

# Genetic Code- Table

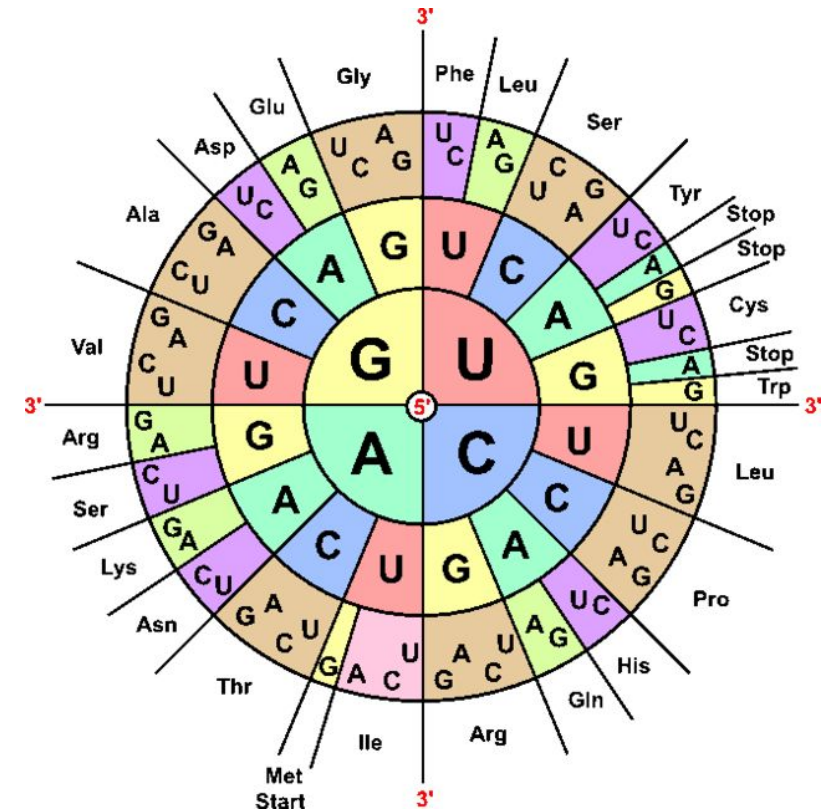
Second Letter

		Second Letter					
		U	C	A	G		
1st 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	3rd letter
	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	

# The properties of the genetic code

# Learning objective

- Explain the properties of the genetic code



# Success Criteria

- Describe correctly how triplet code can be transferred to protein mode using at least four given terms.
- Explain properties of genetic code.

# terminology

- Genetic code
- codon/triplet/anticodon/base
- Code is a Triplet
- The Code is Degenerate
- The Code is Non-overlapping
- The Code is Comma Less
- The Code is Unambiguous
- The Code is Universal
- Co-linearity
- Gene-polypeptide Parity

- Генетический код
- кодон / триплет / антикодон/  
основание
- Код - триплетен
- Код - вырожденный
- Код не перекрывается
- Код – нет знаков препинания
- Код - однозначен
- Код - универсальным
- Линейность
- Паритетность гена-  
полипептида

# The scientist investigating nucleic acids

Marshall Nirenberg, the scientist that **deciphered the genetic code** in 1961.



# The scientist investigating nucleic acids

Har Gobind Khorana,  
creator of **new methods** to  
**produce synthetic nucleic**  
**acids.**



# The scientist investigating nucleic acids

Robert Holley, the  
discoverer of **the transfer  
RNA - tRNA**.





# Properties of Genetic Code

## 1. Code is a Triplet:

As pointed out earlier, the coding units or **codons** for **amino acids** comprise **three letter words**,  $4 \times 4 \times 4$  or  $4^3 = 64$ . 64 codons are quite adequate to specify **20 proteinous amino acids**.

		Second base			
		A	C	G	U
First base	A	AA	AC	AG	AU
	C	CA	CC	CG	CU
	G	GA	GC	GG	GU
	U	UA	UC	UG	UU

Singlet Code: $4^1 = 4 \times 1 = 4$ codons	Doublet Code: $4^2 = 4 \times 4 = 16$ codons
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		Second base				
		U	C	A	G	
First base	U	UUU] Phenyl-alanine UUC UUA] Leucine UUG	UCU] Serine UCC UCA UCG	UAU] Tyrosine UAC UAA Stop codon UAG Stop codon	UGU] Cysteine UGC UGA Stop codon UGG Tryptophan	Third base U C A G U C A G U C A G U C A G
	C	CUU] Leucine CUC CUA CUG	CCU] Proline CCC CCA CCG	CAU] Histidine CAC CAA] Glutamine CAG	CGU] Arginine CGC CGA CGG	
	A	AUU] Isoleucine AUC AUA AUG Methionine start codon	ACU] Threonine ACC ACA ACG	AAU] Asparagine AAC AAA] Lysine AAG	AGU] Serine AGC AGA] Arginine AGG	
	G	GUU] Valine GUC GUA GUG	GCU] Alanine GCC GCA GCG	GAU] Aspartic acid GAC GAA] Glutamic acid GAG	GGU] Glycine GGC GGA GGG	

Triplet Code: $4^3 = 4 \times 4 \times 4 = 64$ codons	<a href="http://www.biologyexams4u.com">www.biologyexams4u.com</a>
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# Properties of Genetic Code

## 2. The Code is Degenerate:

The occurrence of more than **one codon** for a **single amino acid** is referred to as degenerate. A review of genetic code dictionary will **reveal** that most of **the amino acids** have more than **one codon**. Out of 61 functional codons, AUG and UGG code to one amino acid each. But remaining 18 amino acids are coded by 59 codons.

- a given amino acid may be coded for by more than one codon

64 codons and only 20 amino acids:

so some amino acids are coded for by several codons – exceptions [next slide]:

Valine

GUU  
GUC  
GUA  
GUG

Lysine

AAA  
AAG

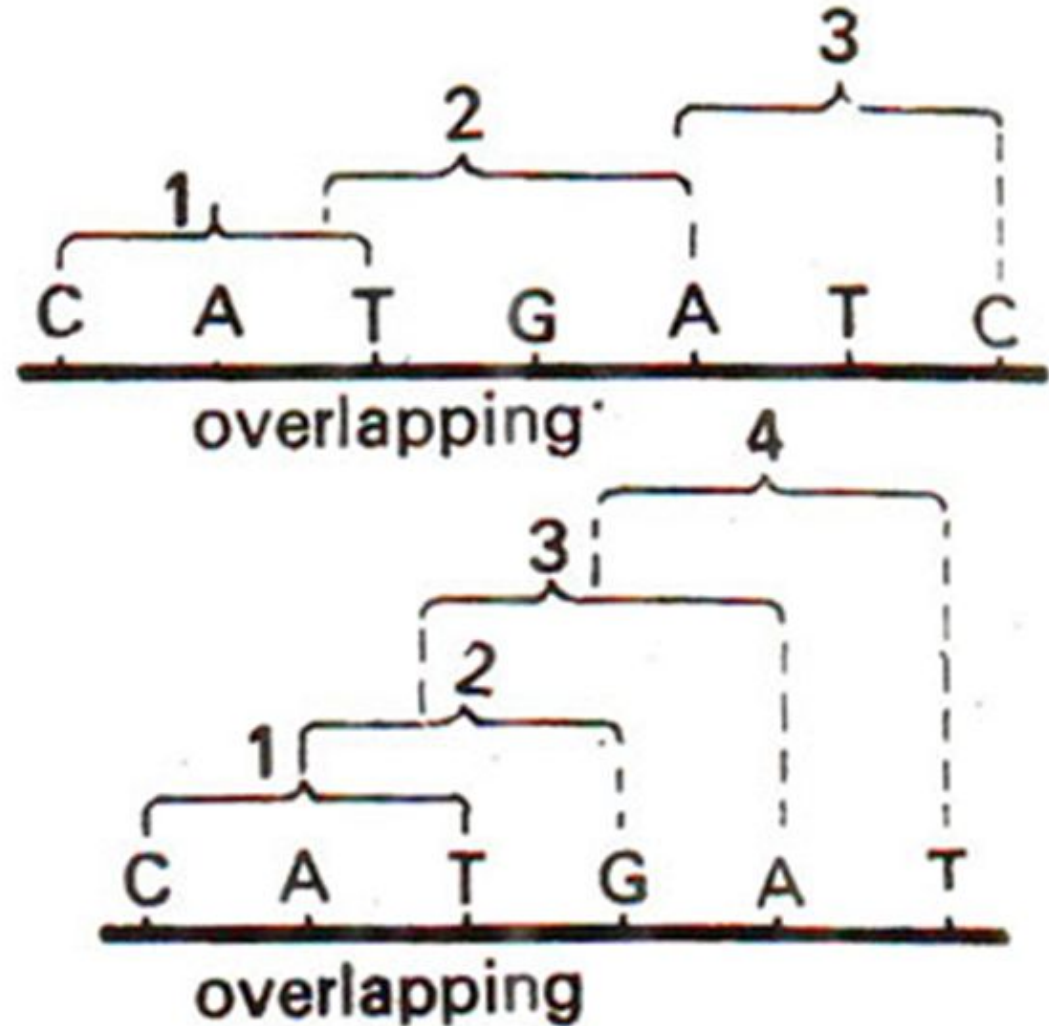
Tyrosine

UAU  
UAC

# Properties of Genetic Code

## 3. The Code is Non-overlapping:

In a non-overlapping code, the same letter (i.e., base) is **not used in the formation of more than one codon**.



# Properties of Genetic Code

## 4. The Code is Comma Less:

A comma less code means that no **nucleotide** or comma (or punctuation) **is present in between two codons**. Therefore, code is continuous and comma less and no letter is wasted between two words or codons.

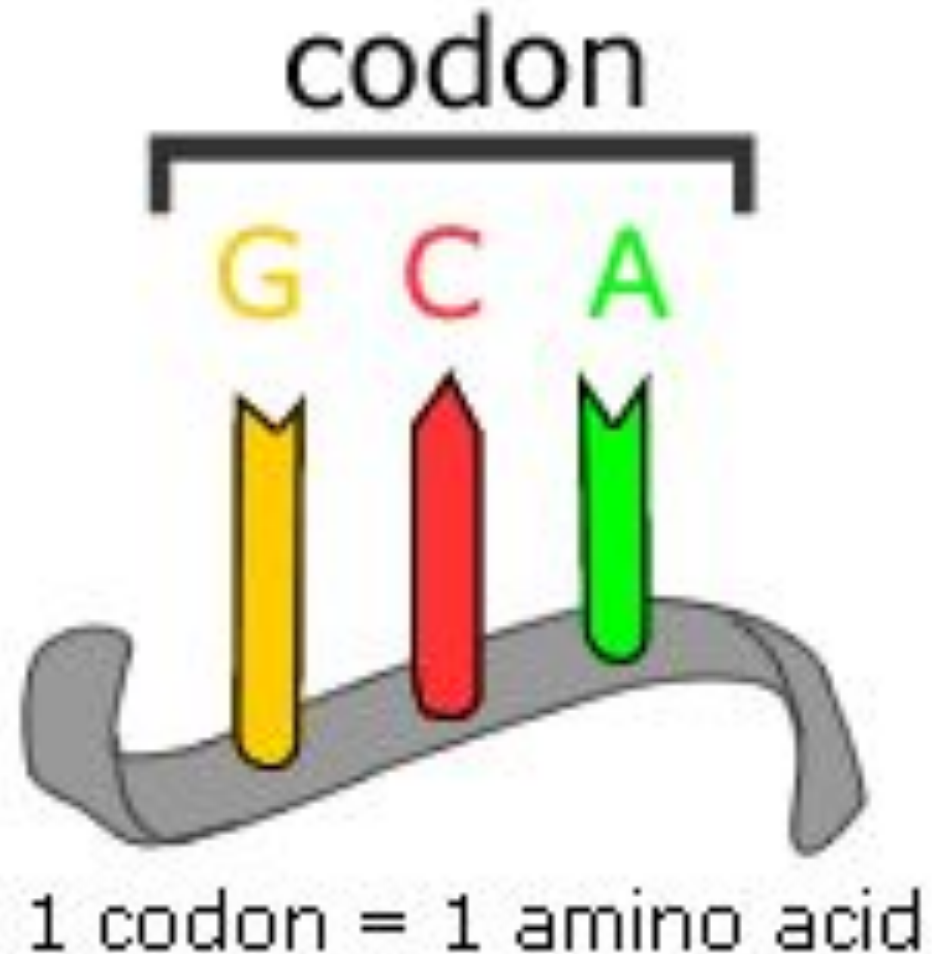
A—U—G,  
aa1

—C—A—G  
aa2

# Properties of Genetic Code

## 5. The Code is Unambiguous:

There is no ambiguity in the genetic code. A given **codon** **always codes** for a **particular amino acid**, wherever it is present.





# Properties of Genetic Code

## 6. The Code is Universal:

The genetic code has been found to be **universal** in **all kinds of living organisms** — prokaryotes and eukaryotes.

What does the DNA of all these organisms have in common?



They all share a universal genetic code.

# Properties of Genetic Code

## 7. Co-linearity:

**DNA is a linear polynucleotide chain** and **a protein is a linear polypeptide chain**. The sequence of amino acids in a polypeptide chain corresponds to the sequence of nucleotide bases in the gene (DNA) that codes for it. Change in **a specific codon in DNA produces a change of amino acid in the corresponding position in the polypeptide**. The gene and the polypeptide it codes for are said to be co-linear.

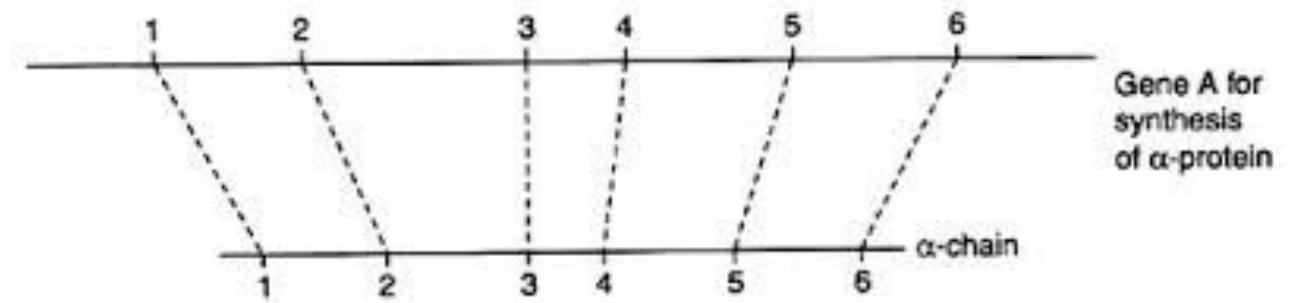
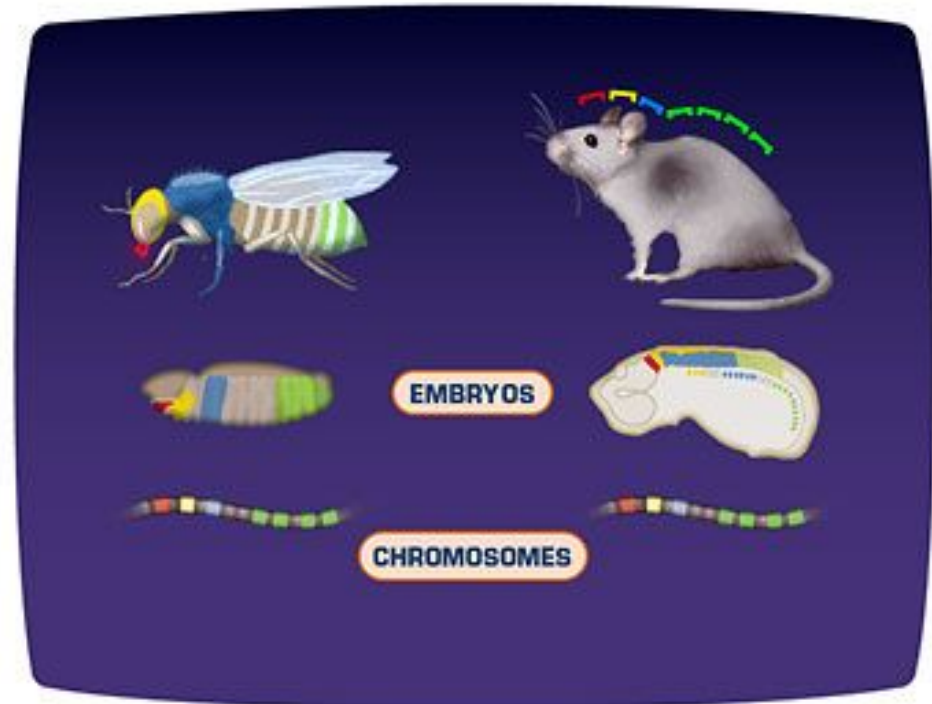


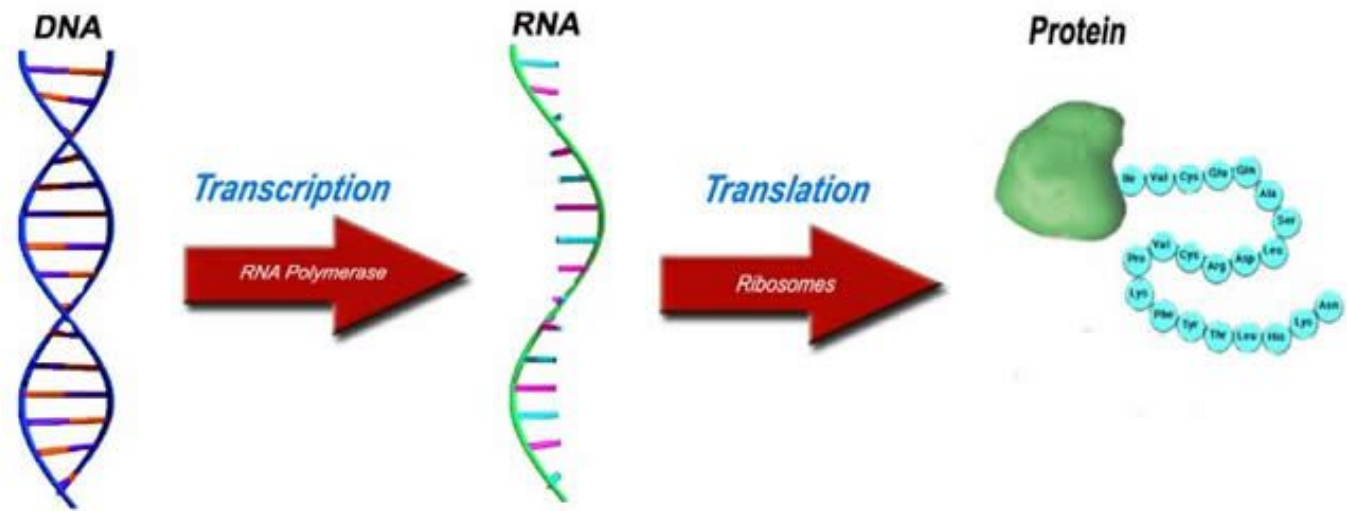
Fig. 15.3 Diagram illustrating colinearity between gene and protein.



# Properties of Genetic Code

## 8. Gene-polypeptide Parity:

A **specific gene transcribes a specific mRNA that produces a specific polypeptide**. On this basis, a cell can have only as many types of polypeptides as it has types of genes. However, this does not apply to certain viruses which have overlapping genes.





# PROPERTIES OF GENETIC CODE

1. **Unambiguous.** In any organism each codon corresponds to only one amino acid.
2. Code is **degenerate.** There are multiple codons for most amino acids.
3. **Universal.** Codons are the same for all organism.
4. **Without punctuation.** There are no punctuations between trinucleotides.
5. **Nonoverlapping.** Codons do not overlap each other.

First position	Second position				Third position
	U	C	A	G	
U	Phe Phe Leu Leu	Ser Ser Ser Ser	Tyr Tyr STOP STOP	Cys Cys STOP Trp	U C A G
C	Leu Leu Leu Leu	Pro Pro Pro Pro	His His Gln Gln	Arg Arg Arg Arg	U C A G
A	Ile Ile Ile Met	Thr Thr Thr Thr	Asn Asn Lys Lys	Ser Ser Arg Arg	U C A G
G	Val Val Val Val	Ala Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	U C A G