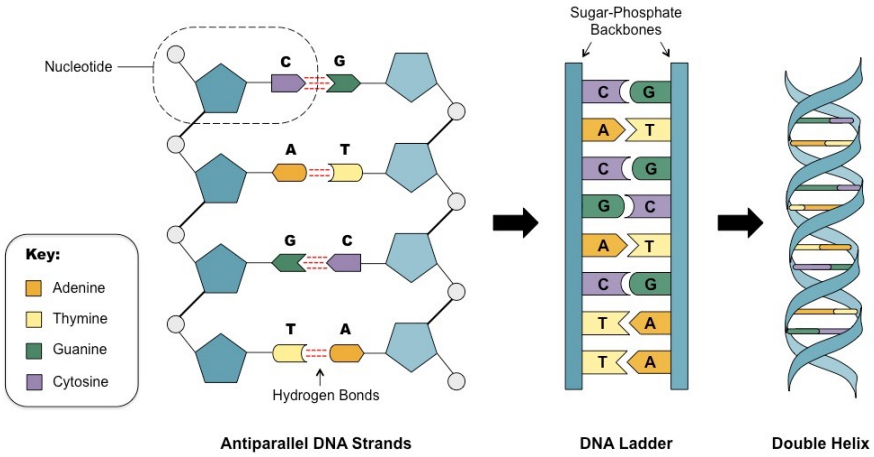
~UNIT 4 GENETIC EXPRESSION TEST STUDY GUIDE~

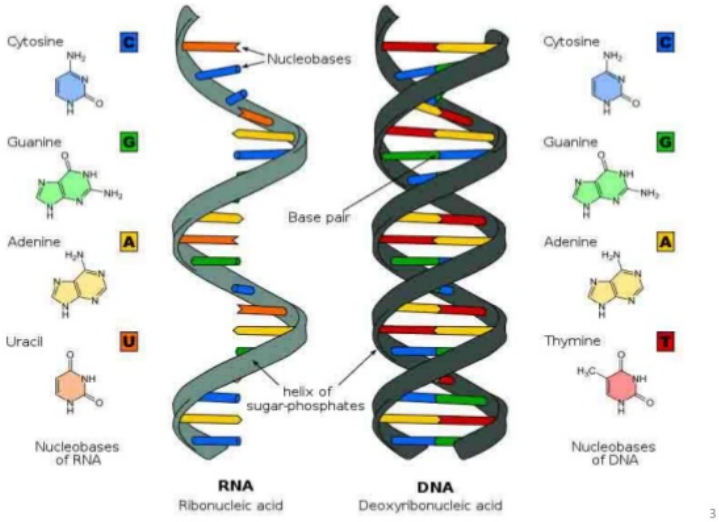
Structure

- **DNA (deoxyribose nucleic acid)**- DNA never, ever, ever leaves the nucleus! (exception mitosis and meiosis)
    - Is shaped like a twisted ladder or spiral staircase called a double helix
    - Is protected behind the cellular membrane and the nuclear membrane
- DNA Made Up
    - Has a backbone made up of phosphate and sugar (deoxyribose)
    - The nitrogen bases are hydrogen bonds and the rest of DNA is covalent bonds
    - One nucleotide has three parts
        - 1 sugar
        - 1 phosphate
        - 1 base (A,T, C or G)
- Base pairs
    - A&T two hydrogen bonds
    - G&C three hydrogen bonds
- Purines (2 rings):
    - Adenine
    - Guanine
- Pyrimidine (1 ring):
    - Thymine
    - Cytosine
    - Uracil (RNA)
- DNA and RNA (similarities and differences):
- Similarities
    - Both helical
    - Share nitrogen bases A,C,G
    - Both have phosphate
- Differences
    - RNA has uracil and DNA has thymine
    - DNA is double stranded and RNA is single stranded
    - Different sugars

Structure Picture



RNA V/S DNA



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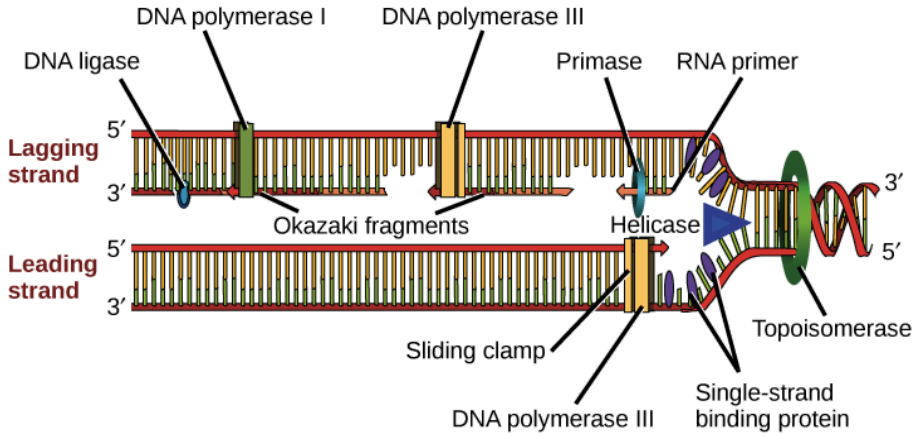
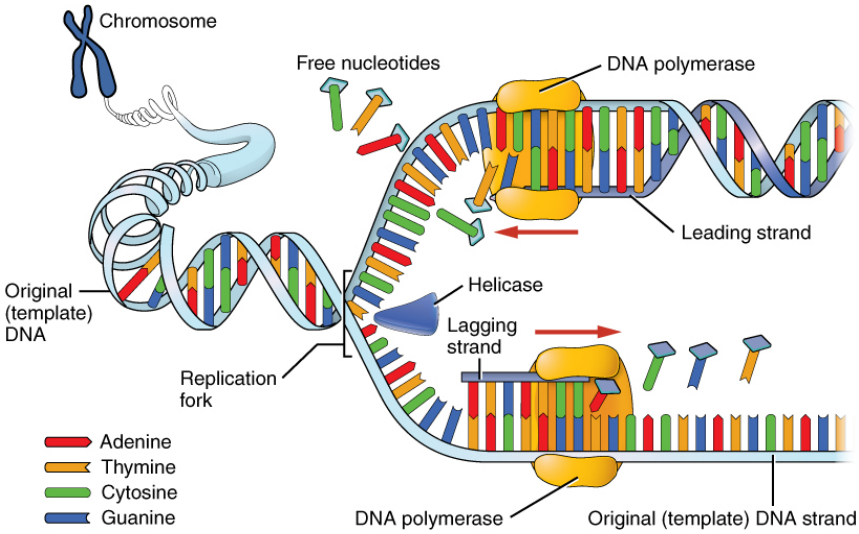
Replication

- **DNA replication**- makes a copy of itself
- How does the base pairing help it make a copy of itself?
    - When the two strands are pulled apart(by helicase)
    - An enzyme (DNA Polymerase) can read them
- **DNA replication is Semi**- conservative meaning each strand is ½ of the original and ½ of the new DNA.
- Process of Replication
    - **Helicase**- breaks unzips the hydrogen bonds in DNA
    - **DNA polymerase**- adds DNA complementary bases to the original DNA to create two DNA strands. DNA polymerase found on each strand.
    - **Leading strand**: goes towards helicase
    - **Lagging strand:** goes away from helicase

Replication Pictures





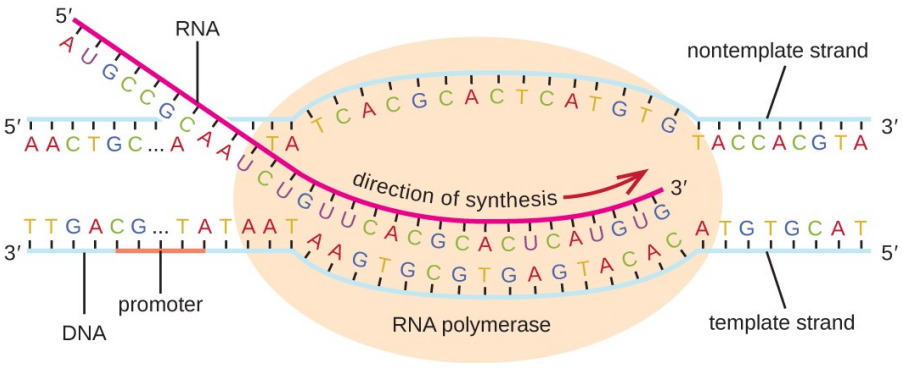
Transcription

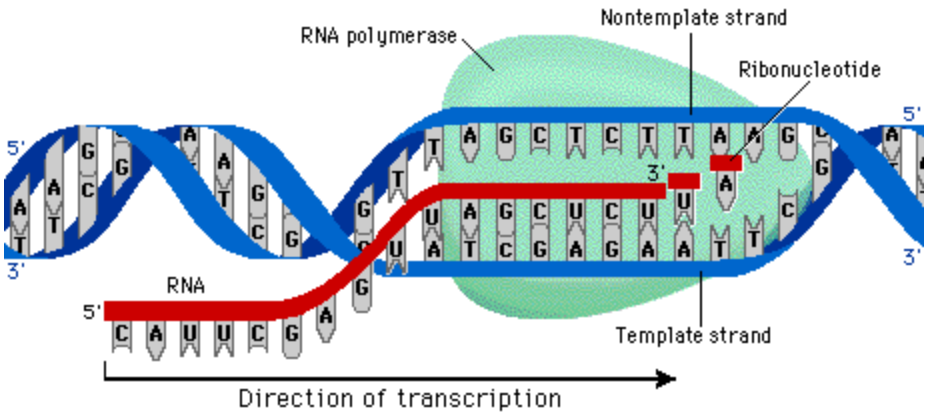
- **Transcription**- The conversion of DNA into mRNA (a cousin of DNA)
- Transcription
  - DNA never leaves the nucleus, but RNA can
  - Messengers RNA(mRNA) become DNA's messenger to the rest of the cell
- RNA
  - Made up of nucleotides
    - sugar (ribose sugar- different than DNA)
    - Phosphate
    - Bases(A,U,G and C) - U= Uracil replaces T
- Helix(not double- single stranded) like a slinky
- DNA acts as the boss RNA as the messenger

Process of Transcription

- Occurs in the nucleus of eukaryotic cells
- This process use DNA to make the mRNA
- These process is split into 3 stage:
    1. **Initiation Stage**: The promoter region acts as a recognition site for RNA polymerase to bind. The binding of the polymerase causes the DNA double helix to open.
    2. **Elongation Stage:** During this stage, The RNA polymerase goes along the DNA strand. The complementary bases will pair up and the RNA polymerase links nucleotides to 3 prime ends to the growing RNA molecule.
    3. **Termination Stage:** Once the RNA polymerase reaches the terminator region the mRNA sequence is complete. Then the RNA polymerase, DNA strand and mRNA transcript break apart from each other.

Pictures of Transcription:





Translation

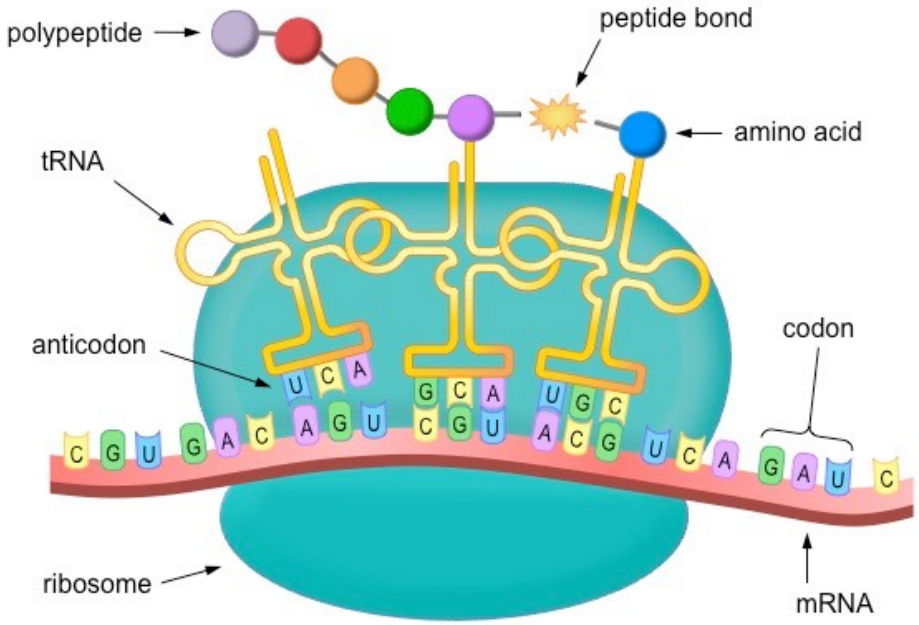
- **Translation**- The conversion of mRNA into protein (made of amino acids)
- Translation
    - Occurs in the cytoplasm, in the ribosome
    - mRNA is "read"
        - 3 bases at a time(called a codon)
        - 1 specific amino acid is added for every codon read
    - Added by a transfer RNA(tRNA) containing an anticodon
    - 20 different amino acids (64 codons)
    - The string of amino acids is "folded" into a specific shape and "shipped" to its designated location.
    - You are made of millions of these proteins! From your skin to your eyes to your liver to your brain!
    - Start codon: AUG and always binds with Methionine- UAC
    - Stop codon: UGA, UAA, or UAG

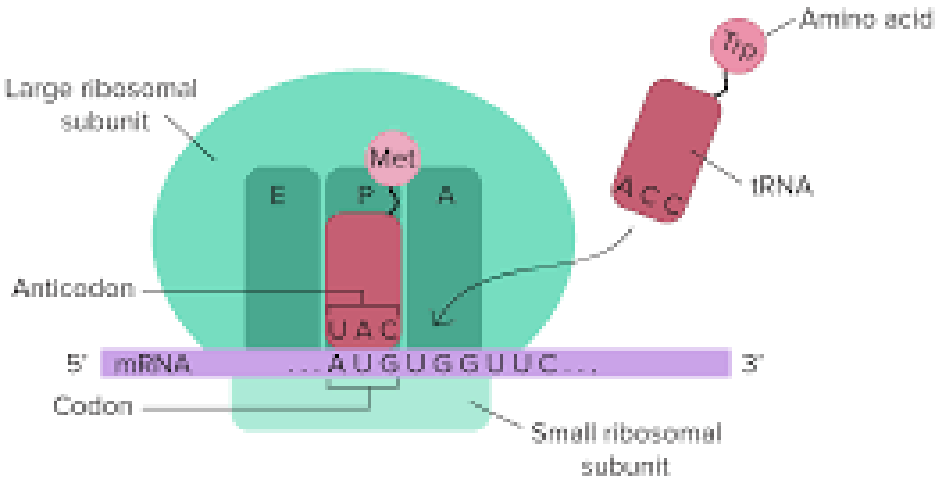
Process of Translation

- Occurs in the cytoplasm of the cell
- The information from mRNA is used to make a polypeptide.
- The information from mRNA is translated into a protein.
- The nitrogen bases are grouped together in three called codons.
- Most codons code for specific amino acids.
- 1 start codon 3 codons to get to the stop:
- The mRNA binds to a small ribosomal subunit of the start codon which has to be AUG.
- Each amino acid is brought to the ribosome by a specific tRNA molecule.
- The amino acid sequence is determined by the anticodon sequence of the transfer RNA.
- Complementary base pairing happens between the codon of mRNA and the anticodon tRNA.
- After the initial tRNA molecule binds to the start codon, the large ribosomal subunit binds to form the translation complex and initiation is complete.
- Ribosomal subunit 3 stages:
    1. E- The uncharged tRNA molecule exits at the E site.
    2. P- A polypeptide bond is formed at the P site and slides to the right.
    3. A- Individual amino acids are brought by tRNA(anticodon) to bind to mRNA(codon) complementary bases.When a charged tRNA molecule binds to the A site a polypeptide bond is formed.
- This process repeats until they reach a stop codon.

- A release site binds to site A when it is at a stop codon, and the polypeptide is released from tRNA from the P site.

Translation Pictures





Mutations

- **Mutation**- The change in a base sequence of DNA or RNA
- Types of Mutations

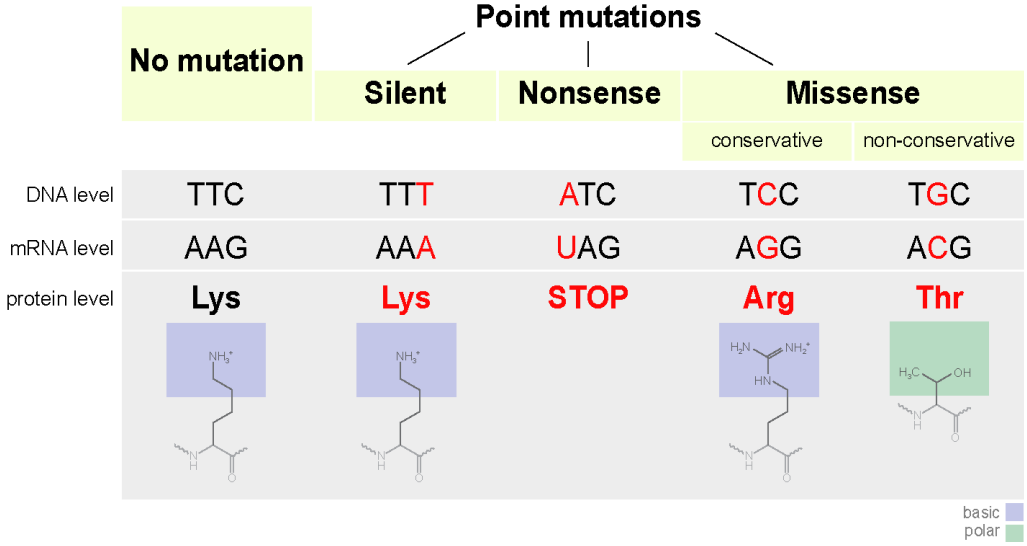
- **Point Mutation -** is a mutation that exchanges one base for another (i.e., a change in a single "chemical letter" such as switching an A to a G). Such a substitution could:
- **Insertion** - are mutations in which extra base pairs are inserted into a new place in the DNA.
- **Deltation**- are mutations in which a section of DNA is lost or deleted.
- **Translocations**- Moving big parts of a DNA sequence which can switch the entire mRNA and amino acid sequence.
- **Frameshift**- Since protein coding DNA is divided into codon three bases long, insertions and deletions can alter a gene so that the message is no longer correctly parsed. These changes are called frame shifts.

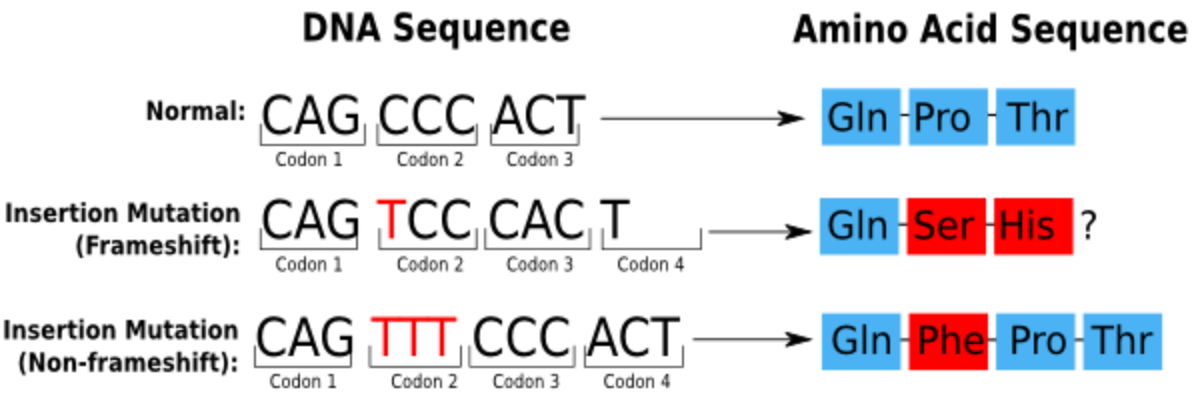
Why do Mutations go Commonly Unnoticed in the body

- Have no effect due to the multiple codons coding for the same amino acid
- Only occurs in one cell of the body
- Not detrimental to the livelihood of the cell or organism

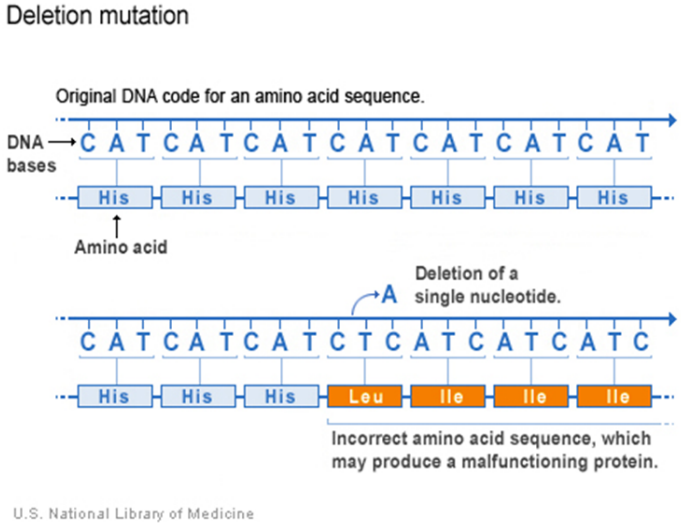
Which Mutation has Worst Effects:

- Translocations because it moves big chunks of the nitrogen bases in the base sequence which can switch most or all of the mRNA sequence and amino acid sequence.





A Deletion Mutation in a Gene



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