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

**Biomolecules: Nucleic Acids and Proteins**

1. **Transcription**
* Formation of a mRNA strand which is complementary to a DNA strand
* Making mRNA from DNA in a 5’ to 3’ direction
	+ Inside the nucleus of a Eukaryotic cell
	+ Inside the cytoplasm of a Prokaryotic cell
* Transcription using the enzyme RNA polymerase





1. **Transcription Process**
2. RNA polymerase is an enzyme that separates the two DNA strands and combines to a portion of DNA that code for a specific protein.
	* Uses only one side of DNA to create a single strand of RNA
	* Uses only DNA as a template to lay RNA nucleotides in a specific order according to the DNA code
3. **Transcription Process Continued…**
4. When the DNA opens a transcription bubble occurs exposing the DNA nucleotides
5. New bases are added to a growing mRNA strand in a 5’ to 3’ direction according to the complementary base pairing rules:

DNA = A T T C G C A T T

RNA = U A A G C G U A A

1. A sequence of DNA nucleotides (terminator) will end the process of transcription and cause RNA polymerase and the mRNA strand to detach
2. **Amino Acids**
* Basic building blocks of proteins
* There are 20 common amino acids
* Amino acids are connected by peptide bonds
* A chain of amino acids is called a polypeptide chain
* The creation of the polypeptide chain (protein) occurs in ribosomes
	+ Free Ribosomes – create proteins for the cell
	+ Bounded Ribosomes – create proteins to be shipped out of the cell
1. **Codon & Anticodon**
* Every 3 nitrogenous bases on the mRNA codes for 1 amino acid. This is called a codon.
* tRNA carries the amino acids to the ribosome and matches them to the mRNA by having an anticodon
	+ Anticodon is a set of three nucleotides on tRNA that is complementary to a mRNA codon
	+ Example: Codon GGG pairs with Anticodon CCC



1. **Translation**
* Process that converts or translates the information in a sequence of nitrogenous on the mRNA into a chain of amino acids to create a protein
* Translation occurs in a 5’ to 3’ direction
* The chain of amino acids is called a polypeptide chain
* The polypeptide chain codes for a protein from a gene on the DNA molecule
1. **Translation Process**
2. Translation begins at the start codon on the mRNA. The start codon is always AUG
3. Delivers the first amino acid to the ribosome to begin to produce the polypeptide chain
* tRNA contains an anticodon that binds to the mRNA’s codon and carries one kind of amino acid.



1. **Translation Process Continued…**
2. The elongation of the polypeptide chain occurs when the next tRNA brings another amino acid to the ribosome
3. The polypeptide chains continue to grow until a stop codon appears on the mRNA
4. The tRNA brings the corresponding amino acid to stop the process of translation. Now the newly formed polypeptide (protein) is then released
5. **Determining Protein Sequence**



1. **The Central Dogma**
* **DNA→ mRNA→ Protein**
* The creation of mRNA from DNA is called Transcription
* The creation of a protein from mRNA is called Translation
1. **Comparing DNA and RNA**

|  |  |  |
| --- | --- | --- |
|  | **DNA**  | **RNA**  |
| **Type of Sugar**  |  |  |
| **Number of Strands**  |  |  |
| **Nitrogenous Bases**  |  |  |
| **Location in Cell**  |  |  |

1. **Mutations**
* A Mutation is a permanent change of the nucleotide sequence of the genome of an organism
	+ Genome is the complete DNA sequence of an organism
* Typically happens during replication if it affects a single gene
* If a mutation is not fixed, if may permanently change an organism’s DNA



1. **Effects of Mutations**
* Genetic diseases
* Cancer
* New genetic traits
* No harm at all
1. **Manipulating DNA**
* How can we manipulate DNA?
	+ Literally cut it into pieces.
	+ Done through proteins called restriction enzymes
* What can it be used for?
	+ Paternity testing
	+ Criminal Investigation
	+ Genetic Engineering
	+ Cloning
1. **Paternity and Criminal Investigations**
* Cut up fragments of DNA are put into a gel electrophoresis
* Depending on how big the segment of DNA, the further down the gel a fragment of DNA will move
* Then compare one person’s DNA to another person’s to see if they’re related
1. **Genetic Engineering**
* Cut up fragments of DNA with specific genes can be added to DNA of a fertilized egg
	+ This can give rise to organisms with new traits
	+ Example: Mice that can glow
1. **Cloning**
* Theoretically, any organism can be cloned to make a genetically identical organism



\*These two cats are clones but, they look different. This is because different genes on the same DNA can be activated by the different environments the organism grew up in



1. **Dolly the Sheep (1996)**
* She was the first mammal to be cloned from an adult cell