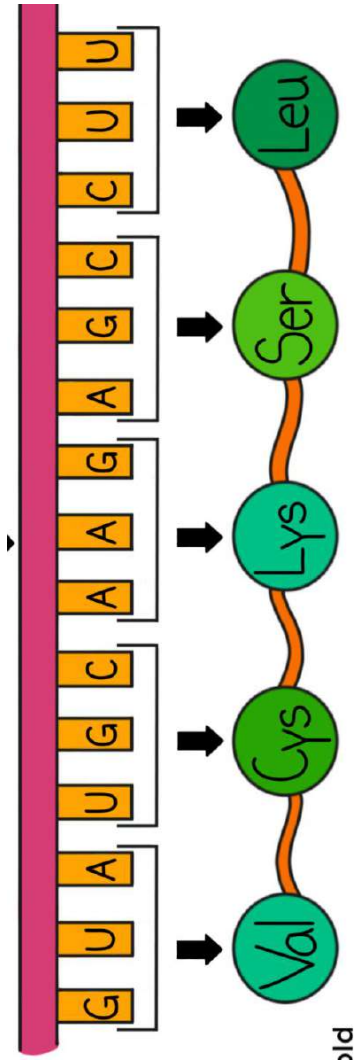
Lesson 5- Protein Synthesis Part 2- mRNA to amino acid



Learning Objectives:

- Identify the role of the ribosome in protein synthesis
- Identify the building blocks of protein
- Use the Universal Genetic Code Chart to determine an amino acid sequence from a strand of mRNA
- Explain why the sequence of amino acids is important to the protein

AIM: *How does the ribosome use the mRNA message to build a functional protein?*

- **Recall:** DNA can be used to make mRNA using the DNA → RNA base pairing rules. **mRNA** (messenger RNA) leaves the nucleus and goes to the **ribosome**- *the site of protein synthesis*
- The ribosome will read the mRNA message ***3 bases at a time***. Once again, the ribosome will read the mRNA in groups of 3 letters at a time. Look at the mRNA below. It's been "spaced out" into groups of 3 so we can think about how the ribosome will read this message.

"Gene"

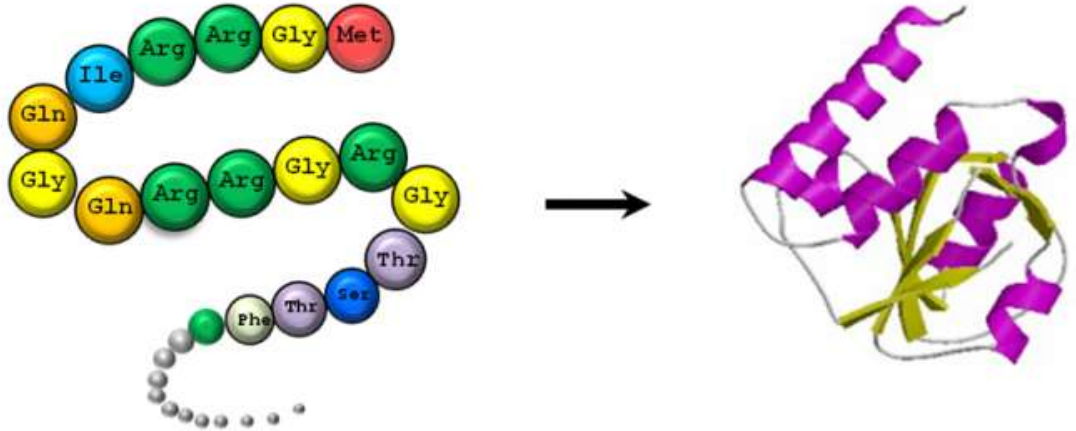
DNA template:	C T A	G G T	A C A	G C G
mRNA message	G A U	C C A	U G U	C G C

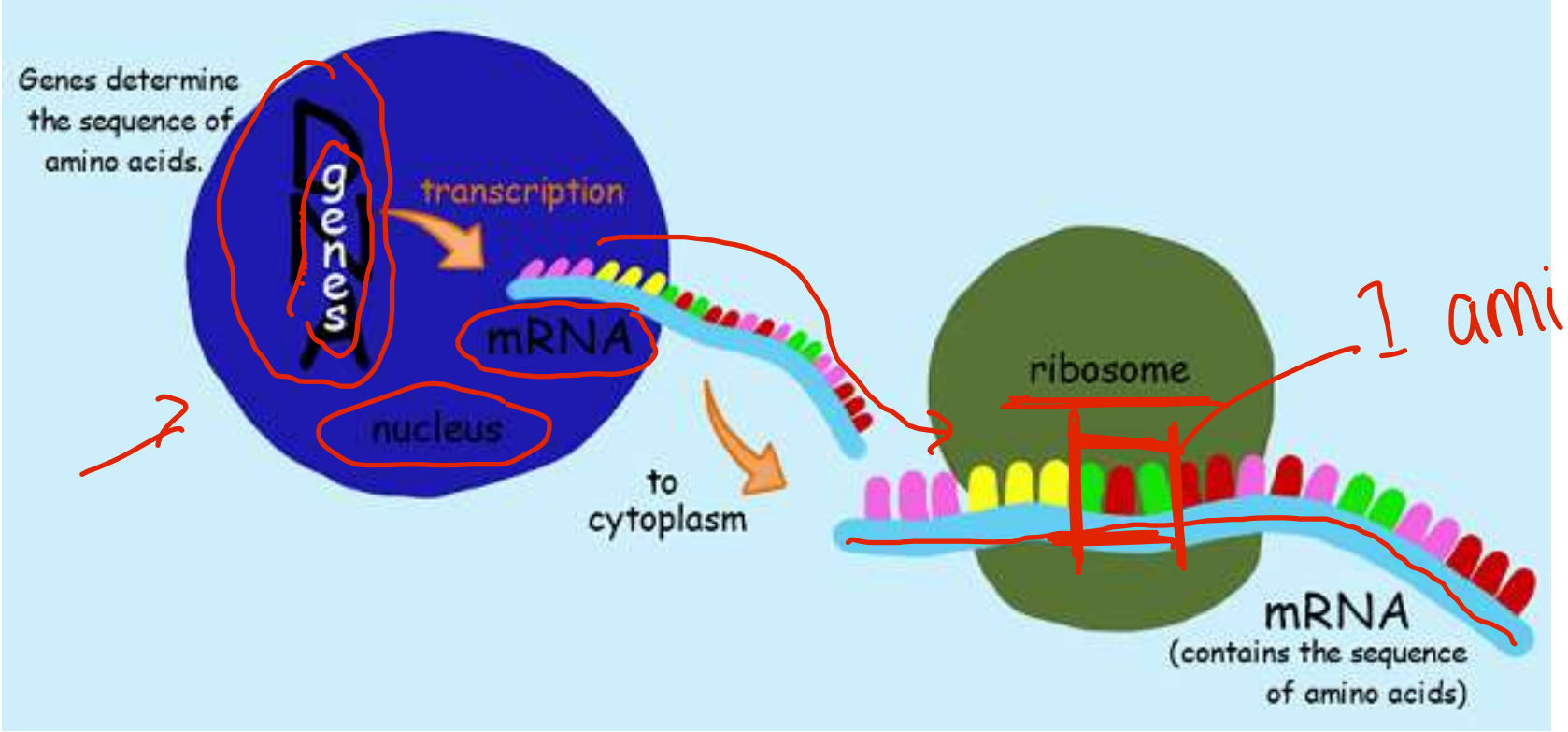
3?

- You should know from the beginning of the year that ***amino acids are the building blocks of proteins.*** Did you know that there are 20 *different* amino acids? And, that each protein is built from a specific combination of amino acids? Here is where the mRNA message comes in.
- Every *3 mRNA bases* codes for **1 amino acid**. The *sequence of bases* in the mRNA message will instruct the ribosome *which amino acids* are needed to build the protein.
- The *sequence of amino acids* is very important, because it will determine the final **SHAPE** of the protein. As you might remember, the shape of most proteins determines their **jobs**. Enzymes, receptors, hormones, and antibodies are all molecules *whose function depends on their SHAPE*.
- If there is a change in the amino acid sequence, there could be a *change in the shape of the protein*, and then it may no longer be able to perform its function.

The 20 amino acids:

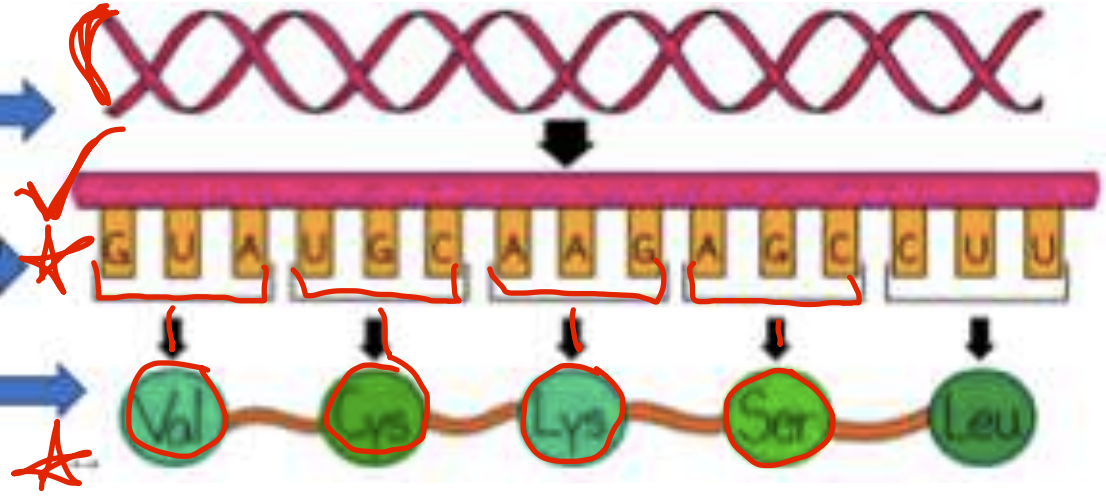
Alanine	Methionine
Cisteine	Asparagine
Aspartic Acid	Proline
Glutamic Acid	Glutamine
Phenylalanine	Arginine
Glycine	Serine
Histidine	Threonine
Isoleucine ile	Valine
Lysine	Tryptophan
Leucine	Tyrosine

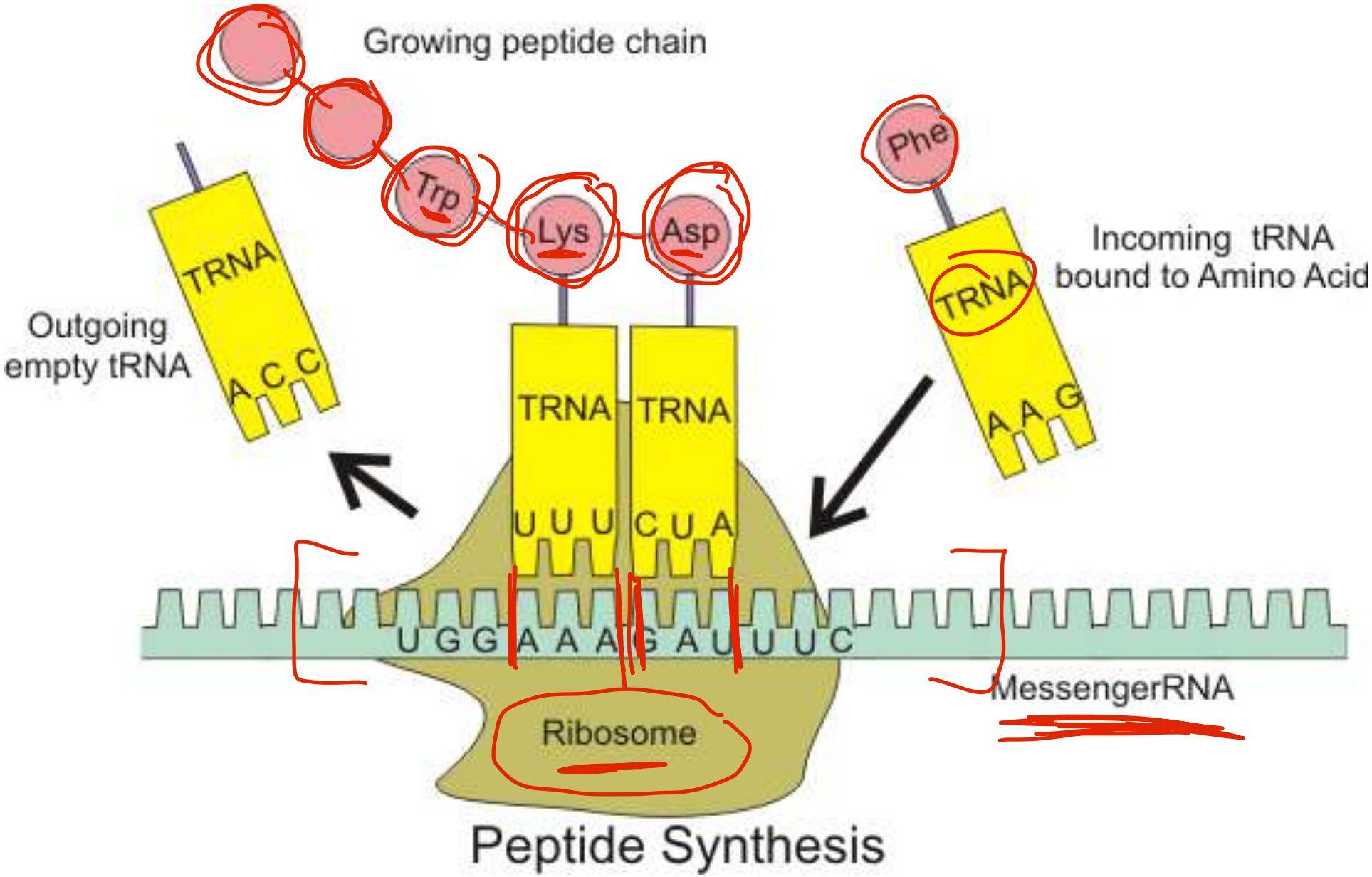




1 amino acids

DNA is used to make mRNA. This happens in the nucleus.
The mRNA goes to the ribosome. The ribosome reads the mRNA 3 bases at a time.
Every 3 bases codes for 1 amino acid. The sequence of amino acids will determine the SHAPE of the protein.





Peptide Synthesis

*How do I know **which** amino acid the ribosome will code for if I am given an mRNA sequence? Do I have to memorize all of the amino acids?*

- To determine which amino acid a group of 3 mRNA bases codes for, you must use the **universal genetic code chart** →
- What amino acid does "AUU" code for?
- The first base is **A**, so I will look in the **A row**. The second base is **U**, so I will look in in the **U column**. From here, I can see that AUU } ILE
- ILE is an abbreviation for "*isoleucine-*" one of the 20 amino acids.
- What amino acid for "GAC" code for? Look in the **G row**, the **A column**, and see that GAC } ASP
- ASP is an abbreviation for "*aspartic acid-*" one of the 20 amino acids

Universal Genetic Code Chart
Messenger RNA Codons and the Amino Acids for Which They Code

FIRST BASE	SECOND BASE: U	SECOND BASE: C	SECOND BASE: A	SECOND BASE: G	THIRD BASE
U	UUU, UUC } PHE UUA, UUG } LEU	UCU, UCC, UCA, UCG } SER	UAU, UAC } TYR UAA, UAG } STOP	UGU, UGC } CYS UGA } STOP UGG } TRP	U C A G
C	CUU, CUC, CUA, CUG } LEU	CCU, CCC, CCA, CCG } PRO	CAU, CAC } HIS CAA, CAG } GLN	CGU, CGC, CGA, CGG } ARG	U C A G
A	AUU, AUC, AUA } ILE AUG } MET or START	ACU, ACC, ACA, ACG } THR	AAU, AAC } ASN AAA, AAG } LYS	AGU, AGC } SER AGA, AGG } ARG	U C A G
G	GUU, GUC, GUA, GUG } VAL	GCU, GCC, GCA, GCG } ALA	GAU, GAC } ASP GAA, GAG } GLU	GGU, GGC, GGA, GGG } GLY	U C A G

CAU

his.

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U	UUU, UUC: PHE UUA, UUG: LEU	UCU, UCC, UCA, UCG: SER	UAU, UAC: TYR UAA, UAG: STOP	UGU, UGC: CYS UGA: STOP UGG: TRP	U C A G
C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
A	AUU, AUC, AUA: ILE AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN AAA, AAG: LYS	AGU, AGC: SER AGA, AGG: ARG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

[GGU]

gly

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	UUA, UUG: LEU		UAA, UAG: STOP	UGA: STOP	C
				UGG: TRP	A
					G
C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS	CGU, CGC, CGA, CGG: ARG	U
			CAA, CAG: GLN		C
					A
					G
A	AUU, AUC, AUA: ILE	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN	AGU, AGC: SER	U
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					A
					G
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			GAA, GAG: GLU		C
					A
					G

UUA

leu

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C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
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CGU

arg

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C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
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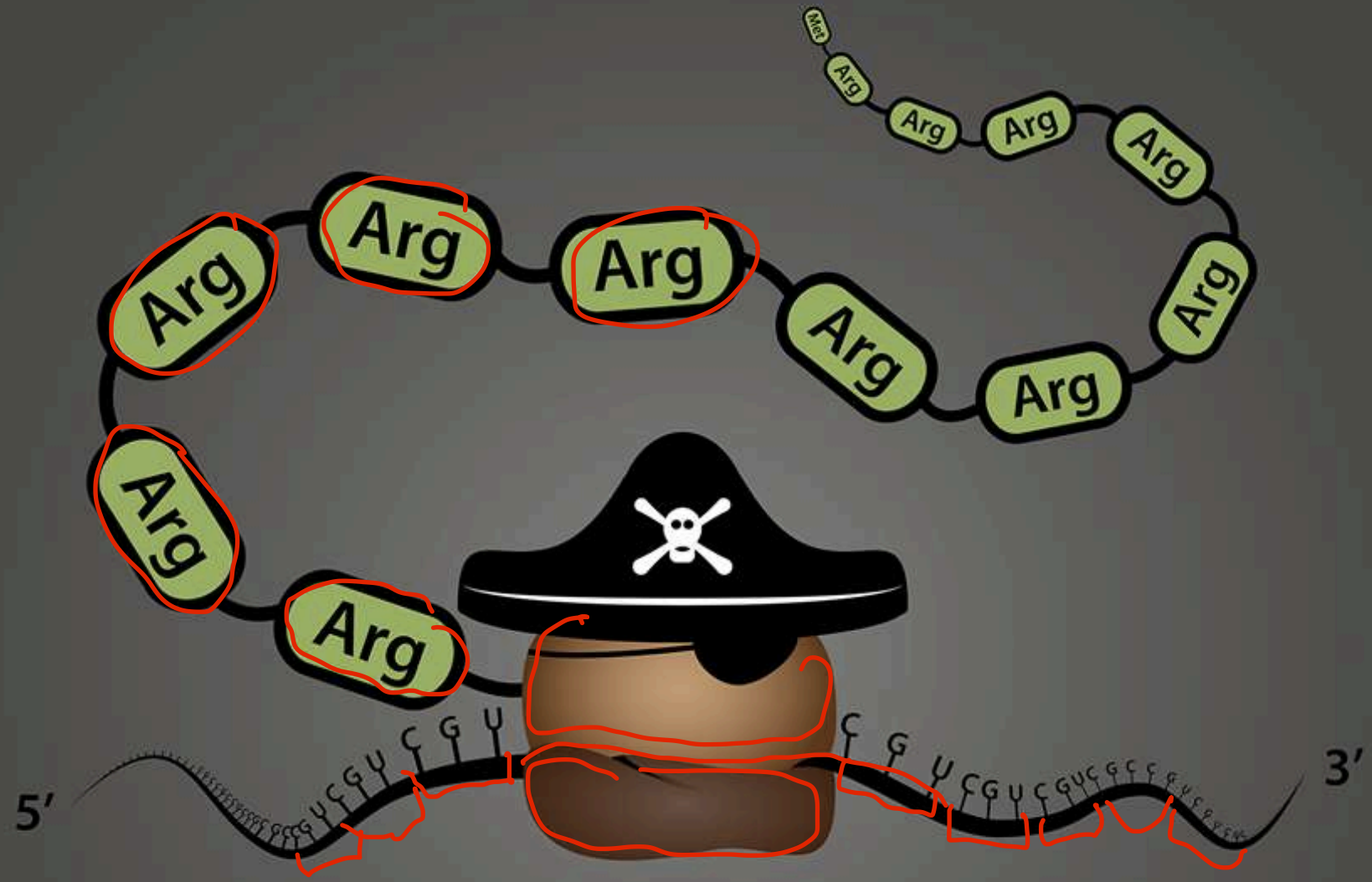
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G



Pirate Ribosome

mRNA: C A U A C A G U G

Amino acids: → his thr val

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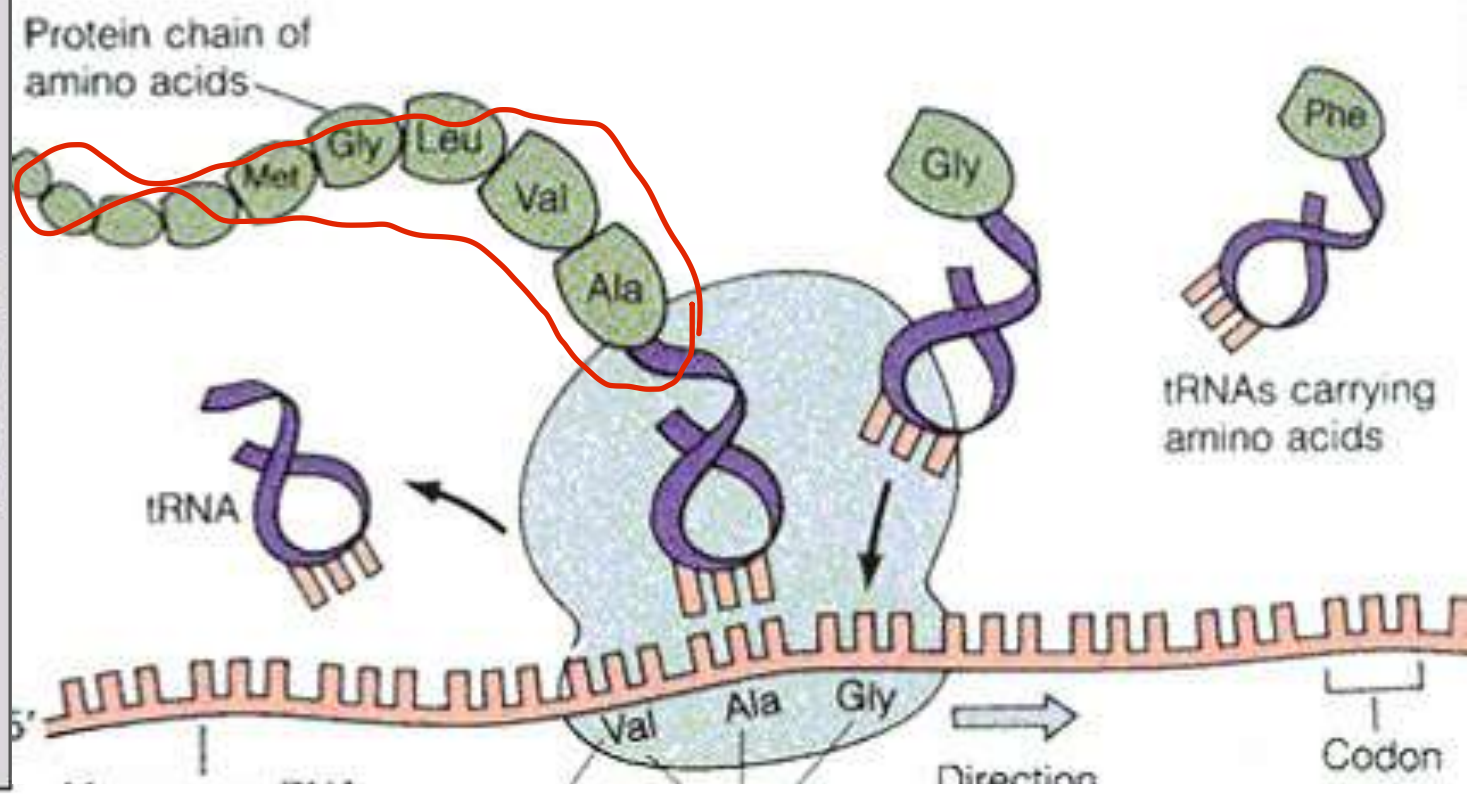
	UUC PHE	UCC SER	UAC TYR	UGC CYS	C
	UUA LEU	UCA SER	UAA STOP	UGA STOP	A
	UUG LEU	UCG SER	UAG STOP	UGG TRP	G
C	CUU LEU	CCU PRO	CAU HIS	CGU ARG	U
	CUC LEU	CCC PRO	CAC HIS	CGC ARG	C
	CUA LEU	CCA PRO	CAA GLN	CGA ARG	A
	CUG LEU	CCG PRO	CAG GLN	CGG ARG	G
A	AUU ILE	ACU THR	AAU ASN	AGU SER	U
	AUC ILE	ACC THR	AAC ASN	AGC SER	C
	AUA ILE	ACA THR	AAA LYS	AGA ARG	A
	AUG MET or START	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 VAL	GCG ALA	GAG GLU	GGG GLY	G



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read the mRNA 3 bases at a time, and builds a chain of amino acids

SHAPE → JOB