

General Principle of Cell Communication

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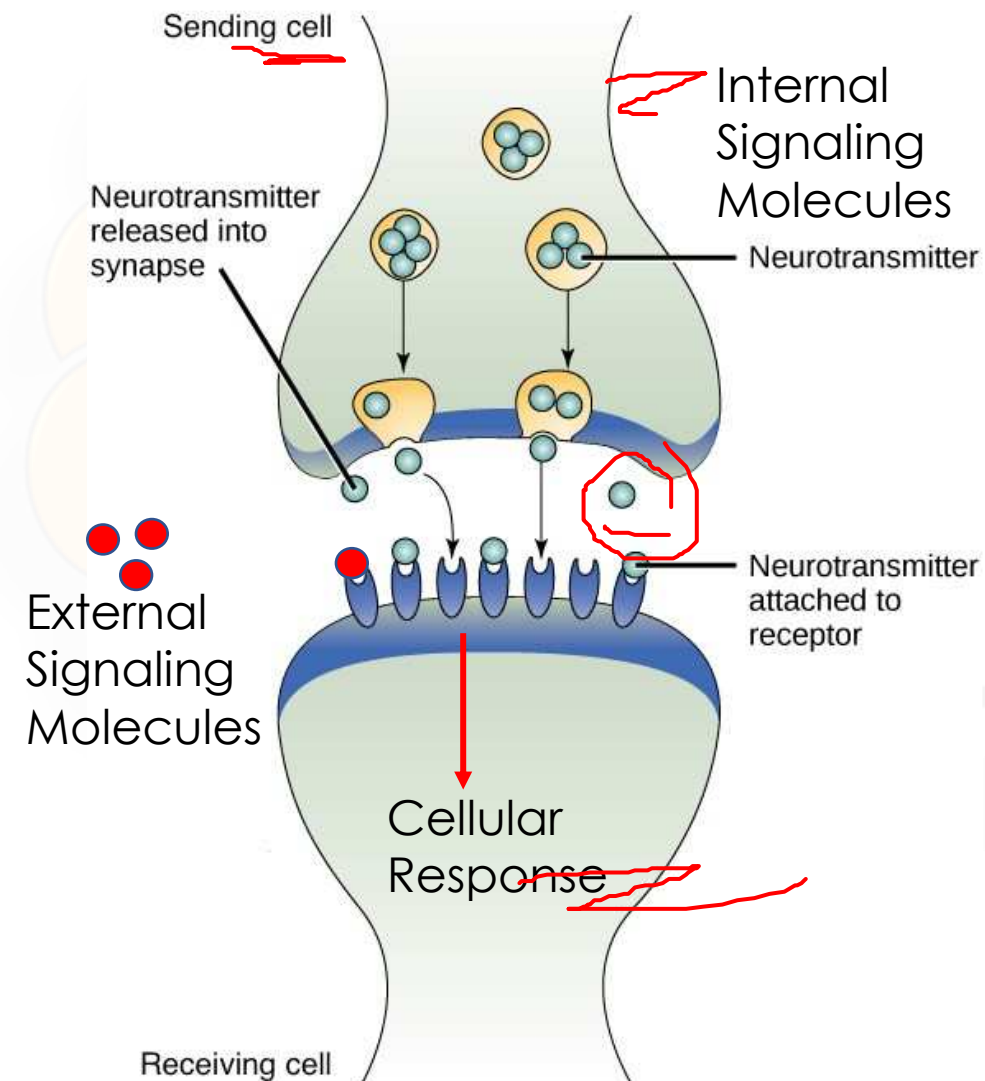
Contents of the Lecture:

- 🧠 Cell Communication
- 🧠 Cell Signaling Process
- 🧠 Intracellular Signaling Pathways
- 🧠 Cell Signaling Types

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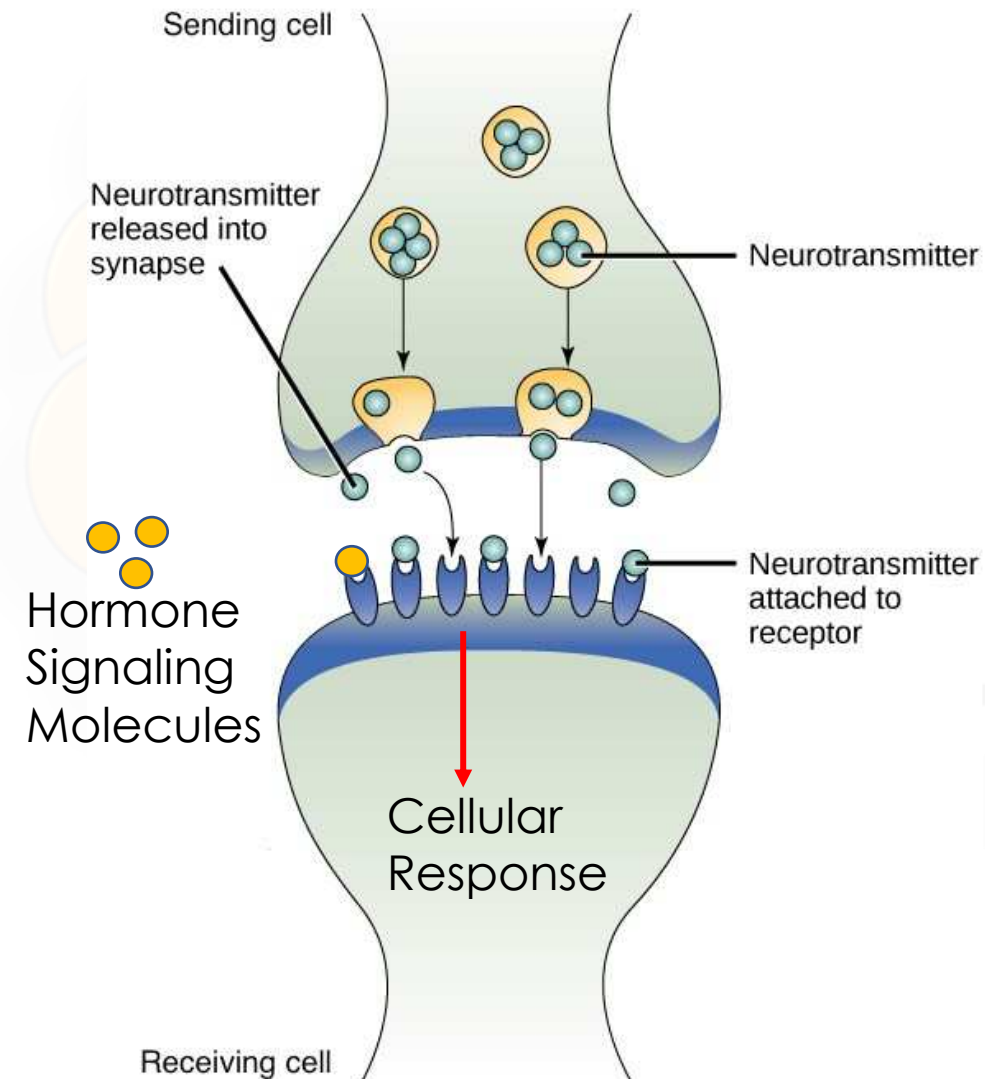
Cell Communication



- 💡 Cell communication is most important for the multicellular organism for the normal activity in a daily life
- 💡 Cell communication occurs by electrochemical communications
- 💡 All the communication system involve receiving, collecting, and responding to appropriate information according to the cell signaling molecules (internal or external communications)
- 💡 **Cellular Response depends upon the signaling molecules and cell type**

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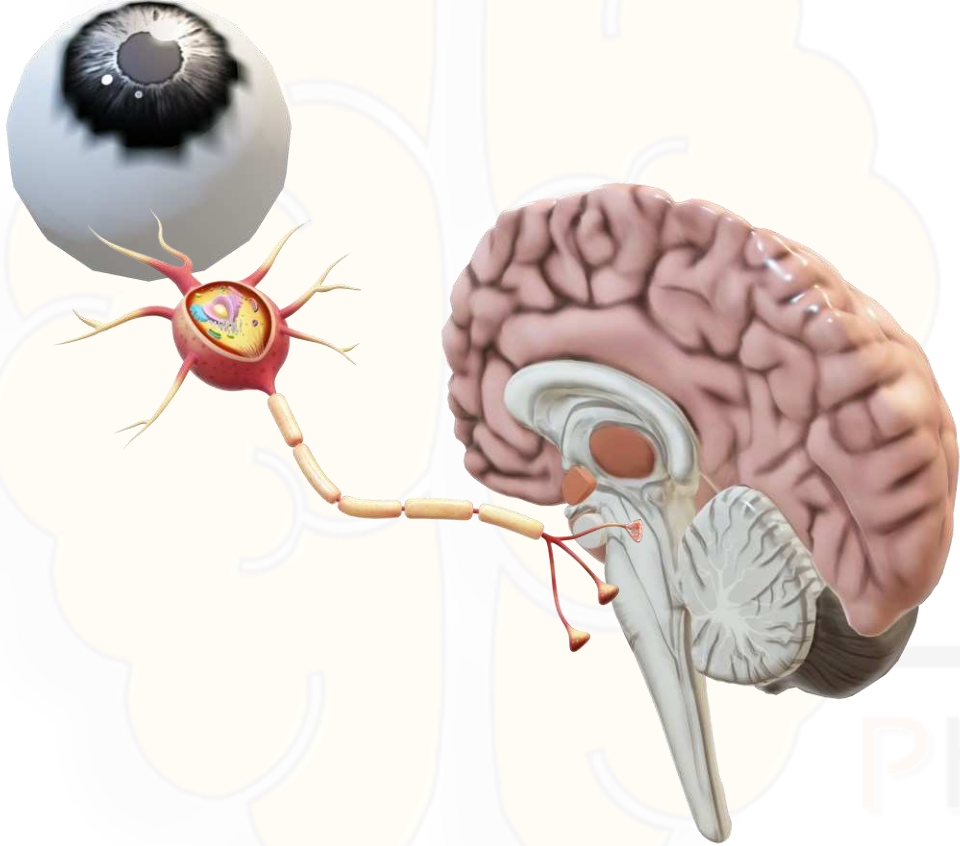
Cell Communication



- 💡 **Internal communication** mainly involves mainly the nervous and endocrine system; these are important for the homeostasis and regulation of the vital body function.
- 💡 **Signaling Molecules: Neurotransmitters and Hormones**

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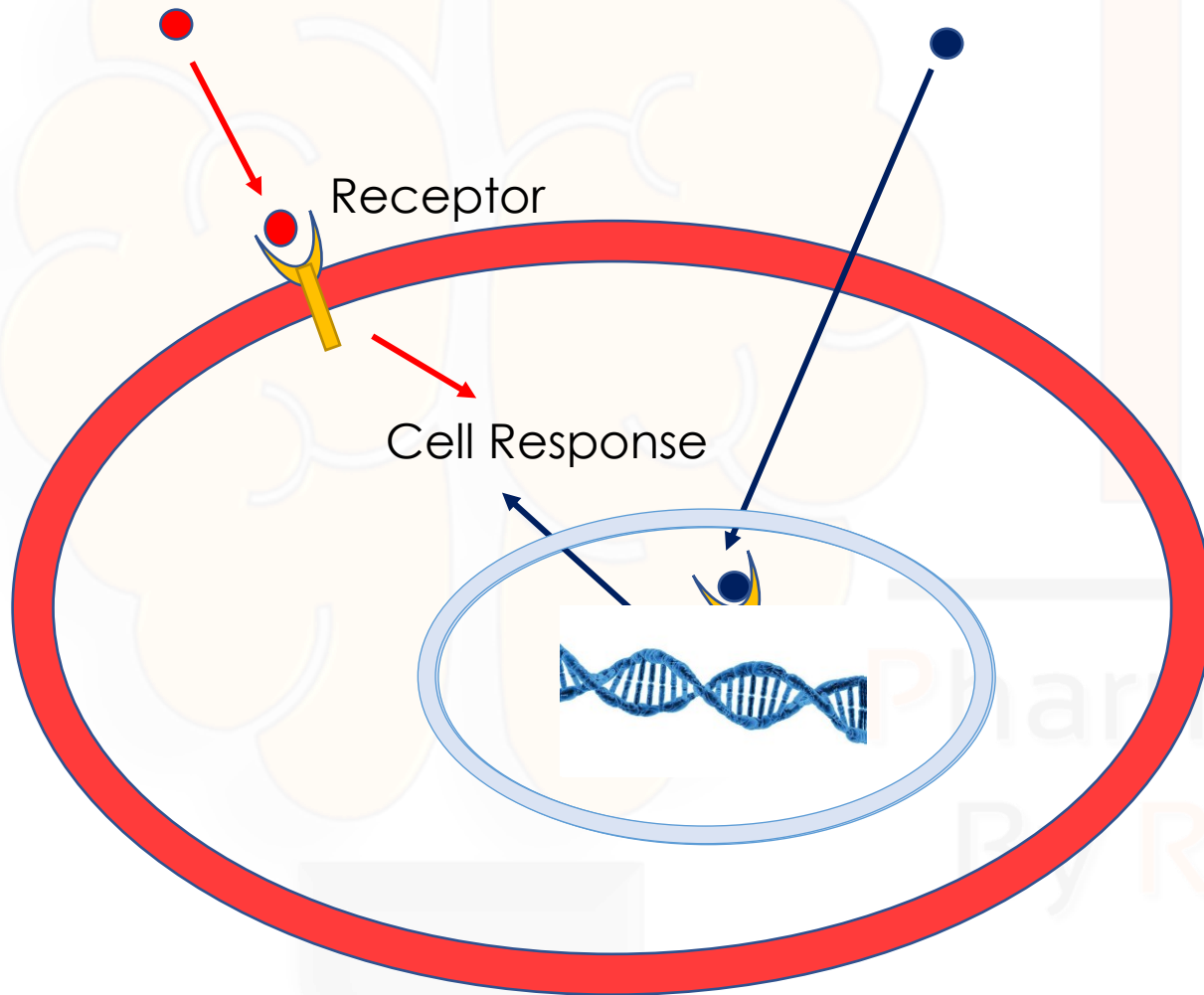
Cell Communication



💡 **Communication with external environments** involves the special senses (Vision, Hear, Taste), and these also depends on the nervous system.

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Cell Signaling

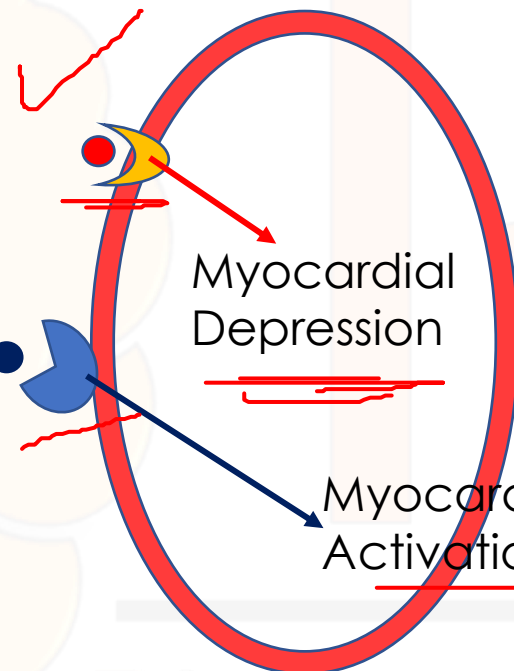


- 💡 **Cell Signaling** are also known as signaling cascade, signal-transduction pathways, etc
- 💡 A signal-transduction pathway is a series of steps by which a signal on a cell's surface or nucleus is converted into a specific cellular response within the cell

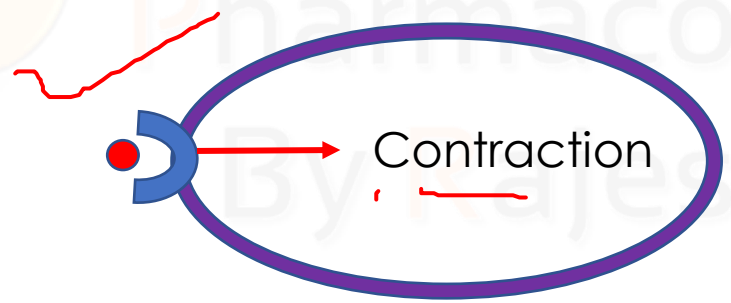
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Cell Signaling

Cellular Responses: Depending upon signaling molecule, cell type and signaling pathways



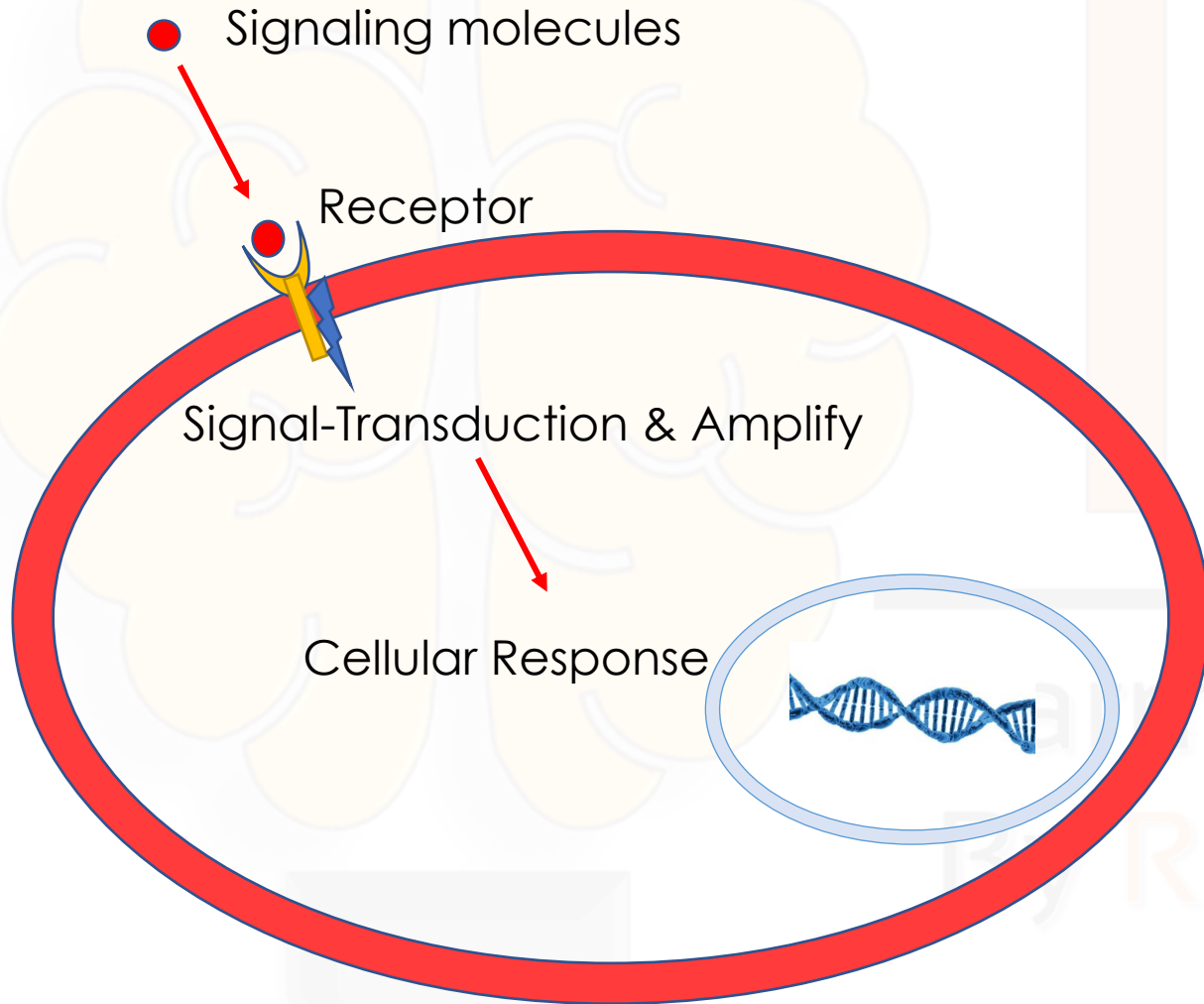
Cardiac muscle



Skeletal Muscle



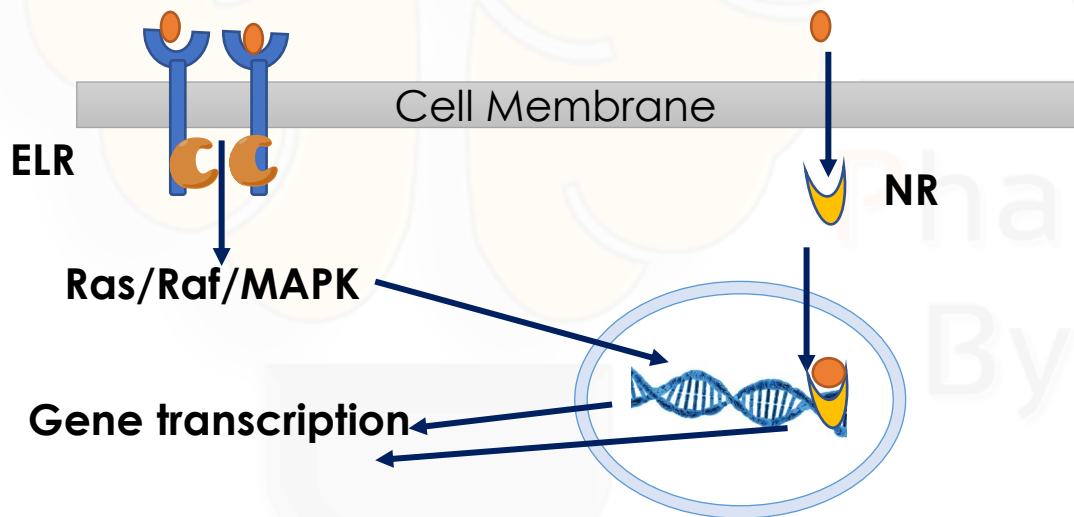
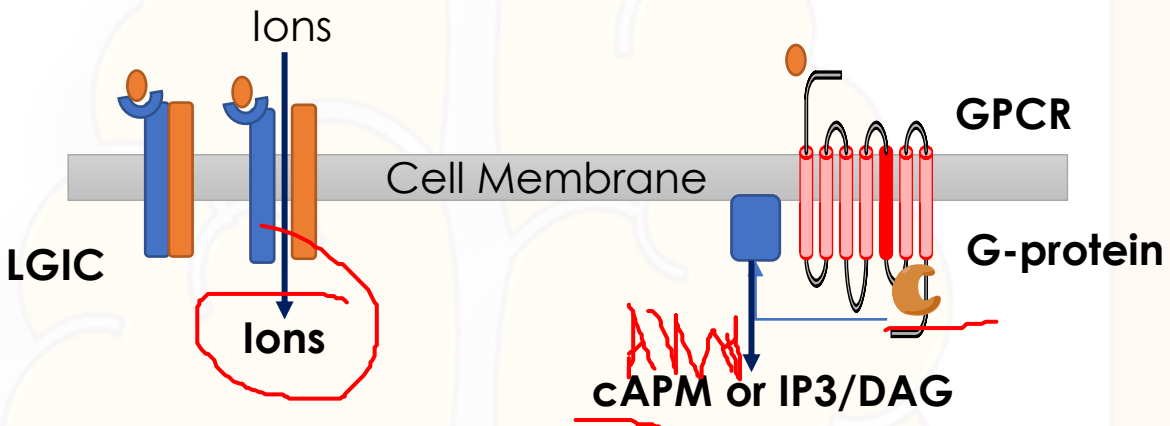
Cell Signaling Process



💡 Cell Signaling occurs in three Stage (As per **Earl W. Sutherland**)

1. Reception
2. Transduction
3. Response

Cell Signaling Receptors



1. Receptors: proteins, which receive the signal from Biological active molecules

1. Ligand Gated Ion Channel (LGIC)- **Fastest**
2. G-Protein Coupled Receptor (GPCR)
3. Enzyme Linked Receptor
4. Nuclear Receptor- **Slowest**

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Cell Signaling Pathways

2. Signal Transduction Pathways

- 💡 cAMP/PKA signaling pathway
- 💡 IP3/Ca²⁺ Signaling Pathway
- 💡 DAG/PK-C Signaling Pathway
- 💡 NO/cGMP Signaling Pathway
- 💡 Ca²⁺ Signaling Pathway
- 💡 MAPK Signaling Pathway
- 💡 Ion conduction Pathway

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Cell Signaling Pathways

🔗 Intracellular Signaling Pathways Activated by Extracellular Signaling Molecules:

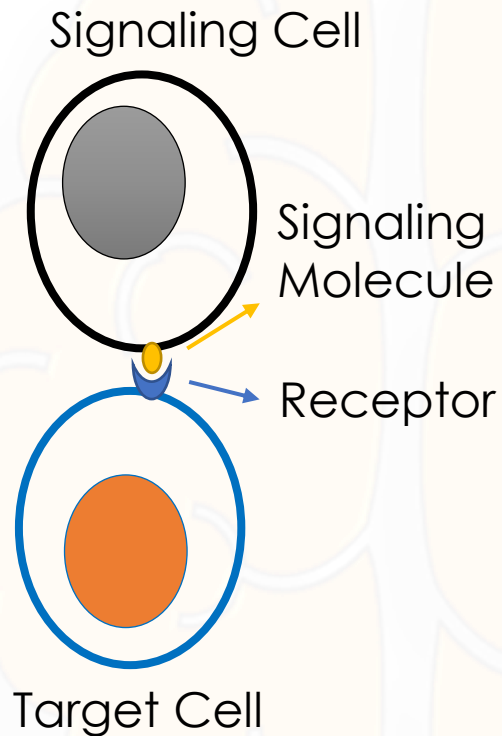
Signaling Molecules	Target Proteins (Receptor/Enzyme)	Intracellular Signaling Pathways	Responses
Acetylcholine	LGIC (Nm Receptor)	Na ⁺ Conduction	Skeletal muscle contraction
Acetylcholine	GPCR (M2-Receptor)	(-) cAMP/PK-A Pathway	Inhibition of Cardiac Activity
Adrenaline	GPCR (Beta-1 Receptor)	(+) cAMP/PK-A Pathway	Increase the cardiac activity
Nor-Adrenaline	GPCR (Alfa-1 Receptor)	(+) IP3/Ca ²⁺ pathway (+) DAG/PK-C Pathway	Vasoconstriction
Growth Factor	Tyrosine Kinase linked receptor	(+)Ras/Raf/MAPK	Protein synthesis for Growth
Nitric Oxide	Cytoplasmic Guanylyl cyclase enzyme	(+) cGMP Pathway	Vasodilation

Cell Signaling Types

- 💡 Cell Signaling is either local or long distance. Based on this signaling can divide in various forms:
 - 💡 A) Contact Dependent
 - 💡 B) Paracrine Signaling
 - 💡 C) Synaptic Signaling
 - 💡 D) Endocrine Signaling
 - 💡 E) Autocrine Signaling

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Cell Signaling Types

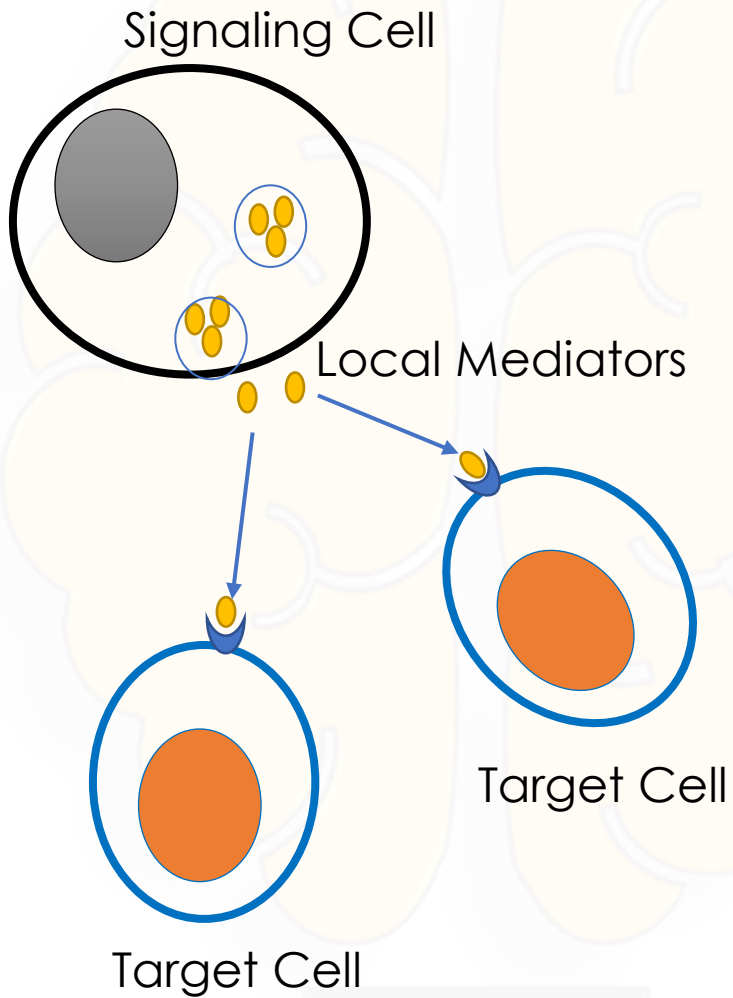


A) **Contact Dependent**

- 💡 cell signal occurs in between cells having physical contact with each other. This occurs at the cell membrane level.
- 💡 One cell has a signal molecule, and the other has a receptor moiety on their cell surfaces.
- 💡 But both the cells are physically connected where the signaling occurs.
- 💡 Important for development of immune cells

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Cell Signaling types



B) Paracrine Signaling

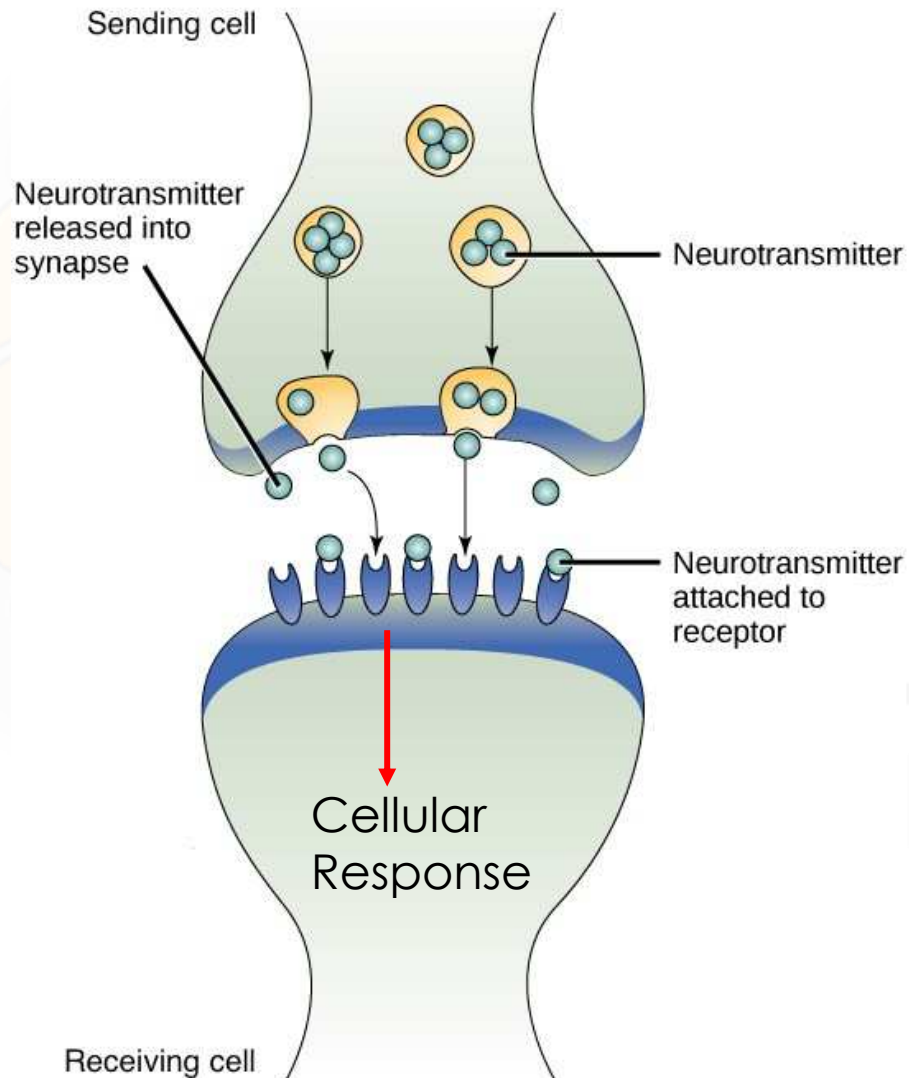
- 💡 This is a signal where one cell signals nearby neighboring cells. This is somewhat similar to the above type. But, the cells need not be directly connected.
- 💡 The signal molecules are released by one cell. These molecules reach nearby cells around and transmit the signal
- 💡 Example: Response of Histamine, Serotonin, Prostaglandins

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Cell Signaling Types

C) Synaptic Signaling

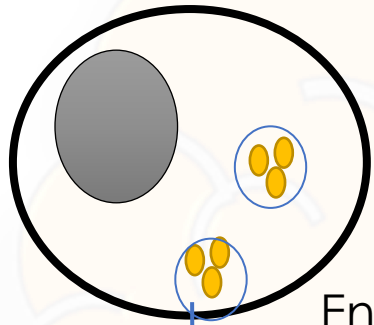
- 💡 This signal occurs at Synaptic junction.
- 💡 Important role in Neurotransmission within the nervous system



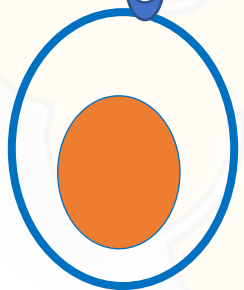
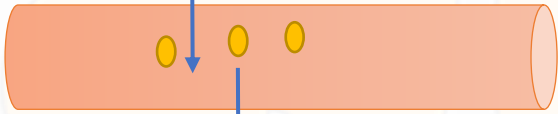
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Cell Signaling Types

Endocrine Cell



Endocrine Hormone



Target Cell

D) Endocrine Signaling

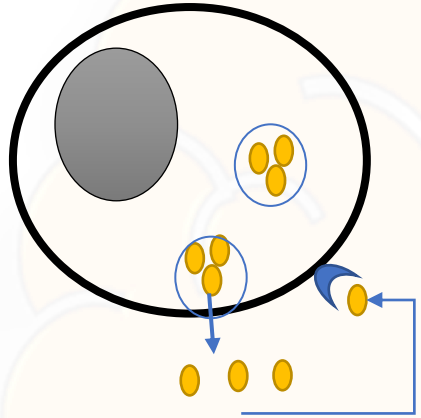
- 💡 This is a signal which is given by one cell to another cell located in a distant region.
- 💡 The signal molecule (endocrine hormone) is released into the bloodstream.
- 💡 This is then carried away and distributed by the blood to other cells. These distant cells receive the signal.
- 💡 Ex: Response of Endocrine hormones

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Cell Signaling Types

E) Autocrine Signaling

- This is a type of cell signal where a cell gives a signal to itself.
- A signal molecule is released out of the cell.
- This molecule, in return, acts and gives a signal to the same cell through surface receptors.
- **Examples:** The monocytes produce cytokines that affect themselves.



Signaling & Target Cell

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