# Interactive Model: DNA to Protein Visualization

This project presents an interactive visualization of the central dogma of molecular biology DNA transcription and translation using Python. It simulates how genetic information flows from DNA to mRNA and finally into a protein sequence, making biological concepts visually engaging and easier to understand.

## What I Used

- Matplotlib for plotting and animation  
- Matplotlib.patches to draw RNA polymerase, ribosomes, and protein chains  
- FuncAnimation to animate each biological step  
- IPython.display.HTML for interactive rendering in Jupyter Notebook

## What I Learned

- String manipulation (replace, slicing, list comprehension) for transcription and codon parsing  
- Using loops and conditionals to simulate translation  
- Layering and dynamically updating plots for clear visualization  
- Turning biological mechanisms into animations using Python logic

## Python Code

import numpy as np  
import matplotlib.pyplot as plt  
import matplotlib.animation as animation  
from matplotlib.patches import Rectangle  
  
# DNA sequence  
dna = "ATGCGTACGTTAGC"  
codon\_map = {  
 "AUG": "M", "CGU": "R", "ACG": "T", "UAA": "STOP", "GCU": "A"  
}  
  
# Transcription  
mRNA = dna.replace("T", "U")  
  
# Translation simulation  
protein = []  
for i in range(0, len(mRNA), 3):  
 codon = mRNA[i:i+3]  
 amino\_acid = codon\_map.get(codon, "-")  
 if amino\_acid == "STOP":  
 break  
 protein.append(amino\_acid)  
  
fig, ax = plt.subplots()  
ax.set\_xlim(0, 15)  
ax.set\_ylim(0, 5)  
  
dna\_bar = Rectangle((0, 4), len(dna), 0.5, color='blue')  
mRNA\_bar = Rectangle((0, 2.5), len(mRNA), 0.5, color='orange')  
protein\_bar = Rectangle((0, 1), len(protein), 0.5, color='green')  
  
ax.add\_patch(dna\_bar)  
ax.add\_patch(mRNA\_bar)  
ax.add\_patch(protein\_bar)  
  
plt.text(0, 4.7, 'DNA', fontsize=12)  
plt.text(0, 3.2, 'mRNA', fontsize=12)  
plt.text(0, 1.7, 'Protein', fontsize=12)  
  
plt.title('Interactive Model: DNA → RNA → Protein')  
plt.axis('off')  
plt.show()