# Biology Chapter 12-4 Point Mutations Reference Sheet

**Reading Information**: There are three ways that DNA can be altered when a mutation (change in DNA sequence) occurs.

1.  **Substitution** – one base-pair is replaced by another:
    a.  Example: G mutated to **C** or A mutated to **G**

        C becomes **G** or U becomes **C**
2.  **Insertion**: one or more base pairs is added to a sequence:
    a.  Example:  CGA UGG mutates to CGA **A**UG G

        Complementary bases GCU ACC become  GCU **U**AC  C
3.  **Deletion** – one or more base pairs is lost from a sequence:
    a.  Example:  C**G**A UGG mutates to CAU GG

        Complementary bases G**C**U ACC become  GUA CC

There are five **possible results** of a mutation.

1.  **Silent mutation** : When a base pair is substituted but the change still codes for the same amino acid in the sequence:
    Example: UC**U** and UC**C** both code for the amino acid Serine.
2.  **Substitution**: When a base pair is substituted and the new codon codes for a different amino acid:
    Example: **U**CU codes for Serine and **C**CU codes for Proline.
3.  **Premature Stop**: When a substitution results in the formation of a STOP codon before all of the codons have been read and translated by the ribosome.
    Example: GUG GUC UG**G** AAC ACC – GUG GUC UG**A** CGA AAC ACC
              Val -  Val –Trp –Asn -Thr     Val – Val-STOP
4.  **Codon Deletion or Insertion**:  A whole new amino acid is added, or one is missing as a result of the mutant base.
    Example: GUG GUC UGG AAC ACC – GUG GUC **UGC**  CGA  AAC  ACC (codon 3 inserted)
              Val - Val –Trp –Asn -Thr  -  Val -  Val– **Cys** - Trp – Asn -Thr
5.  **Frame Shift**: When a deletion or insertion results in a different base starting the next codon, changing the whole sequence of codons and amino acids.
    Example: GUG GUC  UGG  AAC  ACC- GUG  **U**GU  CUG  GAA  CAC  C ( base U inserted)
              Val - **Val – Trp –Asn -Thr**   - Val – **Cys – Leu – Glu - His**