

Name: _____ Period: _____ Date: _____

Open **peebedu.com** and navigate to **Cell Signaling Interactive**. Read the Introduction popup, which describes three categories of cell signaling: direct contact, short distance, and long distance. Then explore all four simulation tabs: Quorum Sensing, Plasmodesmata, Morphogen Gradient, and Pheromone Guidance.

Part 1 – Model Evaluation (MAPP Framework)

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

M – Mode

What type of model is the Cell Signaling Interactive? Describe how this computational simulation represents cell communication. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about how cells signal one another.

A – Accuracy

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

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

P – Purpose

What is the learning goal of this simulation? Explain how the Cell Signaling Interactive is designed to help you understand how cells communicate through chemical signaling across different distances. In your answer, connect at least one specific simulation feature to a biological context where that type of signaling is critical for organism function.

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 Signaling Interactive. 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 cell communication?
- 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 the concept of ligand-receptor binding to coordinated cellular responses?

Part 2 – NGSS Questions

1.

Simulation Task: In the Quorum Sensing simulation, set the population density slider to 20 cells and click Start Simulation. Watch the cyan autoinducer dots spread and read the Global Concentration meter. Then increase the slider to 150 cells and observe whether cells switch from blue (OFF) to green (ON).

Describe how the bacteria in this simulation detect when their population is large enough to act as a group. Explain what role the signaling molecules and the receptors on each cell play in triggering this coordinated response.

HS-LS1-2

2.

Simulation Task: Keep the Quorum Sensing simulation running at 150 cells. Observe the purple biofilm matrix that forms once the population exceeds the threshold. Read the counter showing the number of anchored biofilm units.

Explain how the formation of biofilm after cells receive the quorum sensing signal demonstrates that chemical communication between cells can lead to a group behavior that benefits the whole population. Describe one advantage biofilm provides to the bacteria.

HS-LS1-2

3.

Simulation Task: Navigate to the Plasmodesmata (Plants) simulation. Observe the yellow signal molecules passing through the channels that connect neighboring plant cells and watch for the green glow that indicates a cell has become activated.

Explain how plasmodesmata allow plant cells to communicate by passing signaling molecules directly from one cell to the next without releasing them outside the cell. Describe how this direct connection helps a plant tissue respond quickly and in a coordinated way to a change in the environment, such as a drought.

HS-LS1-2

4.

Simulation Task: Navigate to the Morphogen Gradient (Embryo) simulation. Observe the yellow morphogen molecules diffusing outward from the organizing center. Note how cells closest to the source turn purple (fate C), cells at a medium distance turn blue (fate B), and cells farthest away turn green (fate A).

Explain how the concentration of a signaling molecule can determine what type of cell a developing embryo cell becomes. Use your observations of the three colored zones to describe the relationship between a cell's distance from the signal source and the cell fate it adopts.

HS-LS1-3

5.

Simulation Task: Navigate to the Pheromone Guidance (Gametes) simulation. Observe the pink pheromone molecules diffusing outward from the egg. Click on the canvas to add up to three sperm and watch how they navigate toward the egg.

Describe how the sperm cells use the concentration gradient of pheromone molecules to find the egg. Explain why this type of long-distance chemical signaling is important for reproduction in aquatic organisms where eggs and sperm are released into open water.

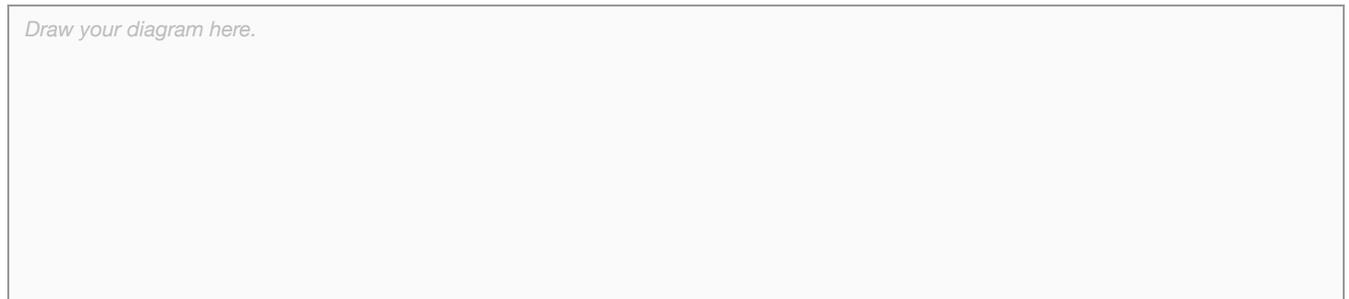
HS-LS1-2

6.

Simulation Task: Review the Introduction popup, which describes three signaling categories: direct contact, short distance, and long distance. Then look at the Plasmodesmata, Quorum Sensing, and Pheromone Guidance simulations as examples of each category.

In the box below, draw a diagram that compares the three categories of cell signaling. For each category, show the signaling cell, the signal molecule, and the receiving cell. Label the distance the signal travels and name the simulation that represents each category.

Draw your diagram here.



HS-LS1-2

7.

Simulation Task: Return to the Quorum Sensing simulation. Run it at 150 cells and observe the biofilm response. Then think about how cells in a multicellular organism use similar signaling systems to control when cells grow and divide.

In multicellular organisms, cells use chemical signals to tell neighboring cells when to grow and when to stop dividing. Explain what could happen to an organism if its cells lost the ability to receive or respond to these growth-regulating signals. Describe why communication between cells is essential for controlling cell division and maintaining healthy tissues.

HS-LS1-4