PEEBEDU

Cell Cycle Simulator

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

> Open **peebedu.com** and navigate to **Cell Cycle Simulator**. Click **Begin Exploring** to dismiss the introduction popup. Read the Cell Cycle Stages Reference panel at the bottom of the screen, which describes each phase of interphase and mitosis. Place a starting cell, add nutrients, and press **Play** to watch a cell progress through the cycle.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Cell Cycle Simulator as a scientific model.

M — Mode

What type of model is the Cell Cycle Simulator? Describe how this computational simulation represents the eukaryotic cell cycle. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about cell division.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about the cell cycle. For each, name the specific simulation feature and explain what aspect of the cell cycle it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about the cell cycle. Consider what you cannot observe in the simulation that would be important for a complete molecular-level understanding of cell division.

P — Purpose

What is the learning goal of this simulation? Explain how the Cell Cycle Simulator is designed to help you understand how eukaryotic cells grow and divide through a regulated series of stages. In your answer, connect at least one specific simulation feature to a biological reason why cell cycle regulation matters for a multicellular organism.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Cell Cycle Simulator. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for the cell cycle?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the simulation help you connect observable cell behaviors to the molecular events occurring at each stage?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Cell Cycle Stages and Growth

> *Simulation Task: Set Cell Type to “Patient 1,” Viability to “Viable,” Starting Phase to “G1 Phase,” and Cell Age to “Young (0%).” Place one starting cell, add nutrients using the “Concentric Circles” pattern, and press Play at 1x speed. Observe the cell as it progresses through each stage. After the first division occurs, increase the speed to 5x and let the simulation run until the population reaches at least 20 cells. Note the population graph and activity log.*

(A) (1 pt) **Describe** the sequential stages of the eukaryotic cell cycle, including what occurs during G1, S, G2, and mitosis.

(B) (1 pt) **Explain** how the requirement for nutrients in the simulation models the role of internal checkpoints that regulate whether a cell progresses through the cell cycle.

(C) (1 pt) **Predict** what would happen to the cell population growth curve if you removed all nutrients from the simulation field after 10 cells had formed.

(D) (1 pt) **Justify** your prediction by explaining how the absence of resources would affect cell cycle progression at specific checkpoints and how this relates to cells entering G0.

EK 4.5.A.1, 4.6.A.1

Analyze Model / Visual Representation

Question 2 — Cancer and Cell Cycle Disruption

> *Simulation Task: Clear the simulation. Place one "Patient 1" viable cell and one "Cancer" cell side by side. Add nutrients and press Play at 5x speed. After 2 minutes of simulation time, click "Spray Colchicine" and observe what happens to both cell populations. Compare the population graph, the statistics panel, and the activity log for normal versus cancer cells.*

(A) (1 pt) **Describe** how disruptions to cell cycle regulation can lead to uncontrolled cell division.

(B) (1 pt) **Explain** the relationship between the behavior of cancer cells in the simulation and the loss of checkpoint function in real cancer cells, including why cancer cells continue to divide when normal cells enter G0 or undergo apoptosis.

(C) (1 pt) **Represent** the difference between normal and cancer cell populations over time.

Draw your graph here.

(D) (1 pt) **Explain** how mutations in genes that encode cell cycle regulators, such as tumor suppressors or proto-oncogenes, connect the disruption of the cell cycle observed in the simulation to changes in gene expression.

EK 4.6.B.1, 4.6.A.2