# Lab 6: The Central Dogma — From DNA to Protein

*BIOL-8*

**Name:** _____ **Date:** _____

## Objectives

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

- **Model DNA replication** by determining 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.

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## Introduction

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

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

In this lab, you will follow a gene through these steps to see how a sequence of DNA bases becomes a functional protein.

**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** | Three-nucleotide sequence on mRNA that codes for an amino acid |
| **Start codon** | AUG — signals the beginning of translation (Methionine) |

| Term | Definition |
| --- | --- |
| **Stop codon** | UAA, UAG, UGA — signals the end of translation |

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## 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. Below is a **Template Strand** of DNA.
2. Determine the **Complementary New Strand**.
3. Remember the base pairing rules for DNA:
    - **A** pairs with **T**
    - **C** pairs with **G**

**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. Where in the cell does DNA replication occur? (Hint: Where is the DNA kept?)**

**2. If the template strand has 20% Adenine (A), what percentage of Thymine (T) would be in the new strand?**

**3. Why is it important for DNA to be copied accurately before a cell divides?**

**4. Which enzyme acts as the "builder" to add new nucleotides?**

## Part 2: Transcription — DNA → mRNA

### Background

**RNA Polymerase** reads the DNA template and builds a single-stranded **mRNA** message to send to the ribosome.

**Important Difference:** RNA does not have Thymine (T). Instead, it uses **Uracil (U)**.

- DNA **A** pairs with RNA **U**
- DNA **T** pairs with RNA **A**

### Procedure

1. Use the same **DNA Template** from Part 1.
2. Transcribe it into **mRNA**.

**DNA Template:** `TAC AAG TTT GCA CCG ATT`

**mRNA Sequence:**
5'— _____ —3'

**5. Where in the eukaryotic cell does transcription occur?**

**6. What is the name of the enzyme that builds the mRNA molecule?**

**7. How is the structure of RNA different from DNA? (List at least two differences)**

**8. If a DNA strand reads `A-T-G`, what will the mRNA read?**

## Part 3: Translation — mRNA → Protein

### Background

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

### Procedure

1. Look at your **mRNA sequence** from Part 2.
2. Group the bases into **triplets (codons)**.
3. Use a **Codon Table** to find the amino acid for each triplet.
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)*

**9. Which organelle is the site of protein synthesis (Translation)?**

**10. What is the very first amino acid in almost every protein? (Hint: Look at the start codon)**

**11. What is the job of tRNA (transfer RNA)?**

**12. How many bases make up one codon?**

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## Part 4: Mutation Simulation

### Background

A **mutation** is a change in the DNA sequence. Even a single base change can alter the protein.

### Procedure

1. Let's simulate a **Point Mutation**.
2. Look at the **4th Codon** of the original DNA Sequence: `GCA`
    - Originally, this transcribed to mRNA `CGU`, which coded for **Arginine (Arg)**.
3. **Change the DNA base C to T**, so the codon becomes `GTA`.
4. Determine the new mRNA codon and the new amino acid.

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

**Mutated DNA Codon:** `GTA`

**New mRNA Codon:**

**New Amino Acid:**

**13. Did this mutation change the amino acid sequence?**

**14. What might happen to the protein's function if its shape changes?**

**15. Are all mutations bad? Explain why or why not.**

## Conclusion

**16. Summarize the flow of information in the Central Dogma:**

**17. Why do you think the cell uses an intermediate (mRNA) instead of using DNA directly for protein synthesis?**

*End of Lab 6*