PEEBEDU # Nucleic Acid Builder
Unit 1: Chemistry of Life

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 — NGSS Questions

1.

> *Simulation Task: Click the Select Mission button and open Mission 1 (Build a DNA Nucleotide). Select a phosphate from the toolbox and place it in the phosphate slot, then select deoxyribose and place it in the sugar slot, and finally select any DNA base (adenine, thymine, guanine, or cytosine) and place it in the base slot. Click the Check button to verify your nucleotide.*

Describe the three components of a DNA nucleotide and explain how each component contributes to the overall structure of a DNA molecule. In your answer, identify which components form the backbone of the DNA strand and which component carries genetic information.

HS-LS1-1

2.

> *Simulation Task: Click the Select Mission button and open Mission 3 (The Base Pairing Rules). A template DNA strand is displayed reading 5′ to 3′ with four bases. 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 and observe the antiparallel orientation labels on both strands.*

Explain the base pairing rules that hold the two strands of DNA together. Describe why adenine pairs only with thymine and guanine pairs only with cytosine, and explain how this complementary base pairing allows DNA to store genetic information reliably.

HS-LS1-1

3.

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

Identify the two structural differences between DNA nucleotides and RNA nucleotides. Explain how these differences relate to the different roles each molecule plays in cells, including why DNA is suited for long-term storage of genetic instructions and RNA is suited for carrying those instructions to where proteins are built.

HS-LS1-1

4.

> *Simulation Task: Click the Select Mission button and open Mission 6 (Eukaryotic Chromosomes). Place histones into the three histone slots along the DNA strand inside the nucleus, then place linear chromosomes into the two chromosome slots. Click the Check button and read the completion information about DNA packaging levels.*

Describe how DNA is organized inside a eukaryotic cell. Explain why DNA must be wrapped around histone proteins and packaged into chromosomes, and how this organization allows approximately two meters of DNA to fit inside a nucleus that is only a few micrometers wide.

HS-LS1-1

5.

> *Simulation Task: Click the Select Mission button and open Mission 7 (Genetic Information Challenge). A template DNA strand reads 3′ to 5′ with bases T, A, and C. Place the correct complementary DNA bases (A, T, G) on the opposite strand, then place the correct mRNA bases (A, U, G) in the mRNA section below. Click the Check button to verify your answers.*

Explain how the sequence of bases in a DNA strand determines the sequence of bases in an mRNA molecule. Describe how the base pairing rules you used in the simulation allow genetic information to be accurately copied from DNA into RNA.

HS-LS3-1

6.

> *Simulation Task: Complete Mission 1 (Build a DNA Nucleotide) and Mission 2 (Build an RNA Nucleotide) if you have not already. After completing each mission, read the educational information that appears. Pay attention to the color-coded components: purple phosphate, pink deoxyribose (DNA) versus teal ribose (RNA), and the different base shapes.*

In the box below, draw a labeled diagram of a short section of double-stranded DNA showing at least two nucleotides on each strand. Label the phosphate groups, sugars, and bases. Show hydrogen bonds between complementary base pairs and indicate the antiparallel orientation of the two strands using 5′ and 3′ labels.

Draw your diagram here.

HS-LS3-1

7.

> *Simulation Task: Click the Select Mission button and open Mission 3 (The Base Pairing Rules). After correctly placing all four complementary bases and clicking Check, imagine that one of the bases on the template strand were changed to a different base. Consider how this would affect the complementary strand and the information encoded in that section of DNA.*

A change in a single base within a DNA sequence is one type of mutation. Using what you learned about base pairing in the simulation, explain how a single base change in a DNA strand could alter the genetic instructions carried by that molecule. Describe how such a change could be passed to future generations of cells and potentially affect the traits of an organism.

HS-LS3-2