DNA, RNA, and Protein

Central Dogma

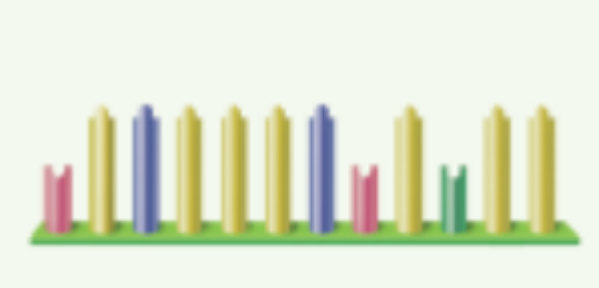
- DNA → RNA → Protein

RNA

RNA	DNA
Uracil	Thymine
Single stranded	Double stranded
Found in the Nucleus and in the cytoplasm as well	Only found inside the Nucleus

There are most commonly three types of RNA:

1. Messenger RNA (**mRNA**)



   - Form complementary to a single strand of DNA
   - Travel from **Nucleus to Ribosome** to instruct it to create proteins
2. Ribosomal RNA (**rRNA**)

   - Associates with proteins to **form ribosomes**

3. Transfer RNA (**tRNA**)

- Smaller RNA
- **Transports amino acids** to the ribosome

Transcription

In Transcription, **DNA is transcribed into mRNA**

- Happens **in the nucleus**
- After DNA is unzipped, **RNA Polymerase** binds to a strand to DNA and creates the **mRNA in the 3' → 5' direction (on the DNA)**
- The strand of DNA that's used to make the RNA is called the **template strand**
  - The other is called the **nontemplate strand**
- After creation is done, it will **leave the nuclear membrane** into the cytoplasm

RNA processing

- After the mRNA is made from the DNA, some of the sequence is not needed
  - Unneeded sections are called the **introns**
  - Needed sections are called **extrons**
- Before leaving the nucleus
  - Introns are removed by spliceozymes (a ribosome)
  - **Protective cap** added on the 5' side
  - **Long sequence of A's** added to the end (3' side)
- Sometimes unprocessed RNA is called **pre-mRNA** (in eukaryotic cells)

The Code

First Base	Second Base				Third Base
	U	C	A	G	
U	UUU phenylalanine	UCU serine	UAU tyrosine	UGU cysteine	U
	UUC phenylalanine	UCC serine	UAC tyrosine	UGC cysteine	C
	UUA leucine	UCA serine	UAA *stop*	UGA *stop*	A
	UUG leucine	UCG serine	UAG *stop*	UGG tryptophan	G
C	CUU leucine	CCU proline	CAU histidine	CGU arginine	U
	CUC leucine	CCC proline	CAC histidine	CGC arginine	C
	CUA leucine	CCA proline	CAA glutamine	CGA arginine	A
	CUG leucine	CCG proline	CAG glutamine	CGG arginine	G
A	AUU isoleucine	ACU threonine	AAU asparagine	AGU serine	U
	AUC isoleucine	ACC threonine	AAC asparagine	AGC serine	C
	AUA isoleucine	ACA threonine	AAA lysine	AGA arginine	A
	AUG *(start)* methionine	ACG threonine	AAG lysine	AGG arginine	G
G	GUU valine	GCU alanine	GAU aspartate	GGU glycine	U
	GUC valine	GCC alanine	GAC aspartate	GGC glycine	C
	GUA valine	GCA alanine	GAA glutamate	GGA glycine	A
	GUG valine	GCG alanine	GAG glutamate	GGG glycine	G

Second letter

	U	C	A	G	
U	UUU, UUC } Phe UUA, UUG } Leu	UCU, UCC, UCA, UCG } Ser	UAU, UAC } Tyr UAA Stop UAG Stop	UGU, UGC } Cys UGA Stop UGG Trp	U C A G
C	CUU, CUC, CUA } Leu	CCU, CCC, CCA } Pro	CAU, CAC } His CAA } Gln	CGU, CGC, CGA } Arg	U C A

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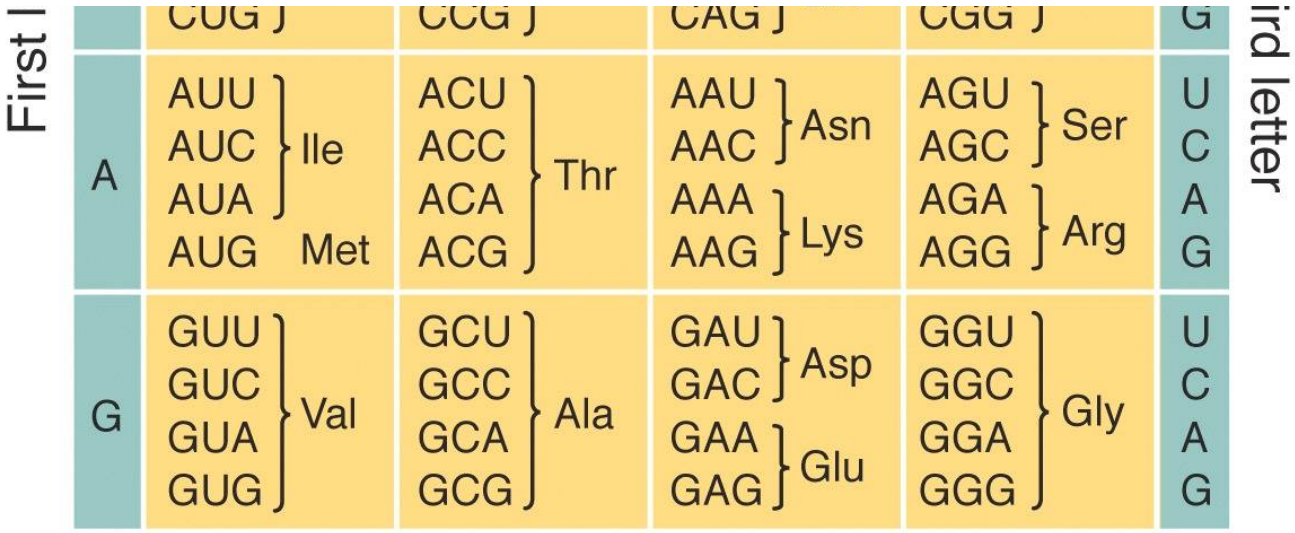

- Hypothesised that protein synthesis instructions are stored in the DNA
- There are **20 types of amino acids**, so there must be more than 20 combinations of DNA
- Later it was found that **three-base codes** were what encoded DNA (giving 64 combinations)
- Group of three pairs is called a **codon**

Translation

1. mRNA's **5' end** connects to the ribosome
2. tRNA folds into a **clover** leaf shape
3. tRNA is activated by an enzyme that attaches an **amino acid** to the 3' end (corresponding to its anticodon)
4. In the middle of the tRNA there is an **anticodon** (codon complementary to a codon on the mRNA)

The role of the ribosome

- The ribosome is made of two parts and are not connected when protein translation is not happening
- Contains three grooves: A, P, E

1. Once the mRNA associates with the ribosome, a tRNA with anticodon CAU will bind to the AUG (start) codon in the mRNA (5' end)
2. Then another tRNA will **attach in the A groove** with an anticodon to the next codon on the tRNA, **carrying its corresponding amino acid**
3. the rRNA in the ribosome **catalyses the two tRNAs to join the amino acids** together with **peptide bonds** into a string, moving the amino acid string from the tRNA in position P to the one in position A
4. tRNA continues to **enter the A site**, pushing the one in the A site into the P site and the one in the P site into the E site and finally, the last tRNA will **leave the E site**

5. the string of mRNA is **read until a stop codon appears** and the string of amino acids is complete
6. Then the string gets folded in the golgi body

tRNA

- They are reusable
- Have a specific anticodon
- They can only bind to a particular amino acid corresponding to the anticodon
- They use the ribosome to help produce amino acid strings