

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.

Free Response Questions

Question 1 – Conceptual Analysis

Simulation Task: *In the Quorum Sensing simulation, set the population density slider to 20 cells and click Start Simulation. Observe the autoinducer concentration on the Global Concentration meter. Then gradually increase the population density slider to 150 cells and observe how the cells change from blue (OFF) to green (ON) and whether biofilm formation occurs.*

(A) (1 pt) **Describe** the relationship between bacterial population density and the concentration of signaling molecules in the surrounding environment.

(B) (1 pt) **Explain** why bacteria at low population density do not form a biofilm, yet the same bacteria simultaneously activate biofilm formation once population density exceeds a threshold.

(C) (1 pt) **Predict** how the survival of a bacterial population with a mutation that prevents receptor binding of autoinducers would compare to that of a wild-type population when both are exposed to an antibiotic in the same environment.

(D) (1 pt) **Justify** your prediction.

Question 2 — Analyze Model / Visual Representation

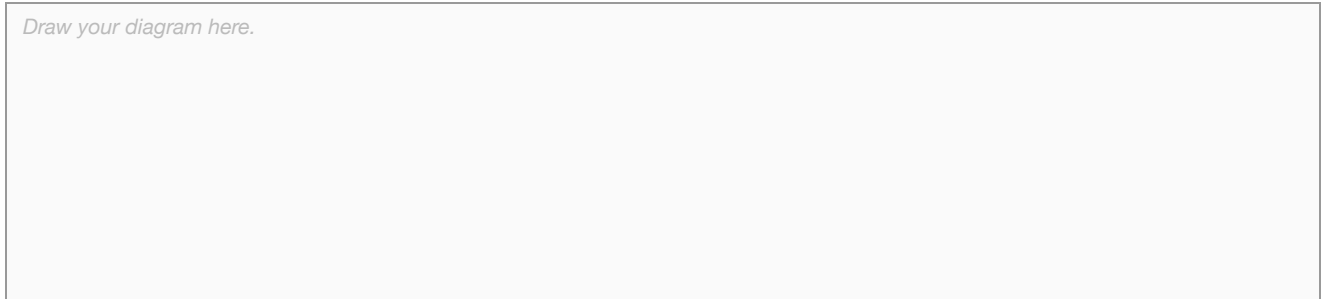
Simulation Task: Navigate to the Morphogen Gradient (Embryo) simulation. Observe how morphogen molecules diffuse outward from the organizing center and how cells in different zones adopt different fates: purple zone (high morphogen, fate C), blue zone (medium morphogen, fate B), and green zone (low morphogen, fate A).

(A) (1 pt) **Describe** the process by which a cell converts the binding of an extracellular signaling molecule into a change in gene expression and cell function.

(B) (1 pt) **Explain** why cells located close to the organizing center adopt a different developmental fate than cells located far from the organizing center, even though all the cells contain the same genome.

(C) (1 pt) **Represent** the relationship between distance from a signaling source and cell fate by drawing a labeled diagram that includes an organizing center, signaling molecules, receptor proteins on target cells at different distances, and the resulting gene products in each cell.

Draw your diagram here.



(D) (1 pt) **Explain** why many different animal species use the same types of signaling molecules to regulate similar developmental processes.
