Heading

Title

**Introduction**

**Purpose**

To investigate the process of protein synthesis from the nucleus of the cell to the ribosomes in the cytoplasm where the actual amino acids are combined into amino acid chains and polypeptide molecules.

# Discussion

There are FIVE parts to this lab exercise, totaling 50 points.

* Part I is the drawing of the model of a **DNA molecule**, showing the **double helix** with 12 *nucleotide* chains and a *compliment* *strand* bonded together with **hydrogen bonds**. (5 pts)
* Part II will demonstrate **DNA replication** in the process of **mitosis**. You will show both DNA strands in the double helix being replicated. This process takes place entirely in the *nucleus* of the cell. (7 pts)
* Part III shows the **overall process of protein synthesis**, starting from DNA in the *nucleus* being *transcribed* to mRNA which passes into the *cytoplasm* where it is *translated* to the tRNA molecule at the *ribosome*. (10 pts: 5 pts per drawing)
* Part IV will display the **transcription of DNA** by the mRNA molecule which takes place in the nucleus of the cell. You will show the **CODON of the mRNA molecule** which is a triplet of nucleotides formed as a *compliment* to the DNA **template**. (5 pts)
* Part V will reveal the **translation of mRNA** to the tRNA molecule which takes place in the cytoplasm at the ribosome. You will show the **ANTICODON of the tRNA** molecule which is a *complimentary triplet* of the mRNA nucleotide sequence. You will use the mRNA-amino acid chart to determine the polypeptide sequence. (5 + 5 pts for amino acid sequence)

**Materials** Class Notes Textbook

**PART I a Model of the DNA molecule (5 pts)**

**Procedures**

1. Use the following nucleotide sequence: CAT CGC GAA AAA to create or draw a model of the DNA molecule on the next page.
2. Show all of the following items in the model with the symbol indicated. Copy and paste the items below as needed.
3. **Nucleotides**

P

1. a phosphate group
2. a nitrogen base

G

C

A

T

G

C

A

T

 adenine thymine guanine cytosine

doR

1. a deoxyribose sugar
2. **Complimentary strand** of DNA molecule 🡪 complimenting CAT CGC GAA AAA
3. **Hydrogen bonds** between the two strands of the DNA molecule (*dashed lines above*)
4. Adenine (A) and Thymine (T) have 2 hydrogen bonds between the strands
5. Cytosine (C) and Guanine (G) have 3 hydrogen bonds between the strands

**Questions (1 pt each)**

1. What is the general name for the shape of the DNA molecule as discovered by Watson and Crick?
2. What holds the two strands of DNA together?

3. Complete the DNA model using the initial strand shown below. Copy and paste item as needed.

doR

P

P

doR

C

G

doR

P

P

doR

A

T

doR

P

P

doR

T

A

*Continue making the rest of the nucleotide sequence* (CAT CGC GAA AAA) *& its compliment*.

**PART II A Model of DNA Replication (7 pts)**

**Procedures**

* Use ONLY the nucleotide sequence of both strands of the DNA molecule you drew in Part I (*CAT CGC GAA AAA and its compliment*) to draw a model of DNA replication.
1. Draw the double helix of two strands of 12 complimentary nucleotides.
2. Draw the two complimentary nucleotide strands separated by an organic molecule.
3. Show the 2 new double helix DNA molecules formed as a result of DNA replication.

**Questions (1 pt each)**

1. During what process of cell division does DNA replication occur? \_\_\_\_\_
2. Where in the cell does DNA replication take place?
3. What general type of organic molecule (*a kind of protein*) is necessary for DNA replication to occur? (*In other words, what organic molecule is necessary to break apart the Hydrogen bonds of the DNA strands and then another one allows the DNA strands to replicate*.)

**PART III An Overview of Protein Synthesis (10 pts)**

**Label the Cell drawing** above using the terms: (5 pts)

Cytoplasm DNA Endoplasmic Reticulum mRNA

Nucleus Ribosome tRNA

C**omplete the equation** below using the terms: (5 pts)

Amino Acid Sequence Cytoplasm DNA Enzyme mRNA

Nucleus Ribosome tRNA Transcription Translation

**PART IV A Model of the Transcription of a DNA molecule (5 pts)**

DNA

 Strand

mRNA Strand

**Procedures**

C

A

T

C

G

C

G

A

A

A

A

A

G

U

A

* Use ONLY the nucleotide sequence of one strand of the DNA molecule you drew in Part I (CAT CGC GAA AAA) to draw a model of the DNA molecule being transcribed.
1. Line up the triplet sequences of nucleotides from the left strand of the double helix of DNA as shown to the right.
2. Show the complimentary nucleotide sequence of mRNA.
3. Show the hydrogen bonds between each nitrogen base of the two strands of nucleotides (A, T & U have 2 hydrogen bonds and G & C have 3 hydrogen bonds between them).

**Questions** (1 pt each)

1. Where does the process of DNA transcription occur in the cell? \_\_\_\_\_
2. What is the name of the “triplet” sequence of nucleotides formed by mRNA when transcribed from a DNA nucleotide sequence?
3. What is the nucleotide sequence of the DNA strand called generally?
4. What general type of organic molecule (*a kind of protein*) is necessary for DNA transcription to occur? (*In other words, what organic molecule is necessary to break apart the Hydrogen bonds of the DNA strands to allow mRNA to transcribe its message?)*

**PART V A Model of the Translation of mRNA to form an Amino Acid Chain (7 pts)**

**Procedure**

1. Use ONLY the nucleotide sequence of the mRNA formed in Part IV.
2. Show the complimentary nucleotide sequence of tRNA bonded to the mRNA as in Part IV.

**Questions** (1 pts each)

1. At what organelle does the process of mRNA translation occur in the cell?
2. What is the name of the “triplet” sequence of nucleotides formed by tRNA when translated from a mRNA nucleotide sequence?
3. Each triplet nucleotide sequence of the tRNA represents an \_\_\_\_\_.
4. What is end product of **mRNA** translation? Use the chart below to determine the actual amino acid chain formed as a result of protein synthesis in this lab.

14. Compare the DNA nucleotide sequence to the tRNA nucleotide sequence. SHOW BOTH. [2]

15. Complete the table below to summarize the entire lab [4]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DNA base sequence | Process | mRNA Codon | Process | tRNA Anticodon | Amino Acid |
| CAT | transcription |  | translation |  |  |
| CGC |  |  |  |
| GAA |  |  |  |
| AAA |  |  |  |

This table shows the 64 codons and the amino acid each codon codes for. The direction of the **mRNA** is [5' to 3'](file:///E%3A%5Cwiki%5CDirectionality_%28molecular_biology%29).

|  |  |  |
| --- | --- | --- |
| **1stbase** | **2nd base** | **3rd base** |
| **U** | **C** | **A** | G |
|  | **U** | UUU [Phenylalanine](file:///E%3A%5Cwiki%5CPhenylalanine)UUC PhenylalanineUUA [Leucine](file:///E%3A%5Cwiki%5CLeucine)UUG Leucine | UCU [Serine](file:///E%3A%5Cwiki%5CSerine)UCC SerineUCA SerineUCG Serine | UAU [Tyrosine](file:///E%3A%5Cwiki%5CTyrosine)UAC TyrosineUAA (*Stop*)UAG (*Stop*) | UGU [Cysteine](file:///E%3A%5Cwiki%5CCysteine)UGC CysteineUGA (*Stop*)UGG [Tryptophan](file:///E%3A%5Cwiki%5CTryptophan) | U |
| C |
| A |
| G |
| **C** | CUU LeucineCUC LeucineCUA LeucineCUG Leucine | CCU [Proline](file:///E%3A%5Cwiki%5CProline)CCC ProlineCCA ProlineCCG Proline | CAU [Histidine](file:///E%3A%5Cwiki%5CHistidine)CAC HistidineCAA [Glutamine](file:///E%3A%5Cwiki%5CGlutamine)CAG Glutamine | CGU [Arginine](file:///E%3A%5Cwiki%5CArginine)CGC ArginineCGA ArginineCGG Arginine | U |
| C |
| A |
| G |
| **A** | AUU [Isoleucine](file:///E%3A%5Cwiki%5CIsoleucine)AUC IsoleucineAUA IsoleucineAUG [Methionine](file:///E%3A%5Cwiki%5CMethionine) | ACU [Threonine](file:///E%3A%5Cwiki%5CThreonine)ACC ThreonineACA ThreonineACG Threonine | AAU [Asparagine](file:///E%3A%5Cwiki%5CAsparagine)AAC AsparagineAAA [Lysine](file:///E%3A%5Cwiki%5CLysine)AAG Lysine | AGU SerineAGC SerineAGA ArginineAGG Arginine | U |
| C |
| A |
| G |
| **G** | GUU [Valine](file:///E%3A%5Cwiki%5CValine)GUC ValineGUA ValineGUG Valine | GCU [Alanine](file:///E%3A%5Cwiki%5CAlanine)GCC AlanineGCA AlanineGCG Alanine | GAU [Aspartic acid](file:///E%3A%5Cwiki%5CAspartic_acid)GAC Aspartic acidGAA [Glutamic acid](file:///E%3A%5Cwiki%5CGlutamic_acid)GAG Glutamic acid | GGU [Glycine](file:///E%3A%5Cwiki%5CGlycine)GGC GlycineGGA GlycineGGG Glycine | U |
| C |
| A |
| G |