**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.