Lab 6: The Central Dogma — From DNA to Protein

BIOL-8

Name: _____ **Date:** _____

Name: [ ] **Date:** [ ]

Objectives

By the end of this lab, you will be able to:

- **Model DNA replication** by drawing complementary strands.
- **Perform transcription** by converting a DNA template strand into an mRNA sequence.
- **Perform translation** by decoding mRNA codons into an amino acid chain.
- **Trace the flow of genetic information** from DNA → RNA → Protein (the Central Dogma).
- **Use a codon table** to identify amino acids.
- **Simulate a mutation** and observe its effect on the final protein.

Introduction

The **Central Dogma of Molecular Biology** describes the flow of genetic information:

DNA (Nucleus) —> **mRNA** (Nucleus → Cytoplasm) —> **PROTEIN** (Ribosome)

In this lab, we will use a **digital dashboard** to simulate these processes step-by-step as a class, while you **draw and record** the results on this worksheet.

Key Terms:

Term	Definition
Nucleotide	Building block of DNA/RNA (base + sugar + phosphate)
Complementary base pairing	A pairs with T (DNA) or U (RNA); G pairs with C
Codon	

Term	Definition
	Three-nucleotide sequence on mRNA that codes for an amino acid
Start codon	AUG — signals the beginning of translation (Methionine)
Stop codon	UAA, UAG, UGA — signals the end of translation

Materials

- Computer/Tablet with Lab 6 Dashboard open
- Colored pencils or markers (4 colors recommended)
- This lab packet

Part 1: DNA Replication

> ***Dashboard Tool:*** *Go to* ***Part 1: DNA Replication****.*

Background

Before a cell divides, it must copy its DNA. **Helicase** unzips the strands, and **DNA Polymerase** builds new ones.

Procedure

1. On the dashboard, you will see a **Template Strand**.
2. Use the buttons to build the complementary **New Strand**.
3. Once verified on the screen, **draw/write** the sequence below.

Template Strand (3' to 5'):
`T A C A A G T T T G C A C C G A T T`

Complementary New Strand (5' to 3'):

> **1. Why is DNA replication called "semi-conservative"?**

2. Which enzyme is responsible for adding the new nucleotides?

Part 2: Transcription — DNA → mRNA

> ***Dashboard Tool:*** *Click* ***Next: Transcription****.*

Background

RNA Polymerase reads the DNA template and builds a single-stranded **mRNA** message to send to the ribosome. Remember: **RNA uses Uracil (U)** instead of Thymine (T).

Procedure

1. The dashboard shows the same gene's DNA template.
2. Transcribe it into mRNA using the on-screen tools.
3. **Record** your mRNA sequence below. By convention, write mRNA 5' to 3'.

DNA Template: `TAC AAG TTT GCA CCG ATT`

mRNA Sequence:

5'— _____ —3'

3. Where in the cell does transcription occur?

4. Compare your mRNA sequence to the "New Strand" of DNA you wrote in Part 1. What is the observable difference?

Part 3: Translation — mRNA → Protein

> ***Dashboard Tool:*** *Click* ***Next: Translation****.*

Background

The ribosome reads mRNA in triplets called **codons**. **tRNA** molecules bring the matching amino acids.

Procedure

1. The dashboard displays your mRNA sequence.
2. Use the on-screen **Codon Table** to find the amino acid for each triplet.
3. Click the amino acid buttons to build the protein chain.
4. **Write** the final amino acid sequence below.

Polypeptide Chain (Protein):

_ _ _
_ _ _
_ _

(Note: If you encounter a STOP codon, write "STOP" and do not add more amino acids)

5. What is the start postion (codon)?

6. What amino acid does the start codon (AUG) always code for?

Part 4: Mutation Simulation

> ***Dashboard Tool:*** *Click* ***Part 4: Mutation Builder****.*

Procedure

1. Change the **4th Codon** of the original DNA Sequence.
    - Original DNA: `GCA` (codes for Arg in mRNA -> CGU) -> *Wait, let's check the dashboard logic.*
    - *Correction*: DNA `GCA` -> mRNA `CGU` -> AA `Arg`.
2. In the dashboard mutation tool, change the DNA base **C** to **T** in that codon (so it becomes `GTA`).
3. Observe how the mRNA and Protein change.

Original DNA Codon: `GCA` -> **Amino Acid:** Arginine (Arg)

Mutated DNA Codon: `GTA`

New mRNA Codon:

New Amino Acid:

7. Did this mutation change the protein structure?

8. This type of mutation (changing one base) is called a:

A) Frameshift

B) Deletion

C) Point Mutation (Substitution)

Conclusion

9. Summarize the flow of information in one sentence (The Central Dogma):

10. Why is the shape of the final protein so important? (Think about enzymes from the previous lab!)

End of Lab 6