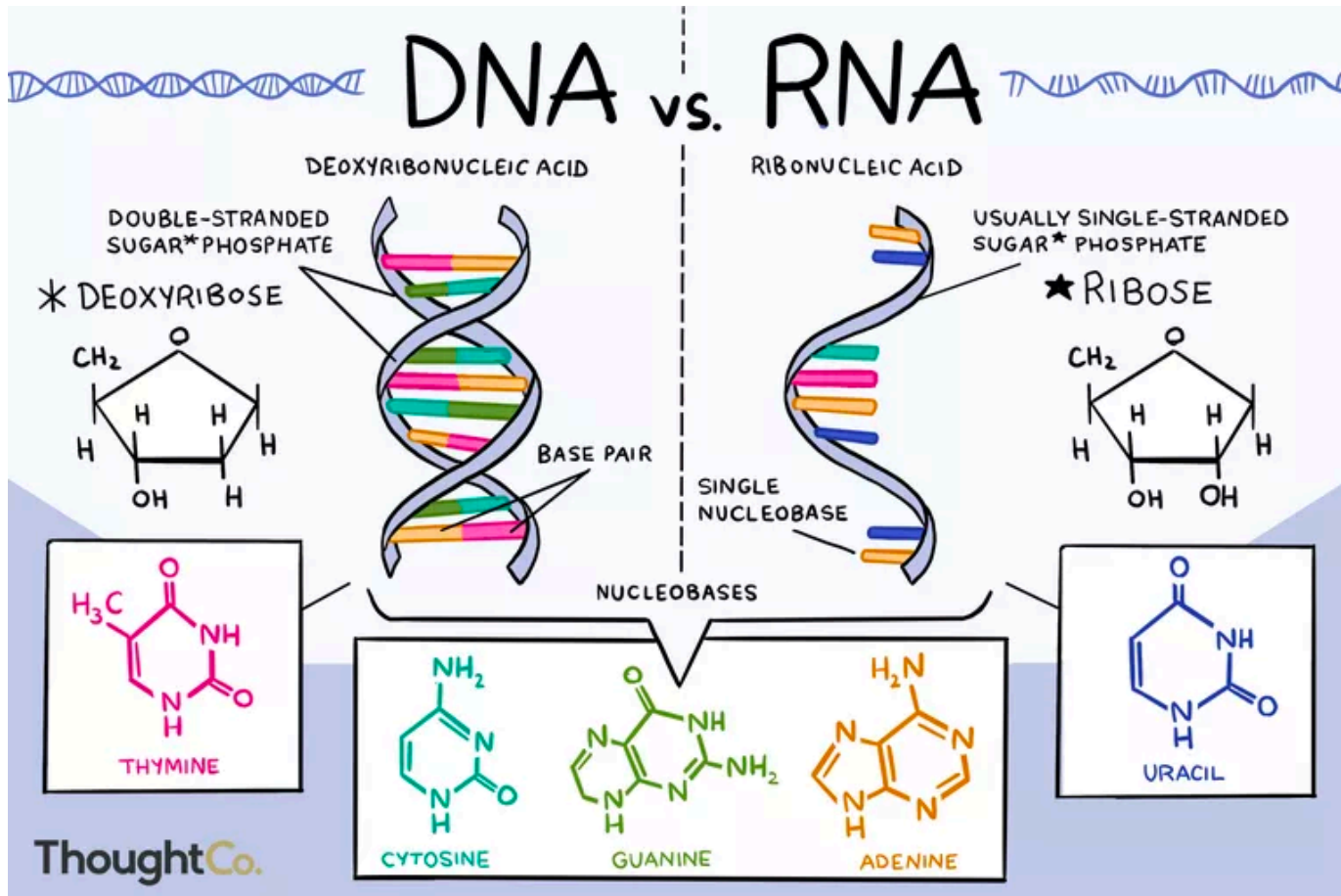


The Central Dogma

- **Replication** of DNA
- **Transcription** of DNA to RNA
- **Translation** of RNA to proteins

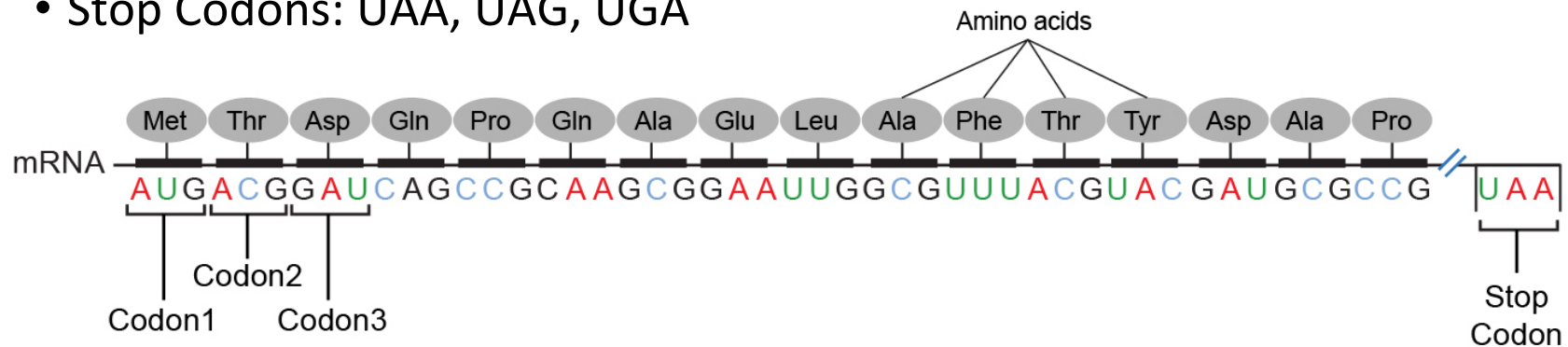


The Central Dogma of Molecular Biology



Genes = transcribed segments of DNA

- Genes are read in sets of 3 nucleotides (codons) during translation
- Each combination codes for one of 20 amino-acids – the building blocks for proteins
- Start codon: AUG (also amino-acid Methionine)
- Stop Codons: UAA, UAG, UGA



<https://www.genome.gov/genetics-glossary/Codon>



and Think

How many possible combinations of
codons are there?



and Think

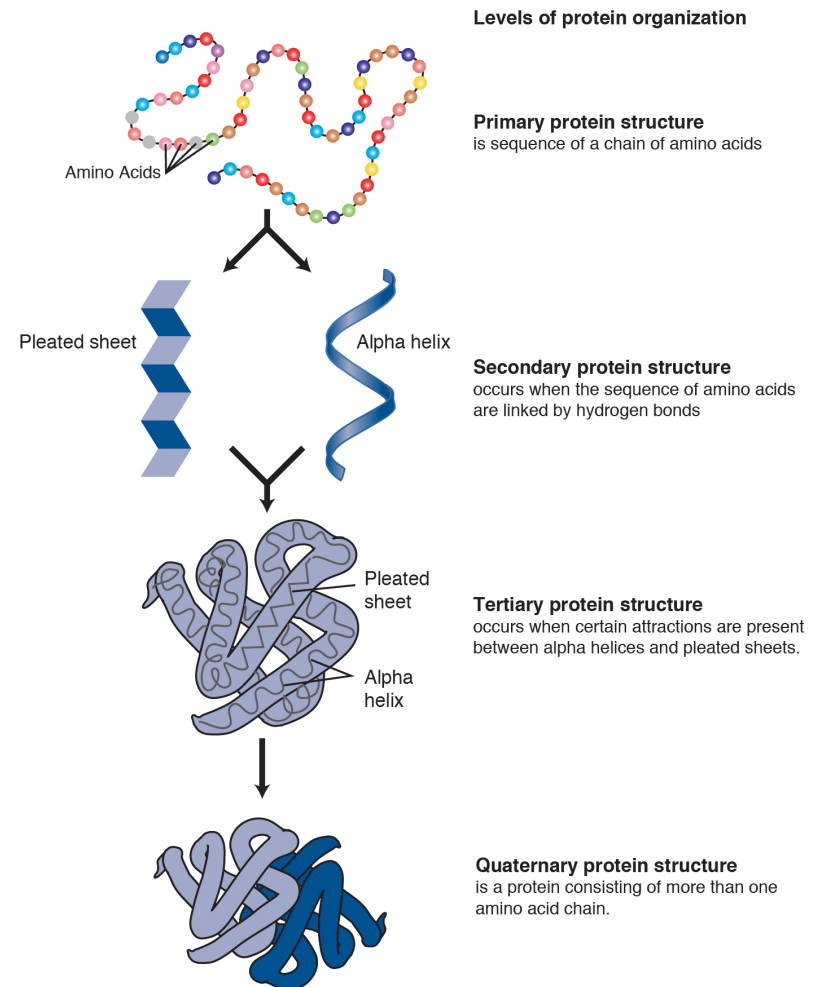
How many possible combinations of
codons are there?

$$4^3 = 64$$

		Second letter				
		U	C	A	G	
First letter	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA Stop UAG Stop	UGU } Cys UGC } UGA Stop 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 } Ile AUA } AUG Met	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

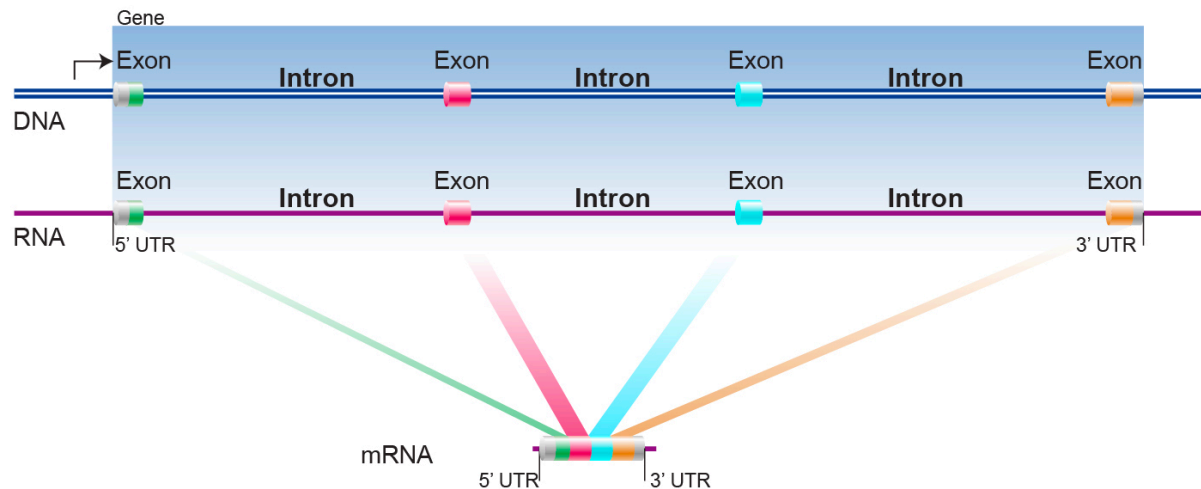
Proteins

- One or more long chains of amino acids linked by peptide bonds
- Fold into 3D structure of lowest energy
- Protein folding is a difficult computational problem



Splicing

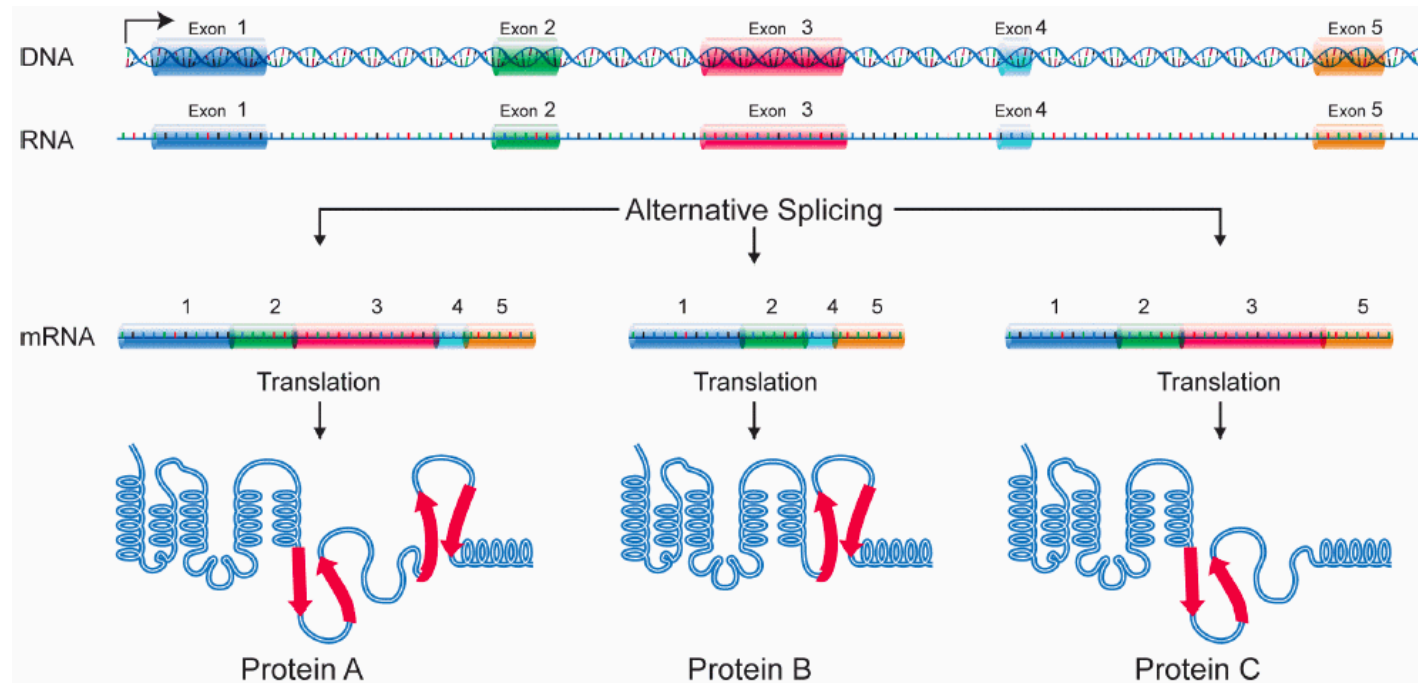
- Genes contain exons (portions that code for amino acids) and introns (portions that do not code for amino acids)
- During splicing, introns are removed and exons are joined together



<https://www.genome.gov/genetics-glossary/Intron>

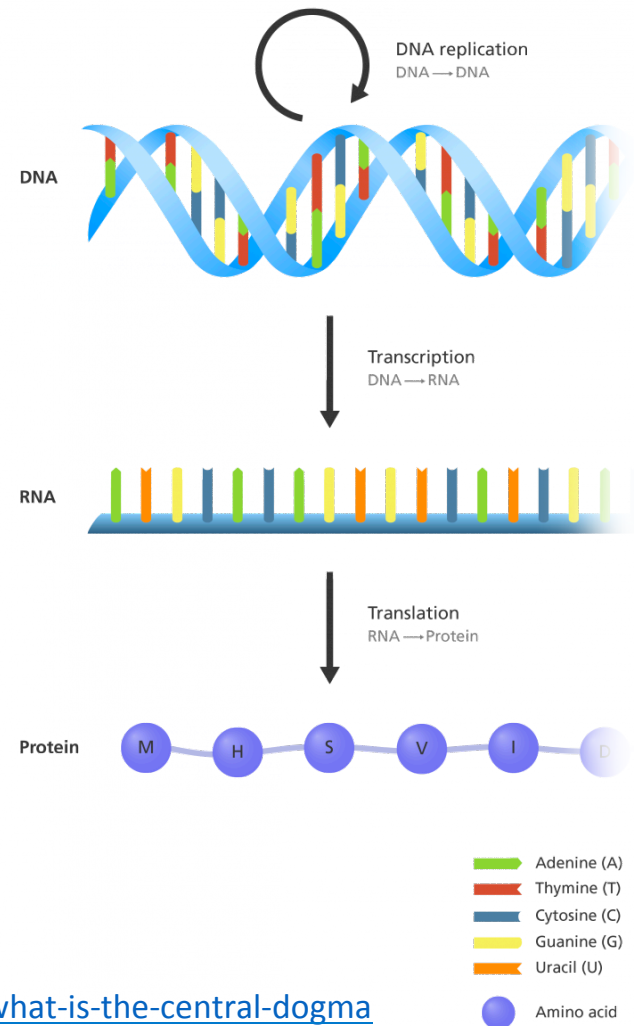
Alternative Splicing

- Enables a single gene to code for multiple proteins



Summary

- DNA encodes genetic information necessary for life
- DNA replicates
- DNA transcribes into RNA
- mRNA is translated into proteins
- These processes make up the Central Dogma of Molecular Biology



<https://www.yourgenome.org/facts/what-is-the-central-dogma>