Unit VII DNA to RNA to protein The Central Dogma

DNA

Deoxyribonucleic acid, the material that contains information that determines inherited characteristics.

A DNA molecule is shaped like a spiral staircase and is composed of two parallel strands of linked nucleotide subunits.

Each nucleotide is made of 3 parts: a phosphate group, a five carbon sugar, and a nitrogen base. The phosphate and sugar groups make up the backbone or the sides of the ladder. The nitrogen bases make up the stairs.

Base Pairs

The information in DNA is contained within the nitrogenous bases.

4 Kinds of bases: Adenine (A) Guanine (G) Thymine (T) Cytosine (C)



Base Pairing Rule

In order to complete the double stranded structure of DNA the nitrogenous bases The following will always pair with each other:

> Adenine --- Thymine Guanine --- Cytosine

Structure of DNA

Paired bases are said to be complimentary because they fit together like puzzle pieces.

Example: If one strand is TATGAGAGT, the sequence of nitrogen bases on the other strand must be ATACTCTCA

TATGAGAGT

ATACTCTCA

Each strand contains the same information just in reverse order.

Timeline of Discovery

1928: Frederick Griffith- transfer of genetic material 1949: Erwin Chargaffobserved that the nitrogen pairs appeared in equal amounts 1952: Rosalind Franklin and Maurice Wilkins- developed high quality X-Rays images of DNA

1940: Oswald Avery-DNA was responsible for transformation in bacteria 1952: Hershey and Chase- DNA is the genetic material in viruses

1953: James Watson and Francis Crickdetermined the 3-D spiral staircase structure

DNA Replication

DNA replication is necessary before cell division so that each new cell has an identical copy of DNA

- Unwinding and Separating DNA strands: the double helix unwinds, the complementary strands separate and form a Y-shape, the replication fork.
- Adding complementary bases: At the replication fork, new nucleotides are added and new bases pairs are formed.
- **3.** Formation of two identical DNA Molecules: Each new double stranded DNA helix is made of one new strand of DNA and one original strand.

DNA Replication

During replication of DNA, many proteins form a machinelike complex of moving parts: **DNA helicases:** unwind the double helix **DNA polymerases:** add new nucleotides, and proofread to reduce errors in pairing **DNA Replication**



<u>RNA</u>

Ribonucleic acid (RNA) takes the genetic information from DNA and builds proteins.

It differs from DNA in two ways:

1. It is only single stranded

2.Instead of thymine, Adenine pairs with Uracil (U).



Types of RNA

There are 3 main types of RNA:

Messenger RNA (mRNA): DNA is transcribed to mRNA so instructions can be carried where the protein will be made.

Transfer RNA (tRNA): transfers the instructions from mRNA into specific amino acids. <u>Ribosomal RNA (rRNA): RNA that is found</u> where proteins are made.



Messenger RNA

Transfer BNA

Amino acid

Transcription

During transcription, the information in a specific region of DNA (gene) is transcribed or copied into mRNA.

- 1. Starts when RNA polymerase binds to a start location on the DNA at the 5' (prime) end.
- 2. RNA polymerase unwinds and unzips the two strands of the double helix.
- 3. RNA polymerase adds complementary RNA bases as it "reads" the gene. Base pairing rules are followed except A now pairs with U.
- 4. RNA polymerase reaches a stop location and the result is a single strand of mRNA.
- 5. The DNA strand rezips and rewinds.

DNA to RNA

AATTAGAC

UUAAUCUG



DNA



Translation

- Translation is the process of converting the language of RNA into the language of proteins.
- The mRNA start codon (3 nucleotide sequence) AUG signals the beginning of a protein chain. The tRNA anticodon UAC and an amino acid bind to the start codon.
- tRNA continues to add amino acid sequences and the chain grows.
- 3. The process is repeated until a stop codon is reached, UAG, UAA, or UGA. Protein production stops here.
- 4. The new polypeptide chain falls off the ribosome and is folded into a protein.



Transcription and Translation

Gene Expression



Gene expression is when a gene becomes expressed as a specific trait. Proteins help regulate the expression of these traits. Therefore: Gene(DNA) to protein regulates genetics.

Mutations: result from a change in a single section of the DNA. If one base is changed, it changes the results of the whole process. Sometimes these mistakes are fixed by the polymerase and sometimes they are not, resulting in different traits being expressed.