PEEBEDU

Nucleic Acid Builder

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

> Open **peebedu.com** and navigate to **Nucleic Acid Builder**. Click the **Start Learning** button to begin. The simulation contains 7 progressive missions that guide you through building nucleotides, applying base pairing rules, comparing DNA and RNA, and exploring genome organization.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Nucleic Acid Builder as a scientific model.

M — Mode

What type of model is the Nucleic Acid Builder? Describe how this computational simulation represents nucleic acid structure and function. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about nucleic acids.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about nucleic acid structure. For each, name the specific simulation feature and explain what structural or functional property of nucleic acids it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about nucleic acid structure. Consider what you cannot observe in the simulation that would be important for a complete understanding of how DNA and RNA function in living cells.

P — Purpose

What is the learning goal of this simulation? Explain how the Nucleic Acid Builder is designed to help you understand how nucleotides are organized into DNA and RNA, and why the structural differences between these molecules determine their biological roles. In your answer, connect at least one specific simulation feature to the importance of nucleic acid structure for storing and transmitting genetic information.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries about nucleic acid structure or function might change or improve a simulation like the Nucleic Acid Builder. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- How does building nucleotides component by component help you understand the relationship between structure and function in nucleic acids?
- What limitations does the simulation have in representing the full complexity of DNA and RNA in living cells?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the simulation help you connect the molecular structure of individual nucleotides to the larger concept of biological information storage?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Complementary Base Pairing in DNA

> *Simulation Task: Click the Select Mission button and open Mission 3 (The Base Pairing Rules). A template DNA strand is displayed with four bases reading 5′ to 3′. Select bases from the toolbox and place each one into the correct complementary position on the opposite strand. Click the Check button to verify your answers, then observe the antiparallel orientation labels on both strands.*

(A) (1 pt) **Describe** the structure of the DNA double helix, including the antiparallel orientation of the two strands and the base pairing rules that hold them together.

(B) (1 pt) **Explain** why adenine pairs specifically with thymine and guanine pairs specifically with cytosine in DNA.

(C) (1 pt) **Predict** what would happen to the structure and function of a DNA molecule if a mutation caused guanine to pair with adenine instead of cytosine at multiple positions along one strand.

(D) (1 pt) **Justify** your prediction by explaining how complementary base pairing maintains the consistency of the DNA double helix and the accuracy of the information encoded in the nucleotide sequence.

EK 1.6.A.3

Analyze Model / Visual Representation

Question 2 — Structural Differences Between DNA and RNA

> *Simulation Task: Click the Select Mission button and open Mission 4 (DNA vs RNA). Build a complete DNA nucleotide on the left side by selecting and placing a phosphate, deoxyribose, and thymine. Then build a complete RNA nucleotide on the right side by selecting and placing a phosphate, ribose, and uracil. Click the Check button and read the comparison information that appears.*

(A) (1 pt) **Describe** the two structural differences between DNA nucleotides and RNA nucleotides, identifying the specific components that differ.

(B) (1 pt) **Explain** how the structural differences between DNA and RNA relate to their different biological roles, including why DNA is suited for long-term information storage and RNA is suited for temporary information transfer.

(C) (1 pt) **Represent** the structural differences between DNA and RNA at the nucleotide level.

Draw your diagrams here.

(D) (1 pt) **Explain** how the structural differences between DNA and RNA are essential for gene expression.

EK 1.6.A.4