

# The Genetic Code

The genetic information that codes for the assembly of amino acids is stored as three-letter codes, called **codons**. Each codon represents one of 20 amino acids used in the construction of polypeptide chains. The **mRNA amino acid table** (below) can be used to identify the amino acid encoded by each of the mRNA codons. Note that the code is **degenerate** in that for each amino

acid, there may be more than one codon (there is redundancy in the code). Most of this degeneracy involves the third nucleotide of a codon. The genetic code is almost **universal**; all living organisms on Earth, from viruses and bacteria, to plants and humans, share the same code (the rare exceptions represent mutations that have occurred over the long history of evolution).

| Amino acid        | Codons that code for this amino acid | No. | Amino acid        | Codons that code for this amino acid | No. |
|-------------------|--------------------------------------|-----|-------------------|--------------------------------------|-----|
| Ala Alanine       | GCU, GCC, GCA, GCG                   | 4   | Leu Leucine       |                                      |     |
| Arg Arginine      |                                      |     | Lys Lysine        |                                      |     |
| Asn Asparagine    |                                      |     | Met Methionine    |                                      |     |
| Asp Aspartic acid |                                      |     | Phe Phenylalanine |                                      |     |
| Cys Cysteine      |                                      |     | Pro Proline       |                                      |     |
| Gln Glutamine     |                                      |     | Ser Serine        |                                      |     |
| Glu Glutamic acid |                                      |     | Thr Threonine     |                                      |     |
| Gly Glycine       |                                      |     | Trp Tryptophan    |                                      |     |
| His Histidine     |                                      |     | Tyr Tyrosine      |                                      |     |
| Ile Isoleucine    |                                      |     | Val Valine        |                                      |     |

## mRNA-Amino Acid Table

**How to read the table:** The table on the right is used to 'decode' the genetic code as a sequence of amino acids in a polypeptide chain, from a given mRNA sequence. To work out which amino acid is coded for by a codon (triplet of bases) look for the first letter of the codon in the row label on the left hand side. Then look for the column that intersects the same row from above that matches the second base. Finally, locate the third base in the codon by looking along the row from the right hand end that matches your codon.

**Example:** Determine CAG

C on the left row,  
A on the top column,  
G on the right row  
**CAG is Gln (glutamine)**

|              |   | Second Letter                            |  |  |   | Third Letter     |
|--------------|---|--|--|--|---|------------------|
|              |   | U  | C  | A  | G   |                  |
| First Letter | U | UUU Phe<br>UUC Phe<br>UUA Leu<br>UUG Leu | UCU Ser<br>UCC Ser<br>UCA Ser<br>UCG Ser | UAU Tyr<br>UAC Tyr<br>UAA STOP<br>UAG STOP | UGU Cys<br>UGC Cys<br>UGA STOP<br>UGG Trp | U<br>C<br>A<br>G |
|              | C | CUU Leu<br>CUC Leu<br>CUA Leu<br>CUG Leu | CCU Pro<br>CCC Pro<br>CCA Pro<br>CCG Pro | CAU His<br>CAC His<br>CAA Gln<br>CAG Gln   | CGU Arg<br>CGC Arg<br>CGA Arg<br>CGG Arg  | U<br>C<br>A<br>G |
|              | A | AUU Ile<br>AUC Ile<br>AUA Ile<br>AUG Met | ACU Thr<br>ACC Thr<br>ACA Thr<br>ACG Thr | AAU Asn<br>AAC Asn<br>AAA Lys<br>AAG Lys   | AGU Ser<br>AGC Ser<br>AGA Arg<br>AGG Arg  | U<br>C<br>A<br>G |
|              | G | GUU Val<br>GUC Val<br>GUA Val<br>GUG Val | GCU Ala<br>GCC Ala<br>GCA Ala<br>GCG Ala | GAU Asp<br>GAC Asp<br>GAA Glu<br>GAG Glu   | GGU Gly<br>GGC Gly<br>GGA Gly<br>GGG Gly  | U<br>C<br>A<br>G |

1. Use the **mRNA-amino acid table** (above) to list in the table above all the **codons** that code for each of the amino acids and the number of different codons that can code for each amino acid (the first amino acid has been done for you).

2. (a) How many amino acids could be coded for if a codon consisted of just two bases? \_\_\_\_\_

(b) Why is this number of bases inadequate to code for the 20 amino acids required to make proteins?

\_\_\_\_\_

\_\_\_\_\_

3. Describe the consequence of the degeneracy of the genetic code to the likely effect of a change to one base in a triplet:

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