

Cell Communication

Learning objective 4.1.A Explain how cell communication is critical for multicellular organisms.

Name: _____

Date: _____

Period: _____

Use the tool **Who Is Listening**. Parts 1 to 3 use the **Send a signal** tab, Part 4 uses **Same signal, different answer** and Part 5 uses **Counting each other**. Keep two questions apart the whole way through: **did the signal reach this cell**, and **can this cell read it**. Almost every mark in this topic depends on not merging them.

Part 1 • How far each mode goes

Select each signaling mode in turn with any signal, and record which cells the signal reaches. Ignore the receptors for now — this part is only about **reach**.

Cell	Distance	Contact	Paracrine	Synaptic	Endocrine
Liver cell next door					
Cell two positions away					
Airway smooth muscle					
Muscle fiber at the end of the axon					
Heart muscle, in another organ					
Cell with no epinephrine receptor					

1. Two of the modes reach only a small number of cells, and they do so for different reasons. Name each reason.

2. The synaptic signal reaches a cell 5 units away and skips four cells that are closer. Explain how that is possible.

Part 2 · Which cells can read which signal

Now ignore the modes. For each cell, record which of the four signals it has a receptor for. This part is only about **the receptor**.

Cell	Growth factor	Neurotransmitter	Epinephrine	Surface marker
Liver cell next door				
Cell two positions away				
Airway smooth muscle				
Muscle fiber at the end of the axon				
Heart muscle, in another organ				
Cell with no epinephrine receptor				

3. One cell in the table has no receptor for any of the four signals. State what happens to it when each signal is sent, and explain why.

4. Explain why a receptor protein is described as specific, and what that specificity depends on. (Look back at Topic 3.1 if the wording sounds familiar.)

Part 3 · Putting the two filters together

Set each combination below and record what happens to the two cells named. Predict each row before you set the chips.

Mode	Signal	Cell	Reached ?	Has receptor?	Responds?
Endocrine	Epinephrine	Cell with no epinephrine receptor			
Paracrine	Epinephrine	Heart muscle, in another organ			
Endocrine	Epinephrine	Heart muscle, in another organ			
Paracrine	Growth factor	Airway smooth muscle			

5. Rows 1 and 2 both end in no response, for two different reasons. State each reason.

6. State the two conditions that must both be met for a cell to respond to a chemical signal.

7. Insulin is released into the blood and reaches every cell in the body, yet only some cells respond. Explain why.

Part 4 · One signal, three answers

Switch to **Same signal, different answer** and step through the three targets.

Target	Signal it receives	Concentration it receives	What it does
Liver cell next door			
Airway smooth muscle			
Heart muscle, in another organ			

8. Two columns of your table are identical on all three rows and one is not. Name them, and explain what that tells you about where the specificity of the response comes from.

9. Explain how one hormone released from one gland can coordinate a matched set of changes across a whole body.

Part 5 · Counting each other

Switch to **Counting each other**. Move the population slider to each value and record the signal concentration and whether the behavior is on.

Population	Signal concentration	Behavior on or off?
1		
20		
39		
40		
100		

10. Describe quorum sensing, and explain how a bacterium that cannot count ends up behaving differently depending on how many others are present.

11. A single bacterium secretes the signaling molecule continuously and never switches the behavior on. Explain why, and state what this shows about the difference between an individual and a population.

12. Many pathogenic bacteria use quorum sensing to decide when to release toxins. Suggest an advantage of waiting until the population is large, rather than releasing them as soon as the first cell arrives.

What the model simplifies

Distance is in arbitrary units on a straight line. Real tissue is three-dimensional and signals diffuse through it unevenly, so the sharp edge of the paracrine range here is a boundary the model draws rather than one a cell would experience.

Receptors are shown as present or absent. In a real cell the number of receptors matters too: a cell with few receptors responds weakly to a concentration that saturates a cell with many, and cells adjust their receptor numbers over time.

The quorum threshold is drawn as a single number. Real quorum sensing involves a positive feedback loop in which the signal switches on its own production, so the transition is sharper than a simple threshold and harder to reverse. Topic 4.4 is about loops of that kind.

Epinephrine's three responses are real and are the standard textbook example. The mechanism by which one signal produces different outcomes in different tissues depends on what sits downstream of the receptor, which is Topic 4.2 and Topic 4.3.