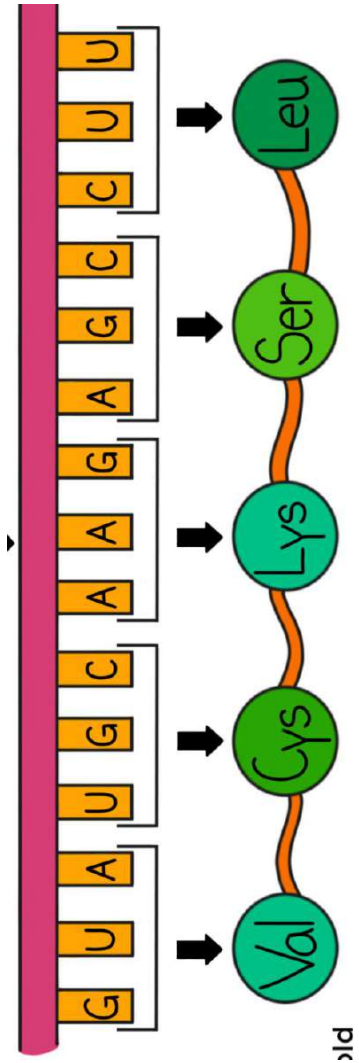
Lesson 5- Protein Synthesis Part 2- mRNA to amino acid



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?***

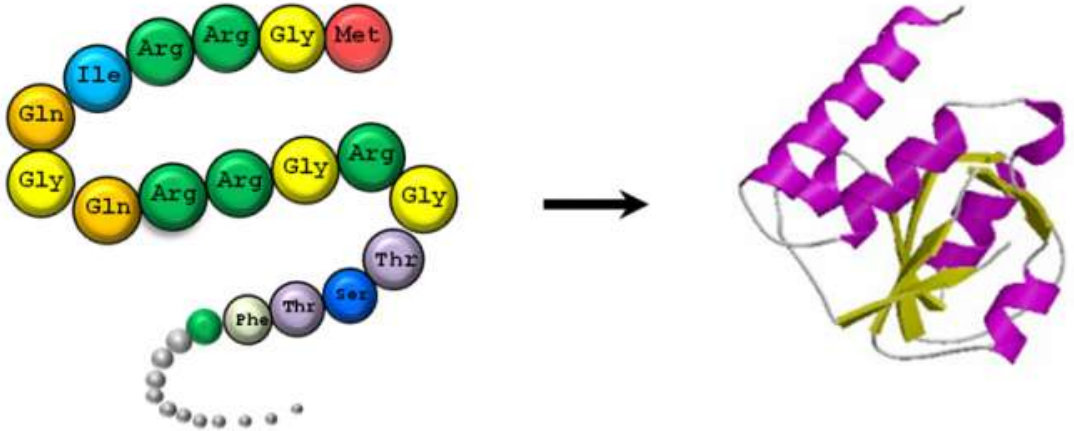
- **Recall:** DNA can be used to make mRNA using the DNA → RNA base pairing rules. **mRNA** (messenger RNA) leaves the nucleus and goes to the **ribosome**- *the site of protein synthesis*
- The ribosome will read the mRNA message ***3 bases at a time***. Once again, the ribosome will read the mRNA in 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.

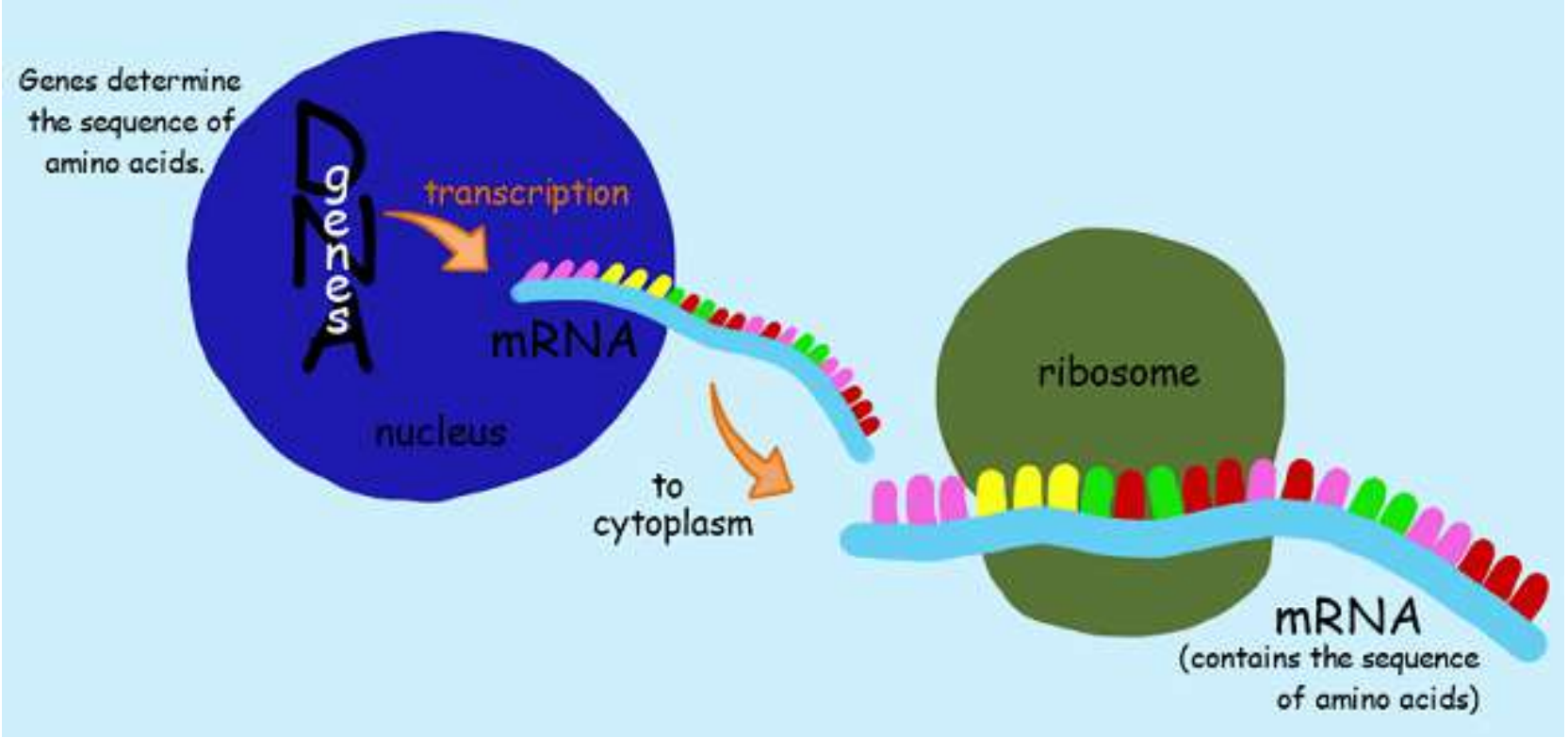
mRNA message G A U C C A U G U C G C

- 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	Valine
Lysine	Tryptophan
Leucine	Tyrosine

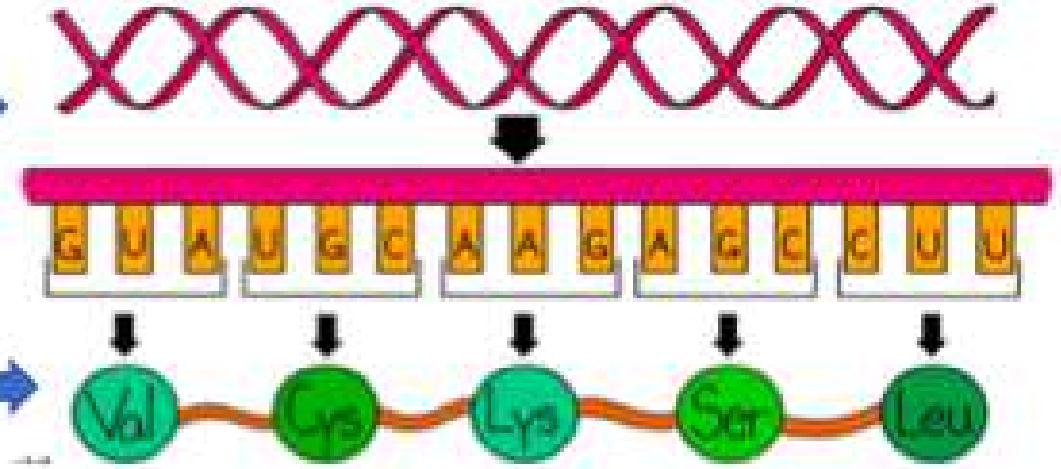


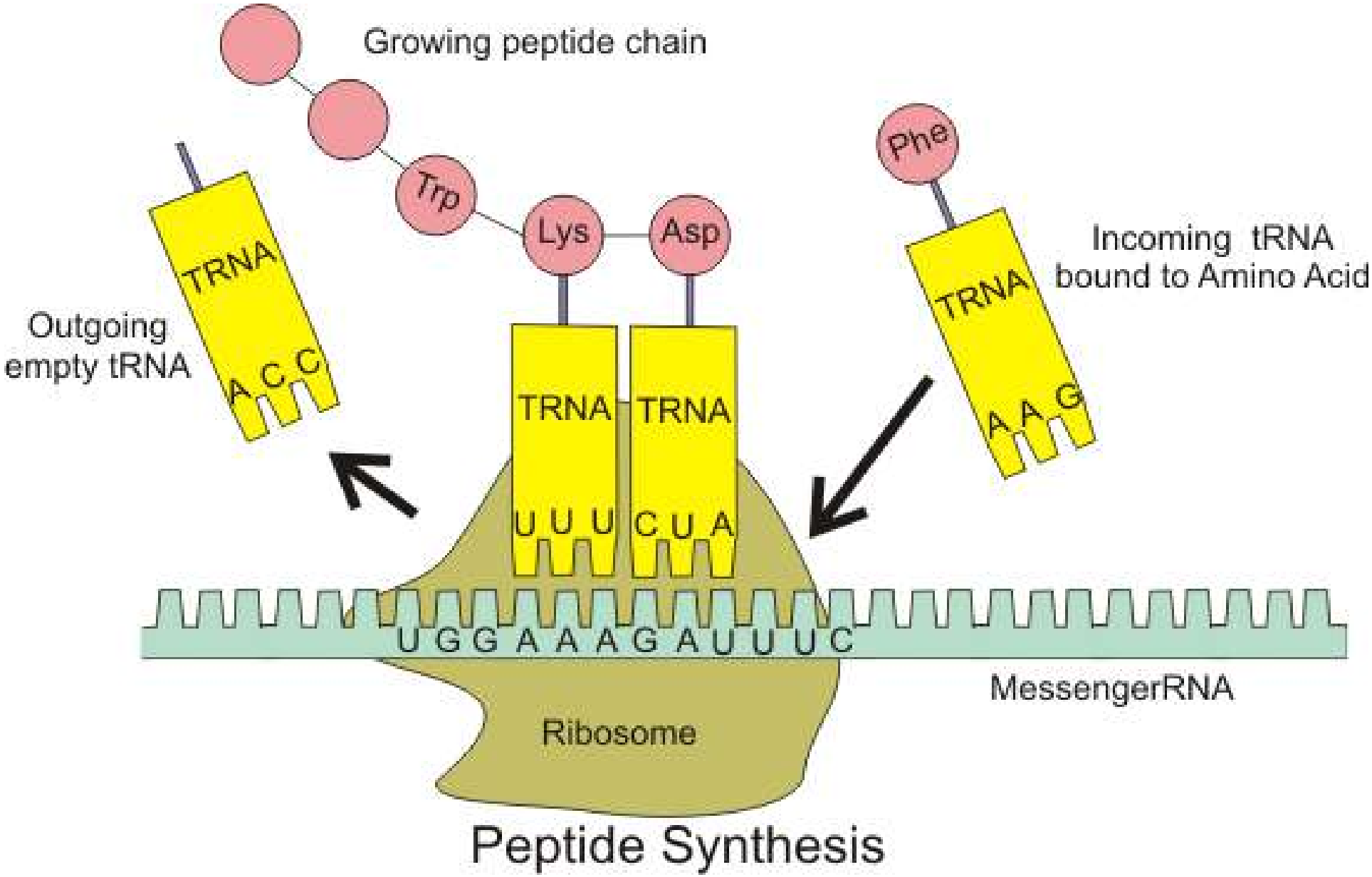


DNA is used to make mRNA. This happens in the nucleus.

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?*

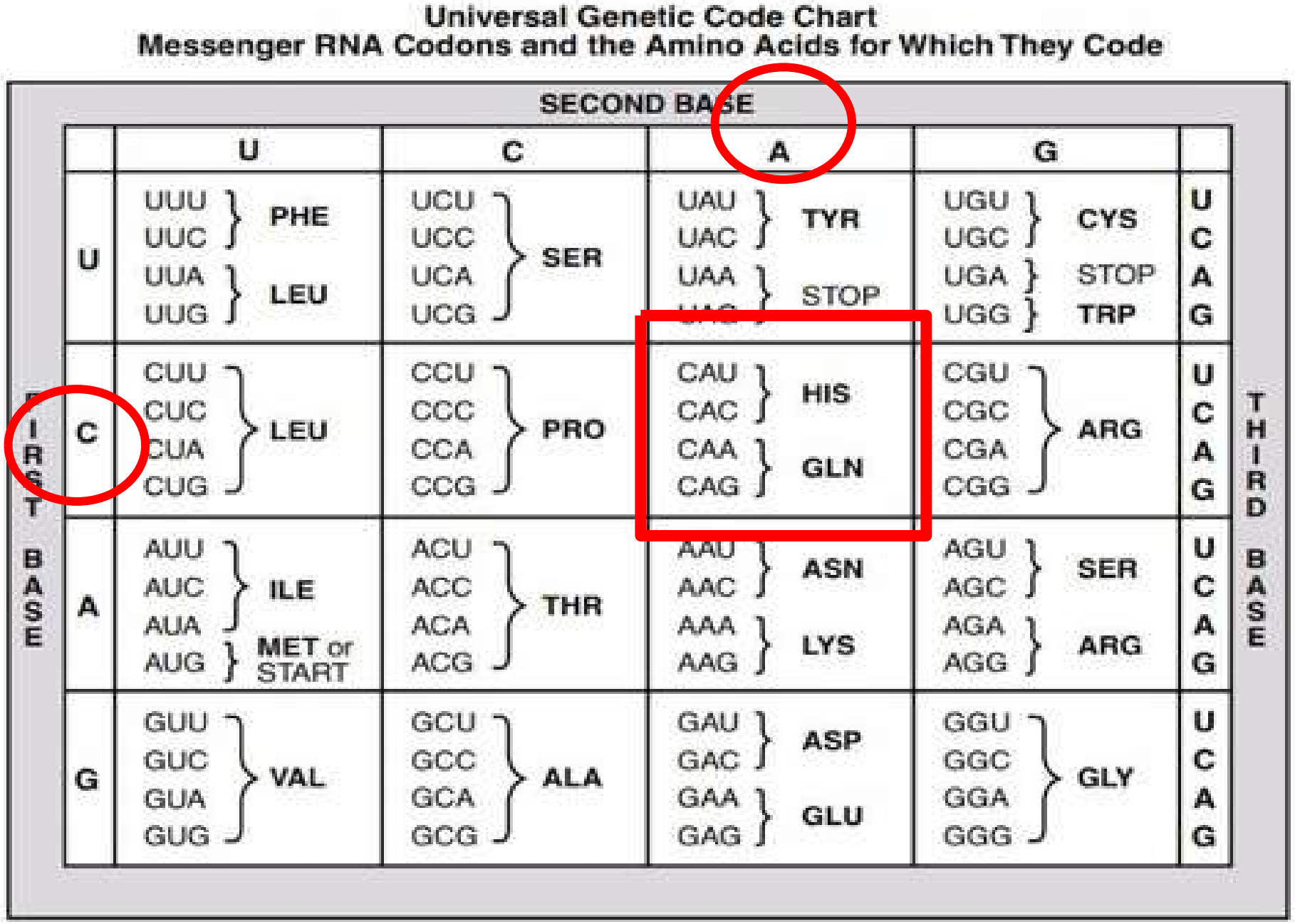
- To determine which amino acid a group of 3 mRNA bases codes for, you must use the **universal genetic code chart** →
- What amino acid does "AUU" code for?
- The first base is **A**, so I will look in the **A row**. The second base is **U**, so I will look in in the **U column**. From here, I can see 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 } PHE UUC } PHE UUA } LEU UUG } LEU	UCU } SER UCC } SER UCA } SER UCG } SER	UAU } TYR UAC } TYR UAA } STOP UAG } STOP	UGU } CYS UGC } CYS UGA } STOP UGG } TRP	U C A G
C	CUU } LEU CUC } LEU CUA } LEU CUG } LEU	CCU } PRO CCC } PRO CCA } PRO CCG } PRO	CAU } HIS CAC } HIS CAA } GLN CAG } GLN	CGU } ARG CGC } ARG CGA } ARG CGG } ARG	U C A G
A	AUU } ILE AUC } ILE AUA } ILE AUG } MET or START	ACU } THR ACC } THR ACA } THR ACG } THR	AAU } ASN AAC } ASN AAA } LYS AAG } LYS	AGU } SER AGC } SER AGA } ARG AGG } ARG	U C A G
G	GUU } VAL GUC } VAL GUA } VAL GUG } VAL	GCU } ALA GCC } ALA GCA } ALA GCG } ALA	GAU } ASP GAC } ASP GAA } GLU GAG } GLU	GGU } GLY GGC } GLY GGA } GLY GGG } GLY	U C A G

CAU

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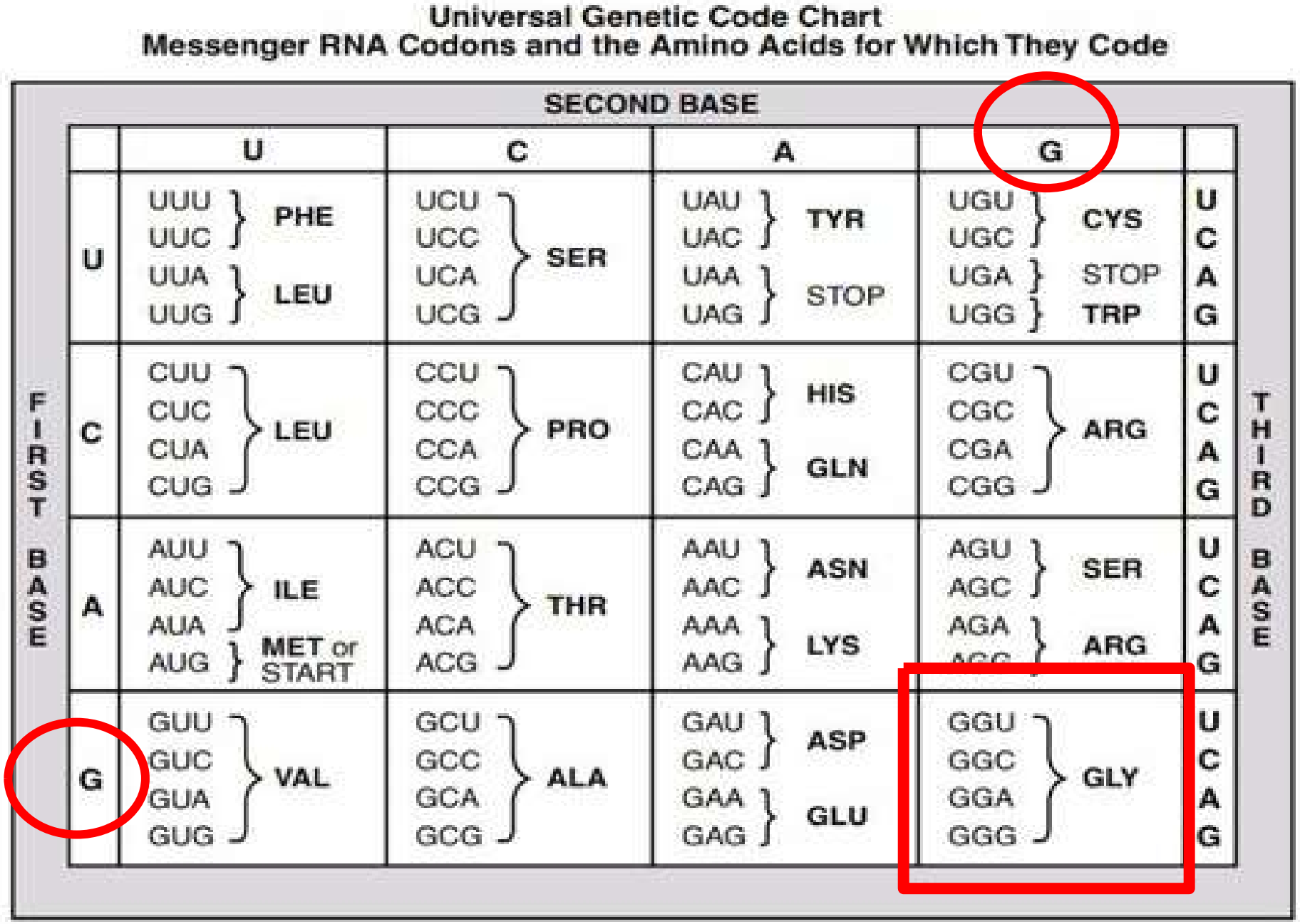
SECOND BASE
FIRST BASE
THIRD BASE
U
C
A
G
UUU PHE
UUC
UUA LEU
UUG
UCU SER
UCC
UCA
UCG
UAU TYR
UAC
UAA STOP
UAG
UGU CYS
UGC
UGA STOP
UGG TRP
CUU LEU
CUC
CUA
CUG
CCU PRO
CCC
CCA
CCG
CAU HIS
CAC
CAA GLN
CAG
CGU ARG
CGC
CGA
CGG
AUU ILE
AUC
AUA
AUG MET or START
ACU THR
ACC
ACA
ACG
AAU ASN
AAC
AAA LYS
AAG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

GGU

Gly



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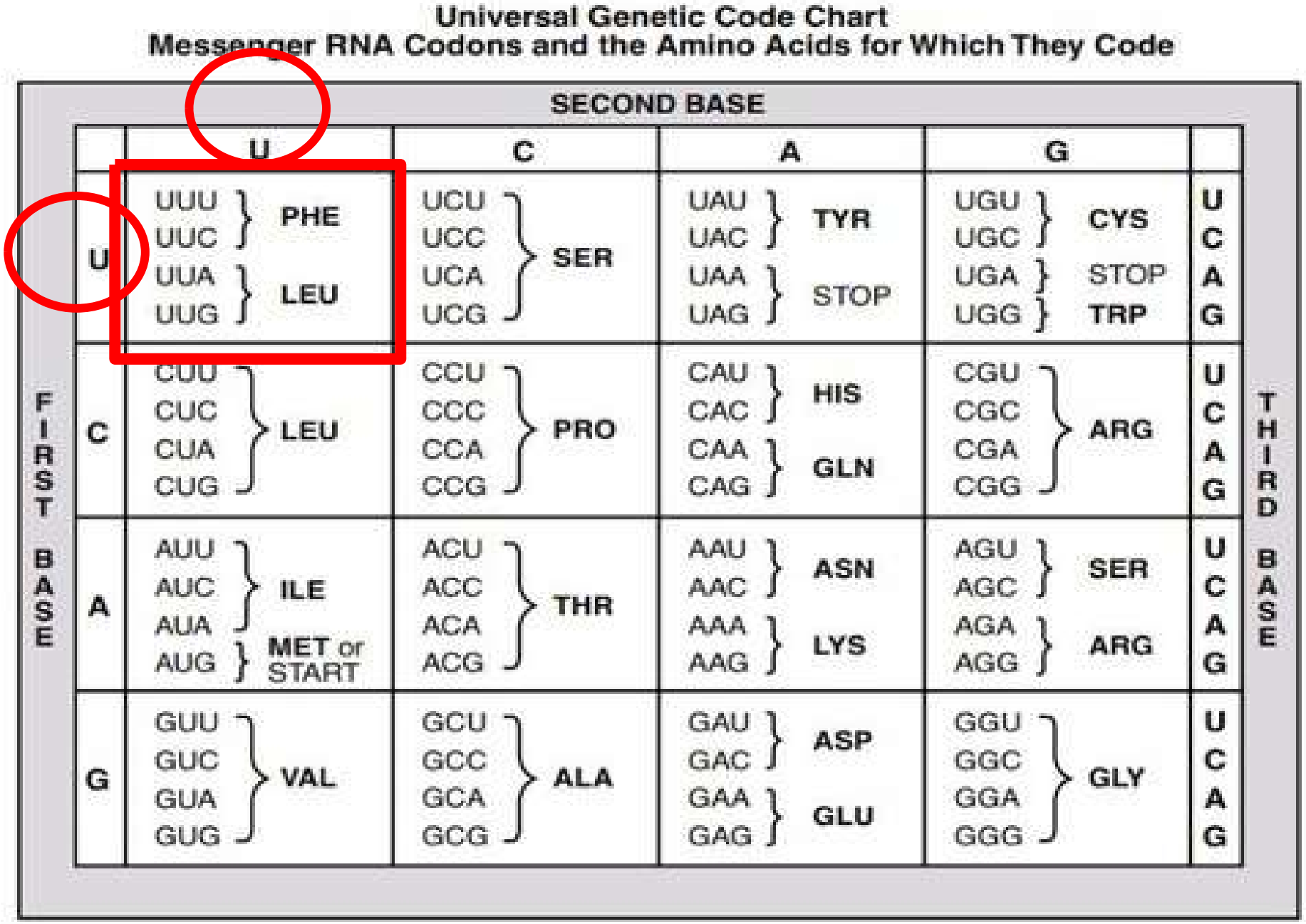
C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
A	AUU, AUC, AUA: ILE AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN AAA, AAG: LYS	AGU, AGC: SER AGA: ARG AGG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

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
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

mRNA: C A U A C A G U G

Amino acids: His ---- Thr ---- Val

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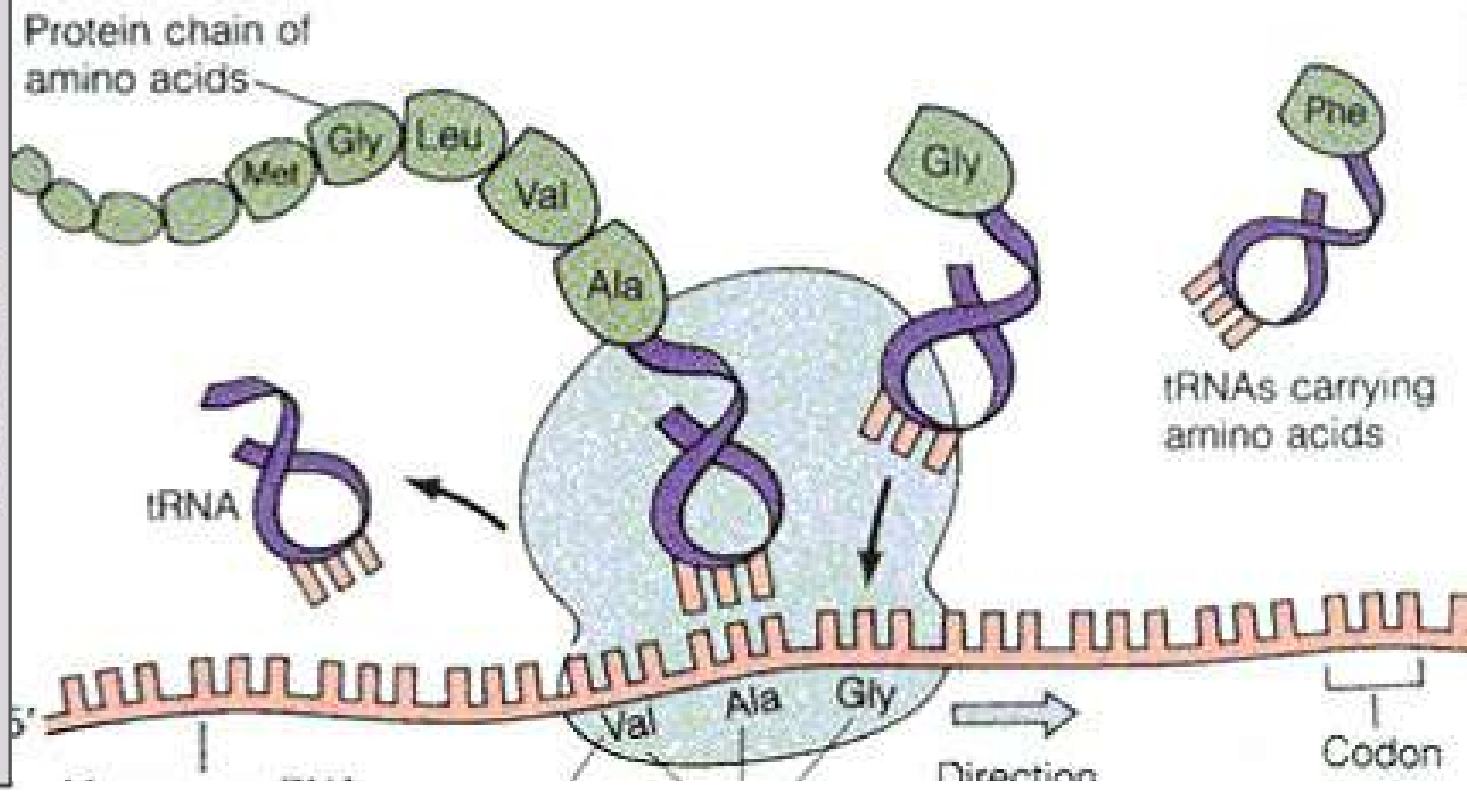
U	UUU PHE UUC PHE UUA LEU UUG LEU	UCU SER UCC SER UCA SER UCG SER	UAU TYR UAC TYR UAA STOP UAG STOP	UGU CYS UGC CYS UGA STOP UGG TRP	U C A G
C	CUU LEU CUC LEU CUA LEU CUG LEU	CCU PRO CCC PRO CCA PRO CCG PRO	CAU HIS CAC HIS CAA GLN CAG GLN	CGU ARG CGC ARG CGA ARG CGG ARG	U C A G
A	AUU ILE AUC ILE AUA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



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