Name: **Date:** **Section:**

Cell Cycle Simulator Activity: Modeling Cell Division

Investigating Cell Cycle Regulation and Mitosis

Phase 1: ENGAGE (10 minutes)

Getting Started:

Open peebedu.com and navigate to Cell Cycle Simulator

Read the introduction popup to understand the stages of the cell cycle.

Initial Investigation:

Cancer cells divide uncontrollably, while normal cells divide in a regulated manner. What controls this difference? _____

Pre-Investigation Questions:

1. List the phases of the cell cycle in order:

Mitosis: _____, _____, _____, _____, _____

1. Based on the introduction, what do cells need to progress through G1? _____

Think-Pair-Share:

- What might happen if cell cycle checkpoints fail? _____

Phase 2: EXPLORE (15 minutes)

Systematic Investigation of Cell Cycle Control

Part A: Normal Cell Division

1. Click "Place Starting Cell" and select "Patient 1 (Normal)"
2. Place a cell and click "Play"

Initial Observations:

- Starting phase (color): _____

1. Add nutrients using "Add Nutrients" button

- **Observation:** What actually happened? _____

Part B: Environmental Effects

1. Test temperature effects:

- Set temperature to 20°C and observe
- Set temperature to 45°C and observe

Part C: Cell Cycle Disruption

1. Select "Patient 3 (Colchicine-sensitive)" and repeat

- Add nutrients and observe
- Spray colchicine when cells reach anaphase

Part D: Cancer Cell Behavior

1. Select "Patient 4 (Cancer)"

- **Observation:** After nutrient consumption: _____

Pattern Check: Compare with partner:

- Normal vs cancer cell division timing
- Role of nutrients in cell cycle progression

Phase 3: EXPLAIN (10 minutes)

Pattern Analysis and Cell Cycle Regulation

1. **Create a Cell Cycle Diagram:**

Draw and label showing:

- All phases with correct colors
- Where nutrients are required
- Major events in each phase
- Approximate time in each phase

1. **Identify Key Patterns (List 3):**

- Pattern 2: Temperature affects _____ phases but not _____

1. **Checkpoint Analysis:**

Complete the cause-effect chains:

- No nutrients → Cell enters _____ → Division _____
- Cancer mutation → Checkpoint _____ → Rapid _____

1. **Data Analysis:**

From your observations, calculate:

- Normal cell cycle duration: _____ seconds
- Percentage of cycle in mitosis: _____%

Phase 4: ELABORATE (10 minutes)

Investigating Cell Cycle Disruptions

Scenario Testing: How do different conditions affect the cell population? _____

1. **Design an Experiment:**

Setup 1: Add nutrients every 30 seconds

Setup 2: Add nutrients once at start

Setup 3: No nutrients added

Predictions:

- Setup 1: _____
- Setup 3: _____

1. **Test and Record:**

Run each setup for 2 minutes. Graph cell numbers over time.

1. **Clinical Applications:**

Based on your observations:

- Why might chemotherapy drugs target rapidly dividing cells? _____
- Why do cancer cells ignore normal growth signals? _____

Phase 5: EVALUATE (5 minutes)

Assessment Questions

1. **Pattern Recognition:** Describe three regulatory mechanisms that control normal cell division. For each, explain what happens when it fails. (4 pts)

1. **Cell Cycle Analysis:** A cell has been in G1 for 10 minutes despite adequate nutrients. Propose two possible explanations based on your observations. (3 pts)

1. **Systems Thinking:** Explain how the cell cycle demonstrates the relationship between cell communication (Unit 4.1-4.4) and cell division (Unit 4.5-4.6). Include specific checkpoints. (3 pts)

Model Evaluation: Complete the Model Evaluation Form noting:

- Which aspects of the cell cycle are accurately represented
- What simplifications exist (e.g., timing, checkpoint complexity)
- How this helps understand cancer biology

Population Growth Curves:

Download the CSV data and analyze:

- Exponential growth phase timing
- Plateau phase (carrying capacity)
- Effect of different patient types on growth rate

Research Connection:

How do real chemotherapy drugs like taxol or vinblastine affect the cell cycle compared to colchicine in this simulation? _____