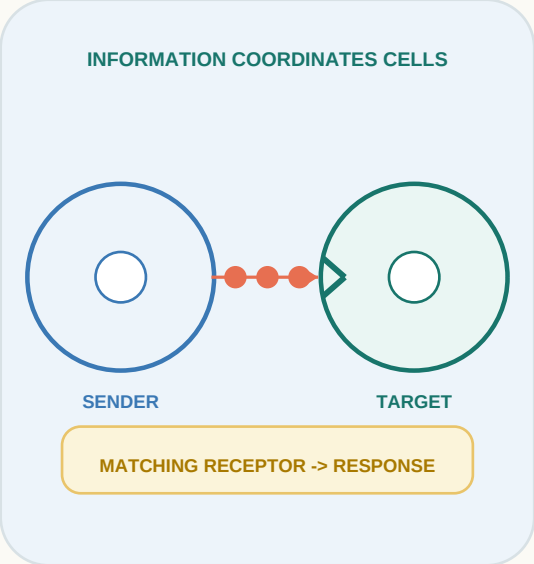
AP BIOLOGY | UNIT 4

TOPIC 4.1

Cell Communication

Cells exchange information through direct contact and chemical signals, allowing tissues and organisms to coordinate their activities.



THE CORE CAUSAL CHAIN

SIGNAL
carries information

→

RECEPTOR
detects signal

→

TARGET CELL
has matching receptor

→

RESPONSE
changes activity

BY THE END, YOU SHOULD BE ABLE TO...

1. Compare direct, local, synaptic, and long-distance signaling.
2. Explain why only target cells respond to a signal.
3. Link cell communication to coordinated biological function.

CENTRAL IDEA

A signal does not cause the same response in every cell. Receptor presence and cell-specific machinery determine whether and how a cell responds.

1 Cells signal across different distances

The distance between sender and target determines how a signal travels, but every pathway still depends on specific information reaching a responsive cell.

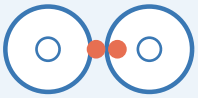
FOUR COMMUNICATION MODES



DIRECT CONTACT

TOUCHING CELLS

Junctions or membrane-bound molecules pass information.



LOCAL SIGNALING

NEARBY CELLS

Local regulators diffuse through nearby extracellular fluid.



SYNAPTIC SIGNALING

ACROSS A SYNAPSE

A neuron releases neurotransmitter near a target cell.



ENDOCRINE SIGNALING

LONG DISTANCE

Hormones travel through circulation to distant targets.

COMPARE THE PATHWAYS

MODE	DISTANCE	EXAMPLE	SIGNAL ROUTE
DIRECT	adjacent	gap junction	cell to cell
LOCAL	short range	growth factor	diffusion
SYNAPTIC	very short	neurotransmitter	synaptic cleft
ENDOCRINE	long range	hormone	circulation

SIGNAL-DISTANCE CONTINUUM



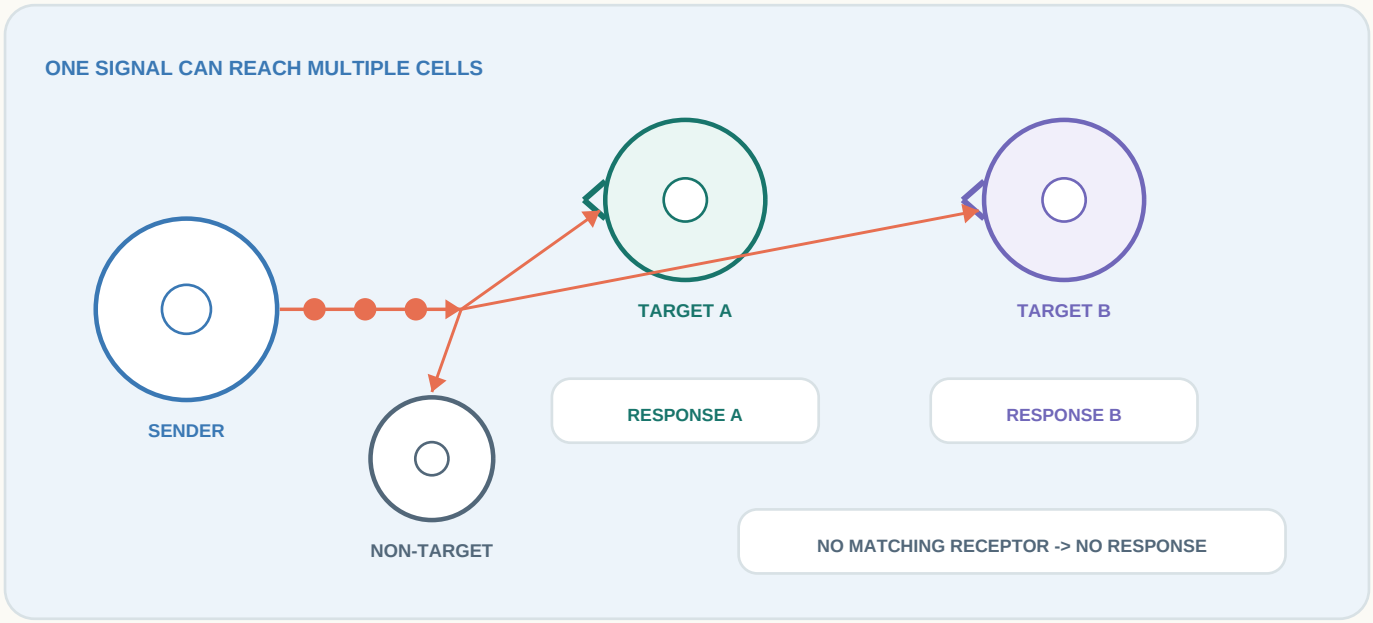
KEY IDEA

Synaptic signaling acts across a tiny gap, while endocrine signaling can reach the whole body. Distance and delivery route are separate ideas.

2 Target cells respond selectively

A ligand can reach many cells, but only cells with the appropriate receptor can detect it; internal cell machinery shapes the final response.

RECEPTOR PRESENCE DETERMINES TARGETING



WHY COMMUNICATION MATTERS

GROWTH AND DEVELOPMENT

Signals coordinate cell division, differentiation, and tissue formation.

IMMUNE RESPONSE

Cells alert, recruit, and activate other immune cells.

HOMEOSTASIS

Hormonal signals coordinate stable internal conditions.

ENVIRONMENTAL RESPONSE

Cells adjust activity when conditions or resources change.

SAME LIGAND + DIFFERENT CELL MACHINERY -> DIFFERENT RESPONSES

COMMON ERROR

A signal molecule does not automatically affect every cell it reaches. A cell must have the correct receptor, and different target cells may produce different responses.