Molecular Biology

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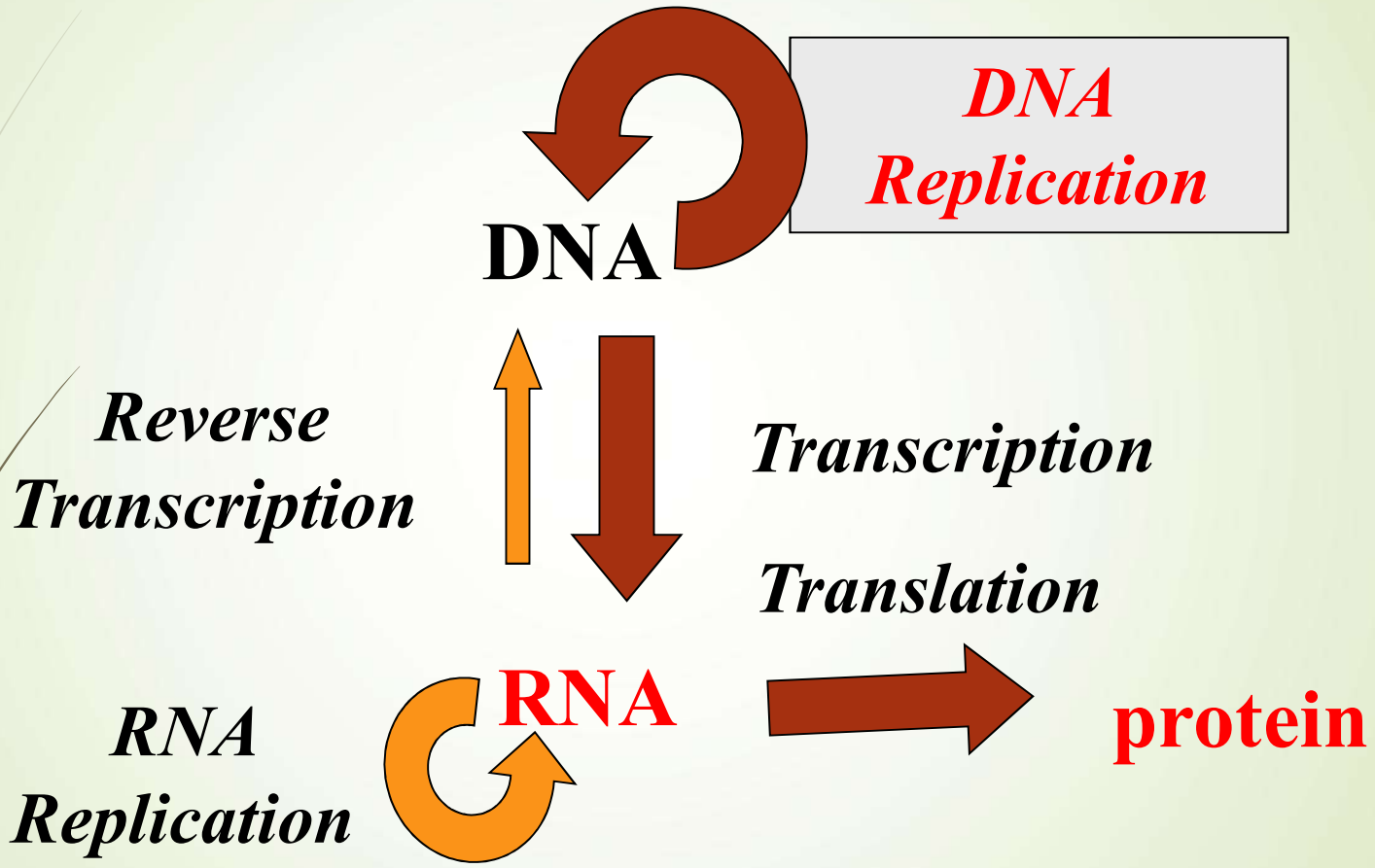
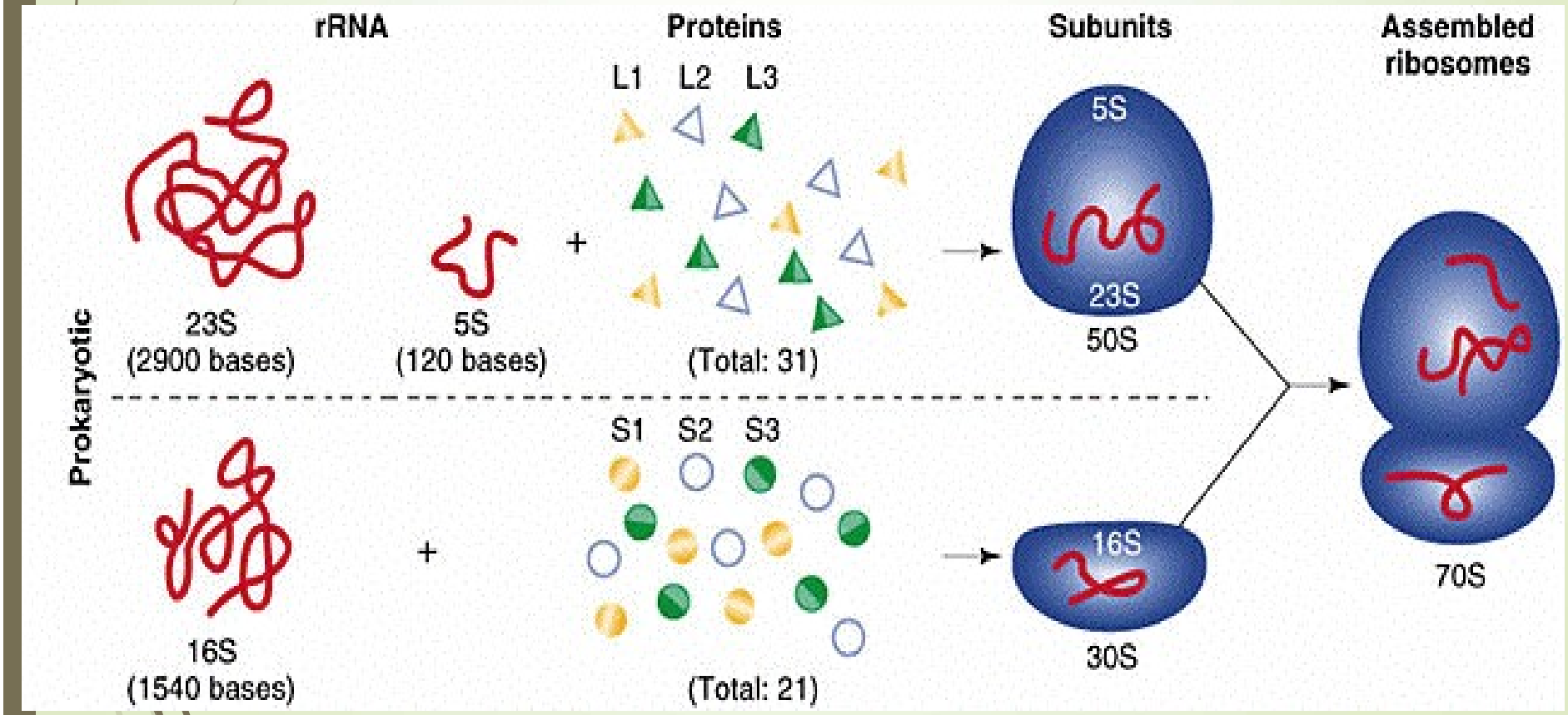

DNA
DNA Replication
Reverse Transcription
Transcription
Translation
RNA
RNA Replication
protein

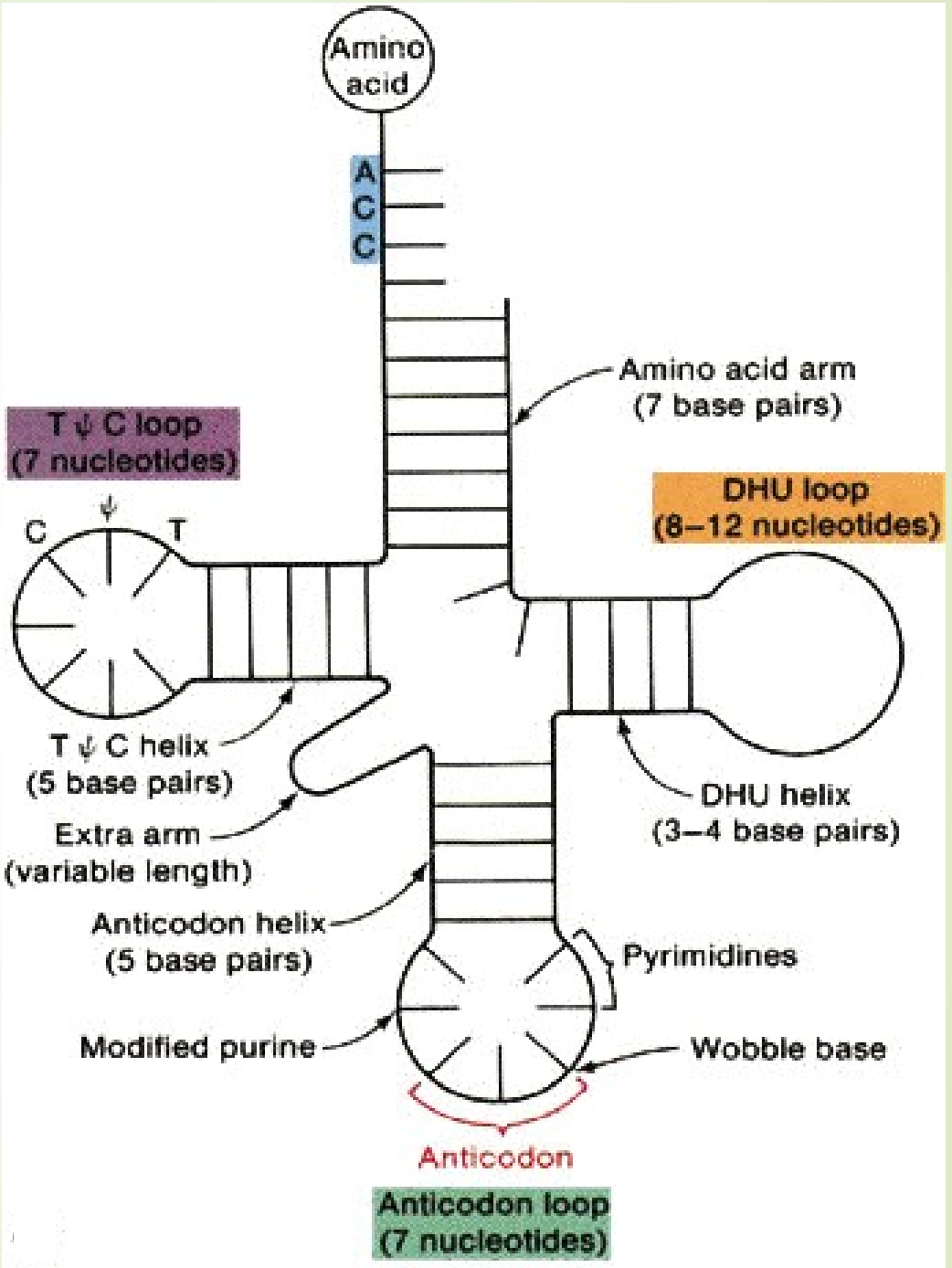
General Structure of Ribosome

prokaryotic



General Structure of tRNA molecules

- Small; approximately 75 nucleotides
- "cloverleaf" structure contains 3 characteristic loops; anticodon loop is responsible for pairing with mRNA
- 3' end of molecule associates with specific amino acid



Three roles of RNA in protein synthesis (Translation)

- Messenger RNA (mRNA) carries information copied from DNA in the form of a series of three base "words" termed codons
- Transfer RNA (tRNA) deciphers the code and delivers the specified amino acid
- Ribosomal RNA (rRNA) form ribosomes, the protein-synthesizing machines

Major points

I. RNA structure and function

II. Genetic code

A. Codons

B. Reading frame

III. Translation mechanism

Genetic code

The set of triplet nucleotides in DNA (or mRNA) coding for the amino acids in proteins.

Start and stop signals

- Start codon (initiate translation)

  AUG (encodes amino acid methionine)

- Stop codons (terminate translation)

  UAA

  UGA

  UAG

Making Proteins

DNA: TAC CGA TCG TGA ACT

Transcription

mRNA: AUG GCU AGC ACU UGA

Translation

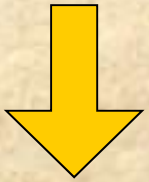
Protein: Met-Ala-Ser-Thr-Stop

Making Proteins

DNA: TAC CGA TCG TGA ACT

Transcription

mRNA: AUG GCU AGC ACU UGA



Translation

Protein: Met-Ala-Ser-Thr-Stop

- Starting with DNA, find the mRNA code, and the amino acid sequence using one of the charts.

- DNA: ATATTTGCCGAA
- mRNA: UAU-AAA-CGG-CUU
- tRNA: AUA-UUU-GCC-GAA
- Amino acid: Tyr-Phe-Ala-Glu
- Use mRNA in the amino acid chart

Do these on your own:

DNA: GCCATTTAACGG

mRNA:

Amino acid:

DNA: AATTCCGGATAT

mRNA:

Amino acid:

- DNA: **GGCCCTATTGGG**
- mRNA: _____
- Amino acid: _____

- DNA: **TACCCCCGATTACGTACC**
- mRNA: _____
- Amino acid:

_____

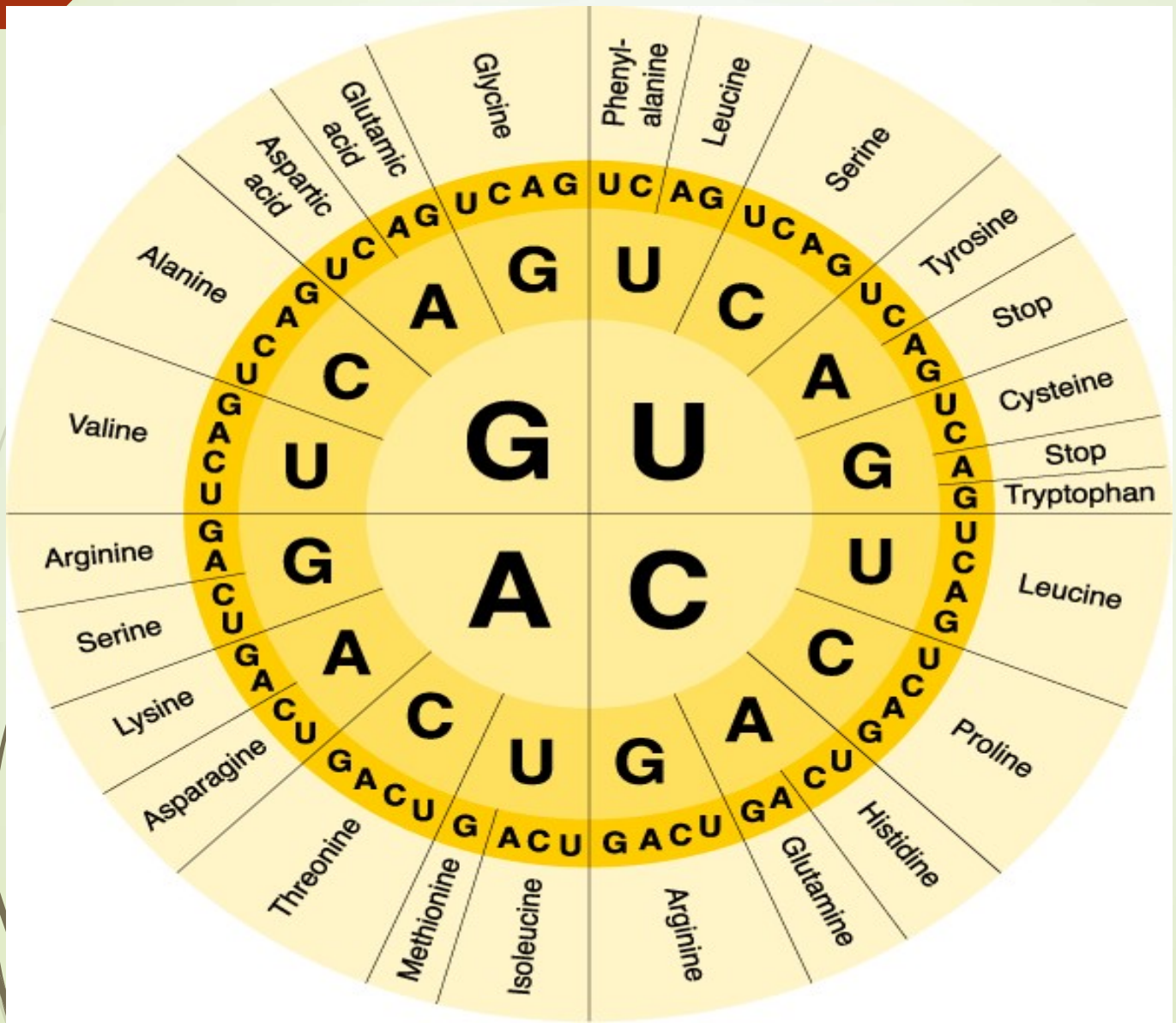
Characteristics of Genetic Code

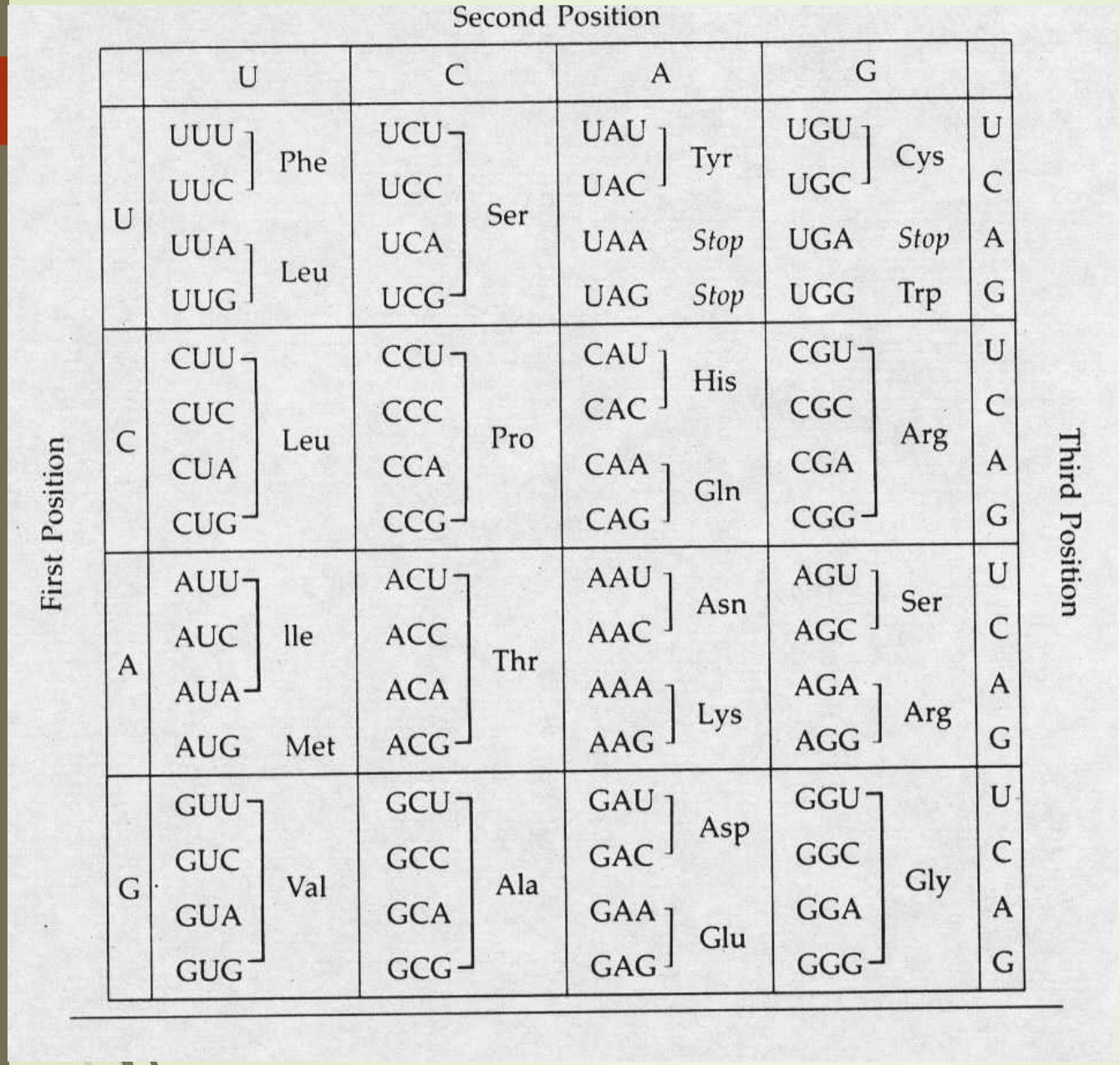
Amino Acids

- The basic unit of proteins is the amino acid. In nature, there are more than 200 amino acids but there are only 20 amino acids that are involved in protein synthesis.

- Each codon thus has 3 bases producing 64 codons.

64 POSSIBLE CODONS





CCC:

GCA

UUU

AUG

AGG

AAA

CGC

ATG:

Characteristics of Genetic Code

- Out of these 64 codons, only 61 are capable of producing amino acids.

- The rest 3 are used as stop codons during the process of translation.

- One codon is responsible to direct the reactions for producing an amino acid. (**Met) .**

Degeneracy of genetic code

(Groupings of codons)

*Some of the amino acids can have multiple codons for production. This is called the degeneracy of genetic code.

- For example, Valine (Val) has four different sequential codons for production.
- They are
- GUA,
- GUC,
- GUU,
- and GUG.

Genetic code is universal

* It means that one codon will lead to the formation of one amino acid. For instance, Phenylalanine (Phe) has the genetic code UUU. It is universal across all living beings. It means that the Phe of a bacterium will be similar to that of a human being.

Codons have dual functions too

- For instance, AUG is the genetic code for Methionine (Met). It also acts as an initiator or start codon.

Codons for initiation of translation

- Major codon for initiation is AUG
- For the 4288 genes identified in *E. coli* :

AUG is used for 3542 genes.

GUG is used for 612 genes.

UUG is used for 130 genes.

AUU is used for 1 gene.

CUG may be used for 1 gene.

Codons for **termination** of translation

- UAA, UAG, UGA
- For the genes identified in *E. coli* :

UAA is used for 2705 genes.

UGA is used for 1257 genes.

UAG is used for 326 genes.

Genetic Code - Properties

- They are mostly triplet coded.
- They are unambiguous as well as universal in nature.
- They have a degenerate code
- They contain start and stop codons
- They showcase polarity.
- Their code is mostly non overlapping.
- They are commaless, hence have no indication of an end or a beginning.

Mutations of Genetic Codes

Not every individuals is similar.

In fact, it has been observed that a particular physiological trait goes missing. It happens when the genetic codes get rearranged and deleted during transcription and replication. The different segments of DNA get rearranged and deleted during the process resulting in mutations.

example: If Valine (Val) is replaced by Glutamine (Gln)

in a particular gene sequence, the individual will

develop Sickle cell anemia, a blood disorder.

What are the following codons?

Chain initiation codons: AUG codons is translation chain initiation codons. It code for Methionine and occur immediately after the terminator codons.

Chain termination codons: UAA, UAG, and UGA are termination codons as they do not code for any amino acid. They are also called stop codons.

Sense codons: 61 codons of the genetic code table are known as the sense codons. All of them code for particular amino acids.

Nonsense codons: As UAA, UAG, and UGA do not code for any amino acid, they are also known as nonsense codons.

Translation in Prokaryotic Systems

See you in the next lecture

With my best wishes

THANK YOU