**Unit 5: DNA-RNA-Proteins**

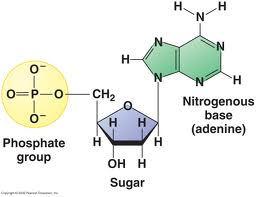
**Biomolecules: Nucleic Acids and Proteins**

1. **What is DNA?**

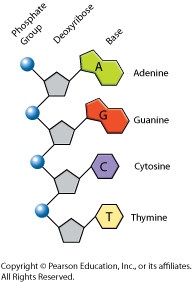
* A complex biomolecule (nucleic acid) that stores all of the cellular information in form of a code to make proteins (Genetic code)
* Has complete instructions for making all proteins for ALL organisms
* Located in the nucleus and self-replicates
* DNA= Deoxyribonucleic Acid

-Genetic material for life and is universal to all life

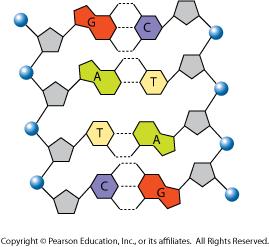
1. **History of DNA Structure**

* Scientists Watson & Crick developed a model of DNA structure
  + proposed that sugar-phosphate backbone on the outside and bases on the inside
  + DNA strands are complementary: they fit together and are opposite of each other
  + DNA is a double helix
    - Two strands of DNA wind around each other like a twisted ladder

1. **Structure of DNA**

* Small subunits that make up DNA are called nucleotides
* Each nucleotide has three parts:
  + A phosphate group
  + A simple sugar (carbohydrate) called deoxyribose
  + A nitrogen-containing base (nitrogenous base = A, T, C & G)
    - Phosphate group and deoxyribose make up backbone

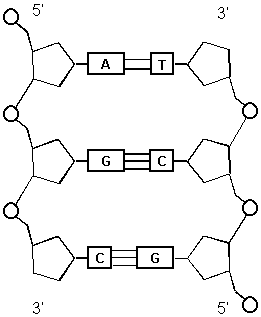
1. **Nitrogen- Containing Bases**

* Two types of nitrogenous bases
  + Purines = A & G (double ring structure)
  + Pyrimidines = T & C (single ring structure)
* 4 different nucleotides only differ in nitrogenous bases.
  + A= adenine
  + G= guanine
  + C=cytosine
  + ****T=thymine

1. **Base Pairing Rules**

* DNA molecule is Anti-parallel due to the Complementary bases

bonding in the middle

* Adenine (A) binds to Thymine (T)
  + - Contains two hydrogen bonds between the bases
* Cytosine (C) binds to Guanine (G)
  + - Contains three hydrogen bonds between the bases
* Explains Chargaff’s theory:
  + - **# of A = # of T**
    - **# of C = # of G**
    - **Example: 20 % of DNA is A**
      * **% of T = ?**
      * **% of U = ?**
      * **% of C = ?**

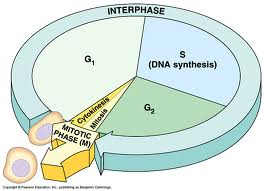
1. **DNA Characteristics**

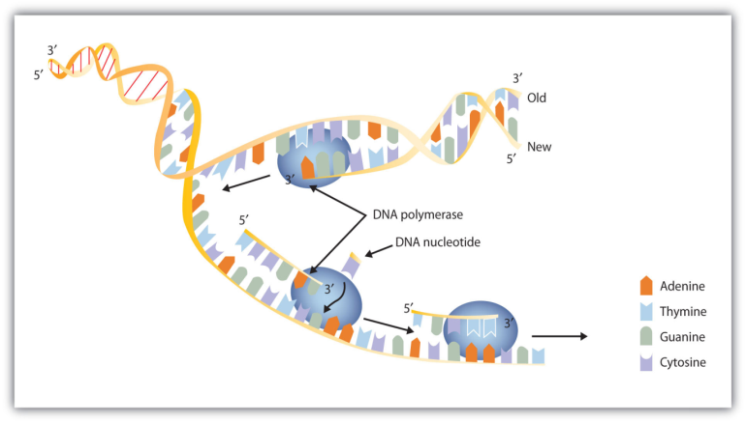
* DNA is a double helix structure
* DNA model is called Anti-parallel
  + Each strand runs in opposite direction - five prime to three prime

(5’ to 3’)

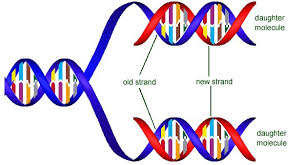
* DNA has complementary base pairing
* Contains Covalent bonds and Hydrogen bonds
* Contains Nucleotides
  + Nitrogenous bases = C, G, T & A
    - Purines & Pyrimidines
  + Phosphate group
  + Deoxyribose sugar

1. **DNA Replication**

* DNA self-replicates by Semi-Conservative
  + Produces two copies of DNA that each contains one strand of the original strands and one new strand
* Process where DNA is copied during the cell cycle (Interphase)
  + occurs during S phase of Interphase of the cell cycle

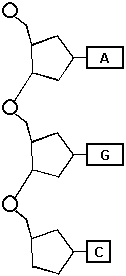
1. **DNA in Eukaryotes & Prokaryotes**
   * **Eukaryotes**
     + - Eukaryotic DNA is in the form of chromosomes
       - Replication occurs in the nucleus
       - Eukaryotes can begin self-replicating at any origin on the chromosome
       - Self-replicates in a five to three prime direction
   * **Prokaryotes** 
     + - Prokaryotic DNA is in the form of a ring
       - Replication occurs in the cytoplasm because the DNA is floating free in the cell
       - Has to begin self-replicating at the Origin of Replication
       - Self-replicates in a five to three prime direction
2. **The DNA Replication Process**
   * Replication begins at the origin. (different places for eukaryotes & prokaryotes)
3. Unzipping of the DNA molecule occurs by the action of the enzyme **Helicase** (this enzyme breaks the Hydrogen bonds between nitrogenous bases)
4. Helicase creates a replication fork and provides the two original strands as templates to create two new strands by means of semi-conservative replication
5. **The DNA Replication Process Continued…**
6. The enzyme **Primase** adds a Primer at the replication fork to begin the replication process (A primer is made of RNA nucleotides that will attach to the DNA strand)
7. **DNA polymerase III** is an enzyme that joins individual nucleotides to the growing DNA strand to produce a new strand of DNA that is complementary to the original DNA strand
   * + New bases are added in a 5’ to 3’ and according to base pairing rules:
       - A with T
       - G with C
8. **The DNA Replication Process Continued…**
9. **DNA polymerase I** removes the primer and replaces it with DNA nucleotides to complete the self-replicating process

* The primer is made of RNA nucleotides so those can’t be left in the DNA molecule
* Two identical DNA molecules result. This is Semi-Conservative Replication (Produces two copies of DNA that each contains one strand of the original stands and one new strand)



1. **The DNA Replication Process Continued…**

* DNA is composed of two anti-parallel strands which are self-replicating at the same time in a 5’ to 3’ direction
  + Leading strand – being produced continuously and being replicated towards the replication fork
  + Lagging strand – being produced discontinuously and being replicated away from the fork



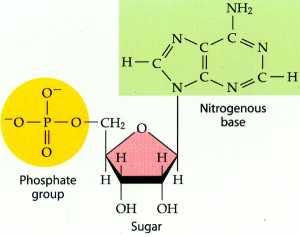
1. **What is RNA?**

* RNA = Ribonucleic Acid
* A complex biomolecule (nucleic acid) that transfers information from

DNA to make proteins

* Single strand of nucleotides
* RNA is a complimentary copy of DNA used to make proteins.

1. **RNA Nucleotides**

* Small subunits that make up RNA are called nucleotides
* Each nucleotide has three parts:
  + A phosphate group
  + A simple sugar (carbohydrate) called ribose
  + A nitrogen-containing base (nitrogenous base = A, C , G & U)
    - *U= uracil (Replaces T)*
    - A= adenine
    - G= guanine
    - C=cytosine
      * *Complementary* base pairs → **A-U & C-G**
* Phosphate group and ribose make up backbone of RNA

1. **3 Types of RNA**

* mRNA → messenger RNA
  + Carries a copy of the DNA’s instructions (code) for the creation of proteins.
* rRNA → ribosomal RNA
  + Makes up ribosomes - structures where proteins are assembled.
* tRNA → transfer RNA
  + Carries amino acids to the ribosome and matches them to the coded mRNA message.