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Cell signaling



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Suman Kumar Mekap
Asst. Professor (Pharmacology)
School of Pharmacy and Life Sciences
Centurion University, Bhubaneswar



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Introduction

Cells must be ready to respond to essential signals in their environment. These are often chemicals in the extracellular fluid (ECF) from:

Distant locations \longrightarrow signaling by hormones;

Nearby cells \longrightarrow cytokines;

or

even secreted by themselves .

Long-range allostery is often a significant component of cell signaling events.



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Cell signaling

Cell signaling is part of a **complex system of communication** that governs basic cellular activities and coordinates cell actions.

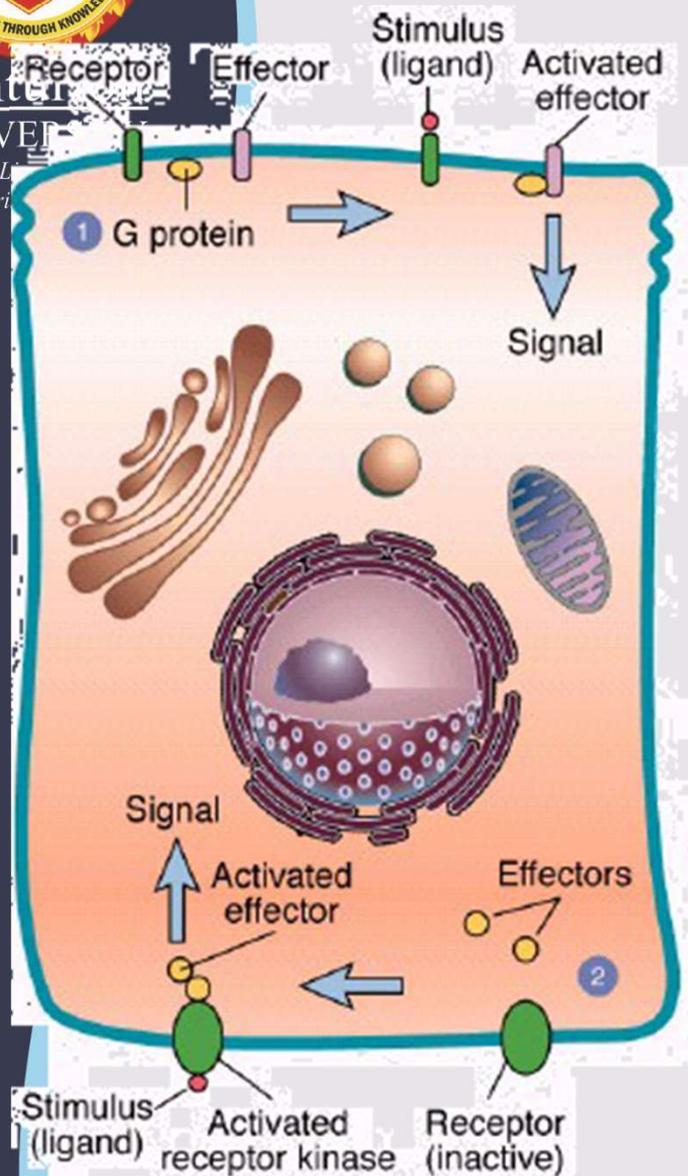
The ability of cells to perceive and correctly respond to their microenvironment is the basis of development, tissue repair, and immunity as well as normal tissue homeostasis

Errors in cellular information processing are responsible for diseases such as cancer, autoimmunity, and diabetes. By understanding cell signaling, diseases may be treated effectively and, theoretically, artificial tissues may be created.



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Cell Signaling and Signal Transduction



CELL SIGNALING is about communication between different groups of cells and tissues...how one group of cells informs another group of cells what to do.

SIGNAL TRANSDUCTION refers to how the presence of an extracellular signal can produce a change in the intracellular state of the cell without the initial signal crossing the membrane.



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Signaling Components

Signaling molecules

Receptors

Signaling intermediates

Effector proteins



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CLASSIFICATION OF INTERCELLULAR COMMUNICATION

Intercellular signaling is subdivided into the following classifications:

Autocrine signals target the cell itself. Sometimes autocrine cells can target cells close by if they are the same type of cell as the emitting cell. An example of this are immune cells.

Paracrine signals target cells in the vicinity of the emitting cell. Neurotransmitters represent an example.

Endocrine signals target distant cells. Endocrine cells produce hormones that travel through the blood to reach all parts of the body.

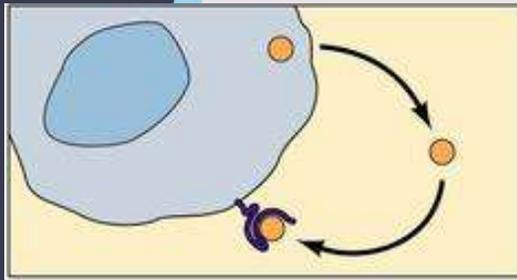
Juxtacrine signals target adjacent (touching) cells. These signals are transmitted along cell membranes via protein or lipid components integral to the membrane and are capable of affecting either the emitting cell or cells immediately adjacent.



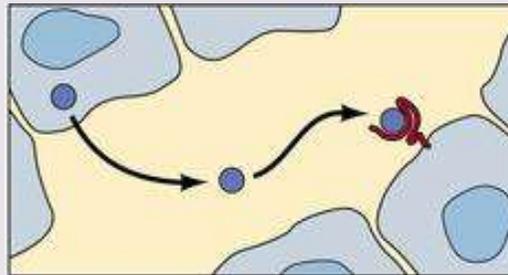
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Types of Signaling

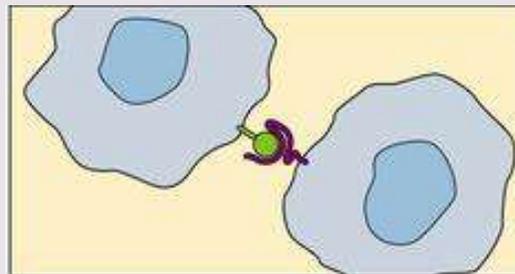
Depending upon distance travelled by signaling molecule



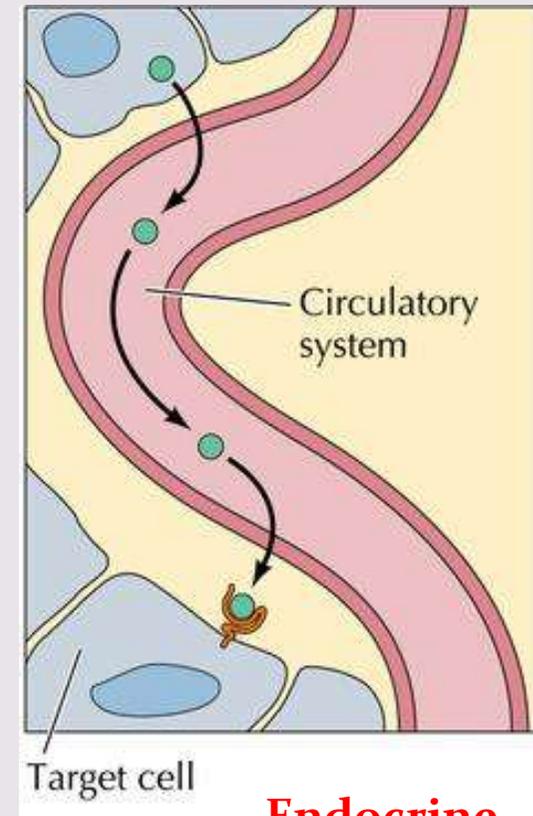
Autocrine



Paracrine



**Contact dependent
or
Juxtacrine**



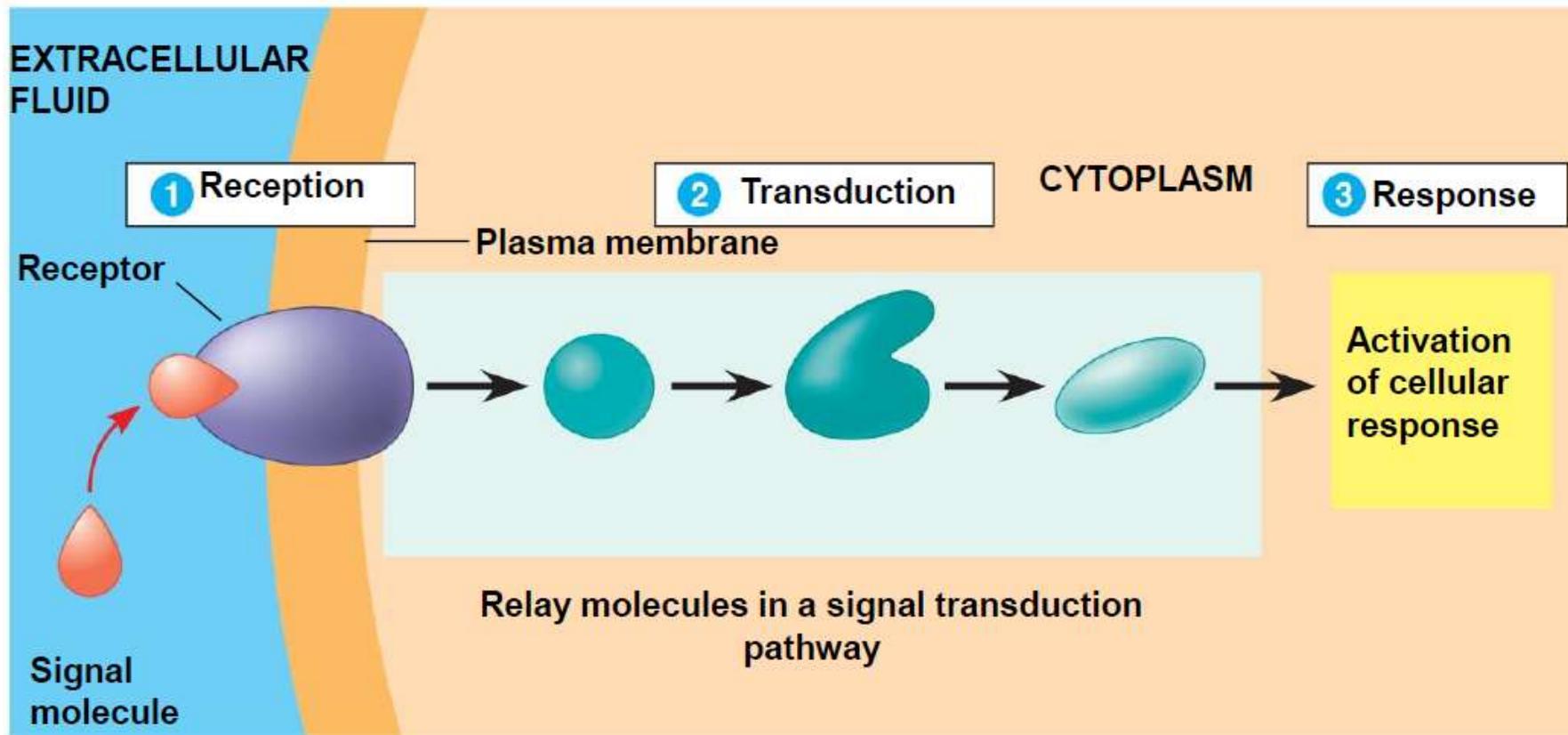
Endocrine



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Stages in Cell Signaling



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1. Reception

Highly specific binding of signaling molecule to its receptor

Binding → leads to conformational change in
receptor often initiation of signal
transduction

Most receptors are plasma membrane proteins



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2. Transduction

May involve multiple steps

Helps in amplification & Transmission of a signal

Provides more opportunities for coordination and regulation

Molecules that relay a signal from receptor to response are mostly proteins



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3. Fine tuning of the Response

Multi-step signaling pathways have important benefits:

Amplification of the signal

Contributing to the specificity of the response

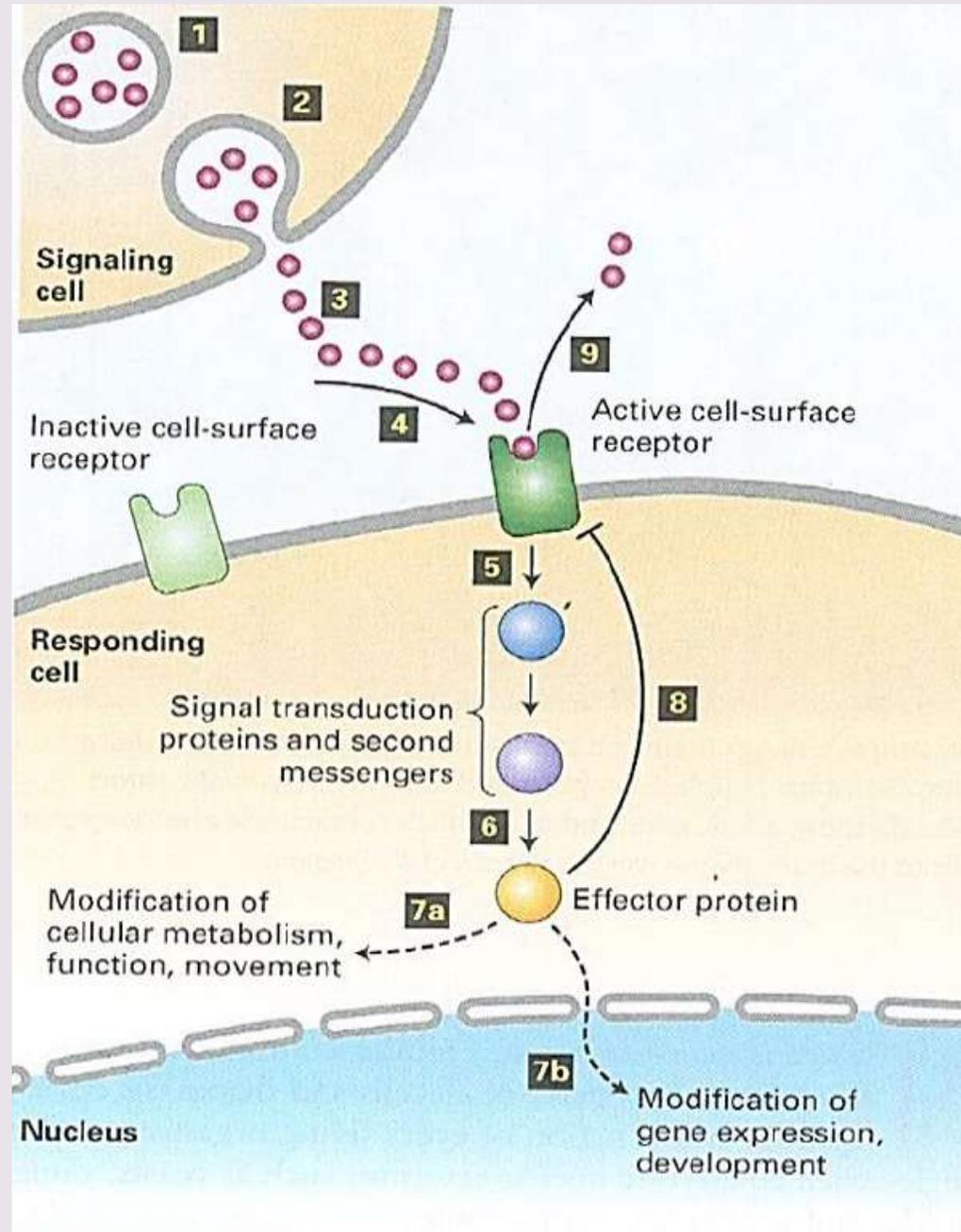
Provide many opportunity to regulate the
signaling cascade



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Basic steps involved in eukaryotic cell signaling





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SUMMARY

Cell signaling - essential for survival of both uni- and multi- cellular organisms

Involves various components and steps

Smooth progression and tight control is required for homeostasis

Many diseases result from defects in cell signaling