The Genetic Code

An amazing story in four simple letters

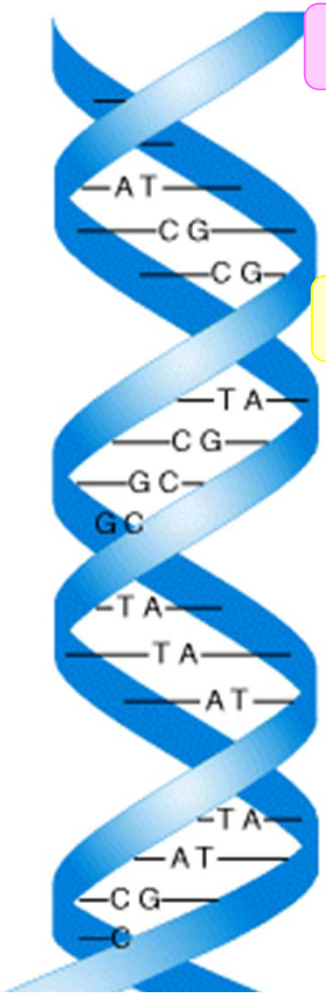
Highlights

- **Introduction**
- **Codon**
- **Properties of the Genetic Code**
- **Reading Frame**
- **Degenerate Code**
- **Cracking the Genetic Code**
- **Wobble Hypothesis**

Genes as Protein Blueprints

DNA

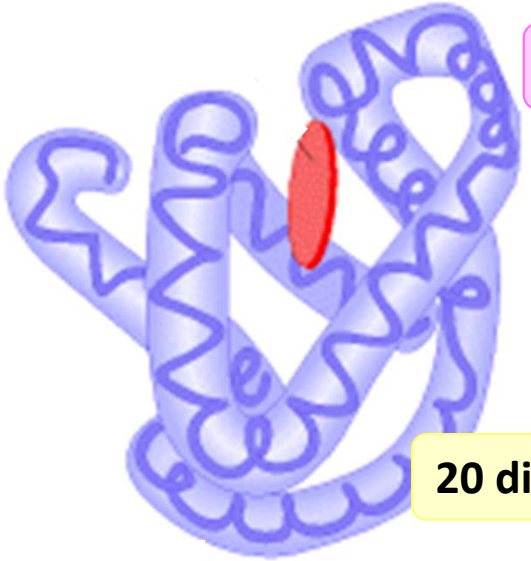
Protein



Simple structure

4 different nucleotides

A, T, G & C



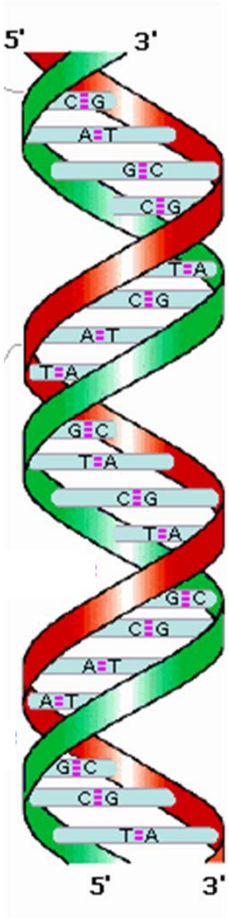
Complex structure

20 different amino acids

Correspondence between 4 letter DNA alphabet & 20 letter protein alphabet: specified by GENETIC CODE

Spelling with DNA

How can such a simple molecule contain the information for such a complex molecule?



DNA is a sequence of letters

Simple alphabets: A, T, G & C

How many different words can be spelt???

Depends upon the length of the word

Number of bases in a Codon

4 bases code for 20 amino acids. How?

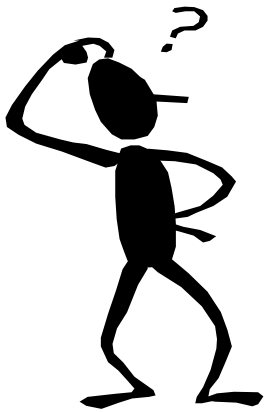
- 1 base per aa

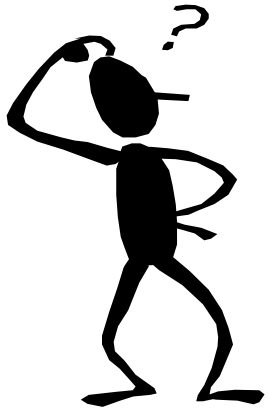
2 bases per aa

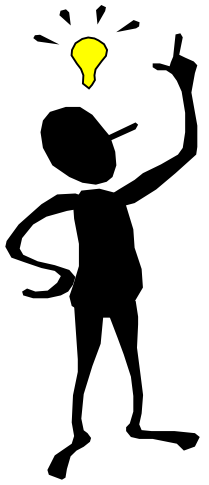
16 possible pairs
(4x4)

3 bases per aa

64 possible pairs
(4x4x4)



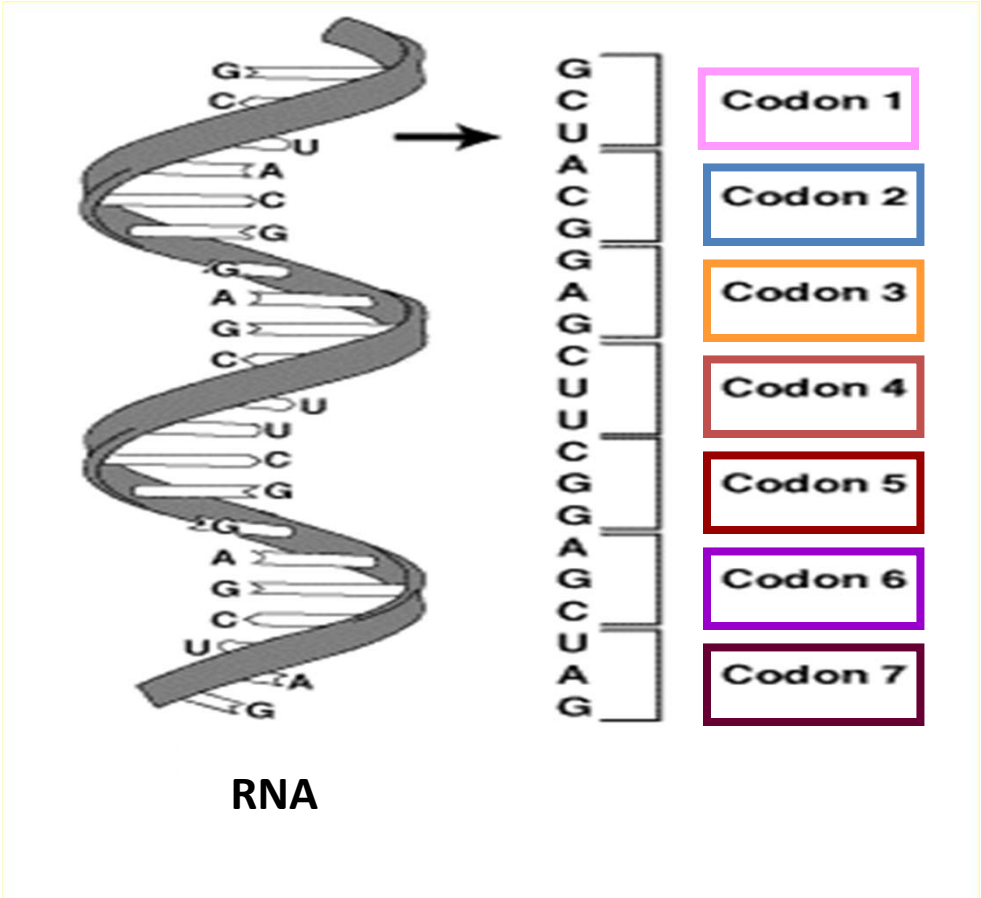




Brenner 1960

Proposes a triplet code on theoretical grounds

Triplet of nucleotides = Codon



Number of bases in a Codon

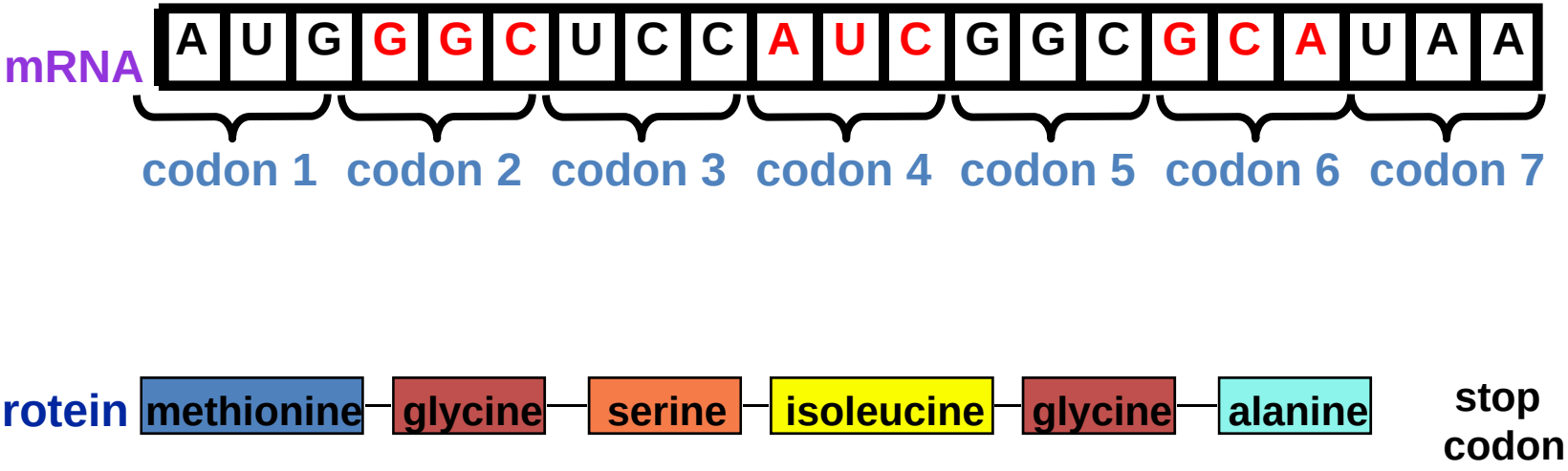
64 possible codons for 20 amino acids

What about the 44 extras???

Some amino acids coded for by more than one codon -
DEGENERATE CODE

Properties of the Genetic Code

- Linear Code
- Triplet Code – triplet is referred to as codon



Properties of the Genetic Code

Contd.

Non- overlapping Code

Triplet codons do not overlap

Each nucleotide is part of only one codon

Non overlapping code

A U G A C G U A G

1 2 3

Overlapping code

A U G A C G U A G

1

2

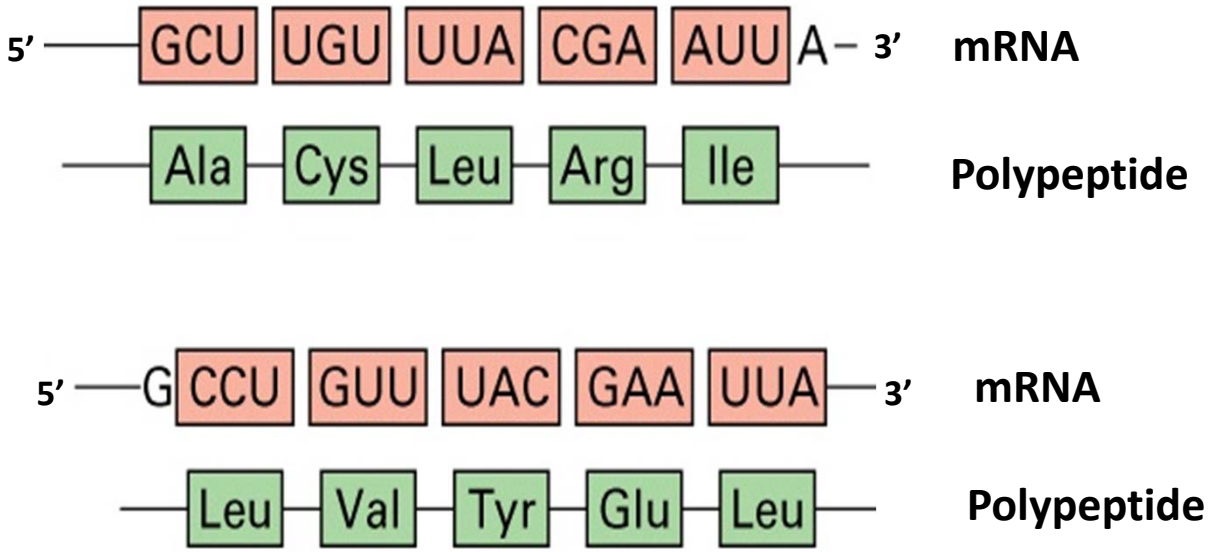
3

Open Reading Frame

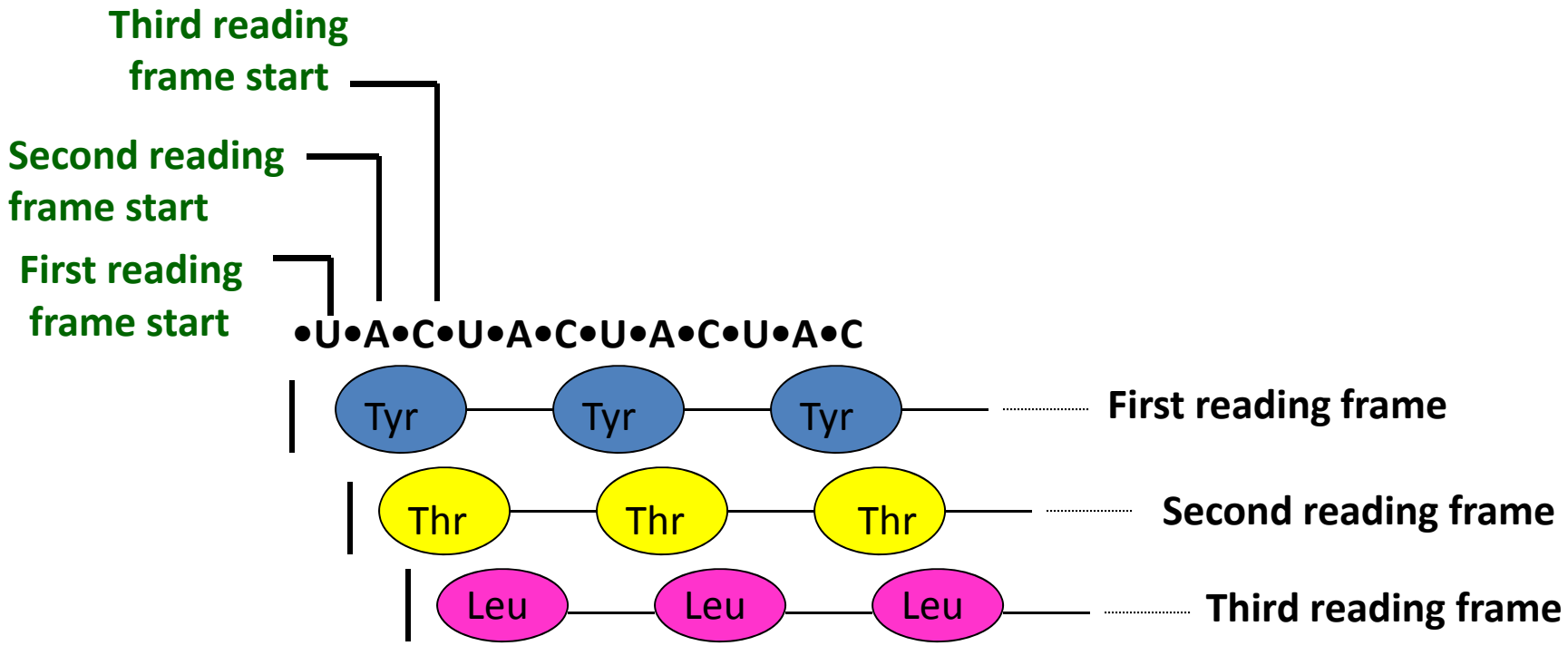
- Sequence of codons from start to stop
- No punctuation in the genetic code

- example: **THE BIG FAT DOG ATE THE EGG**

- The spaces have no physical significance; only to indicate the reading frame

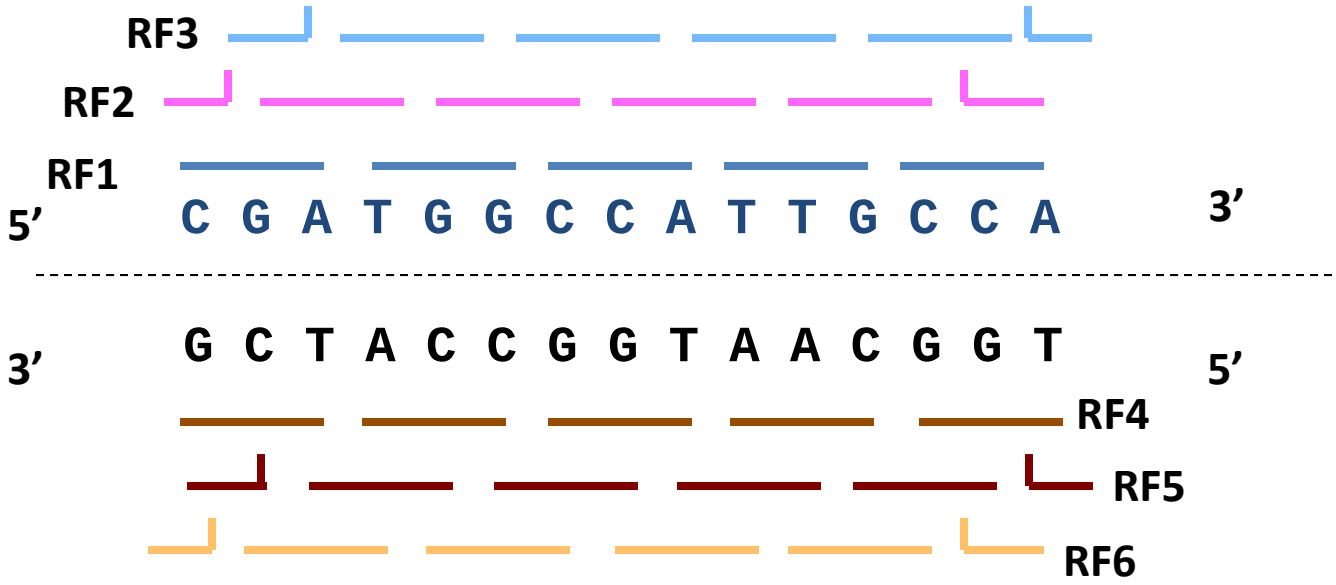


An mRNA can be read in 3 different reading frames



How many possible reading frames on a double stranded DNA molecule ?

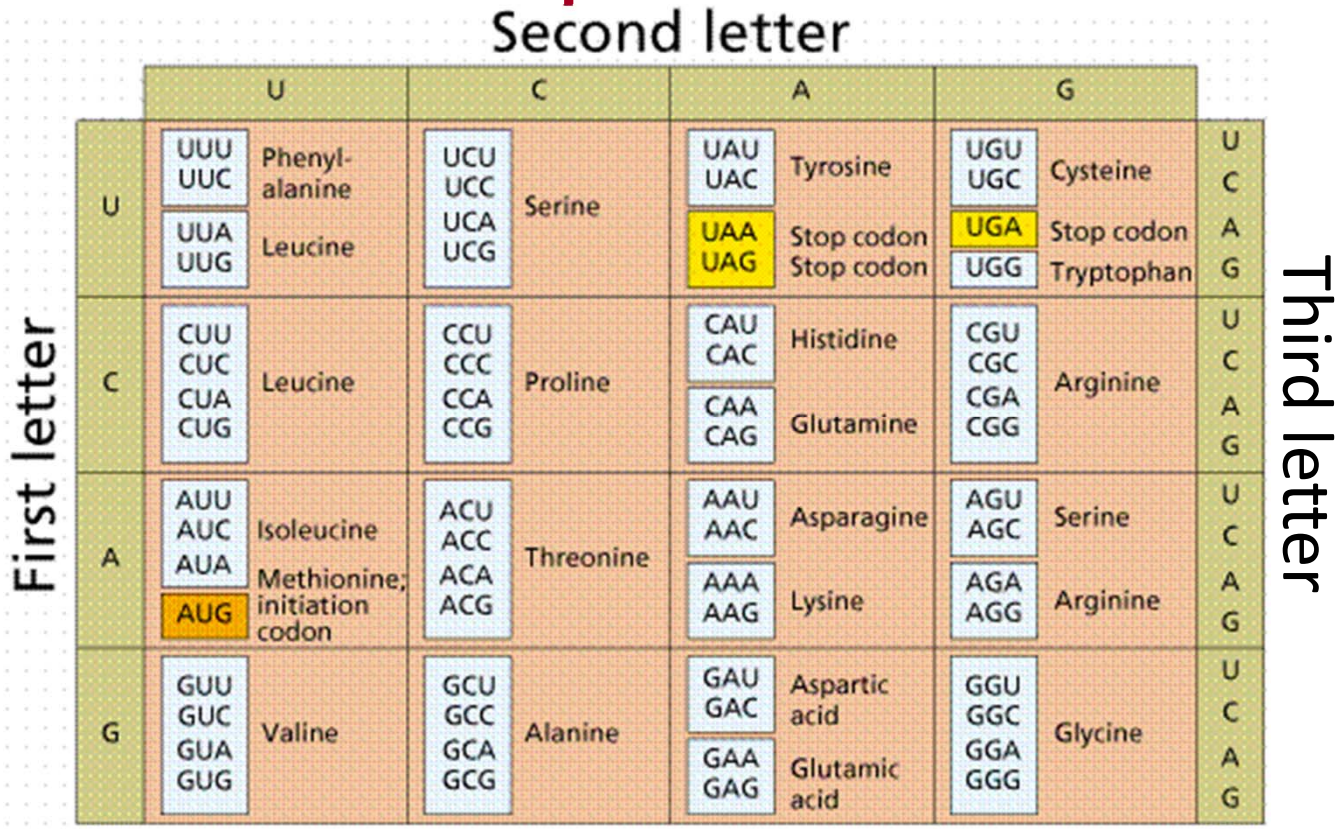
6 reading frames in double stranded DNA



- Insertions or deletions of 1, 2, 4, 5 etc cause a severe loss of function resulting from a change in the reading frame.

- But insertions or deletions of 3, 6, 9 etc have little effect on the phenotype, because the reading frame is not affected for most of the mRNA.

The Genetic Code - Triplet Code



Directional : always read 5'- 3'

Each triplet of bases codes one amino acid

Degenerate: many amino acids have more than one codon

Degeneracy of the code is not uniform

Example, leucine and serine have six codons

glycine and alanine have four, etc

methionine and tryptophan have single codons.