Introduction to Cell Communication

Packet #16

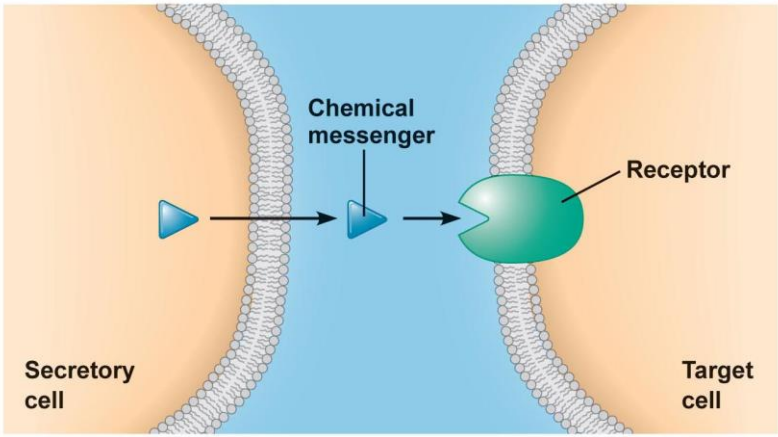
Why Communication Between Cells is Important

- A typical free-living cell must be able to
  - Sniff out nutrients
  - Sense the difference between light and dark
  - Detect and avoid poisons and predators
- Cells must also be able to communicate to provide long range integration of metabolism.
- Therefore, cells must be able to communicate with each other.

Players of Cell Signaling

The Players

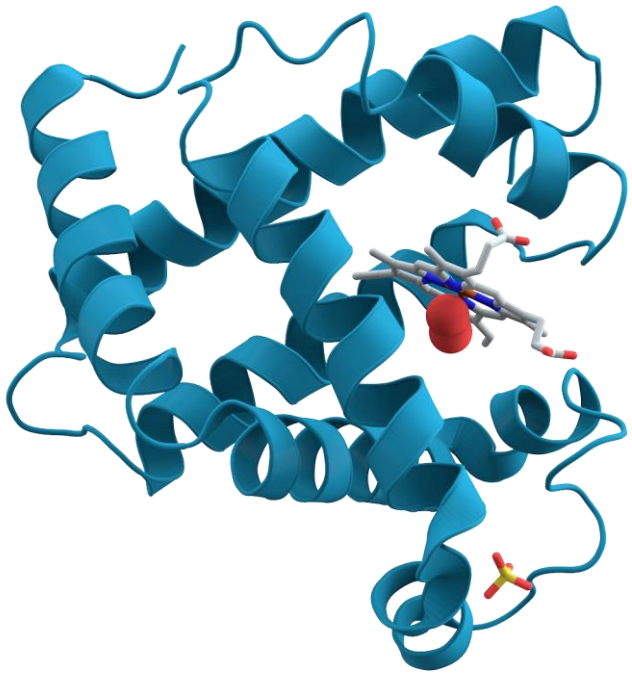
* **Signaling Cell**
  * Cell sending the message
* **The Signal**
  * Ligand
    * Molecule such as a hormone or a neurotransmitter that binds to a specific site on a protein (receptor protein)
* **Target Cell**
  * Cell receiving the message
* **Receptor Protein***
  * Recognizes and responds specifically to the signal molecule
  * Performs the first step in a series of transduction processes at the receiving end



(b) Communication via chemical messengers

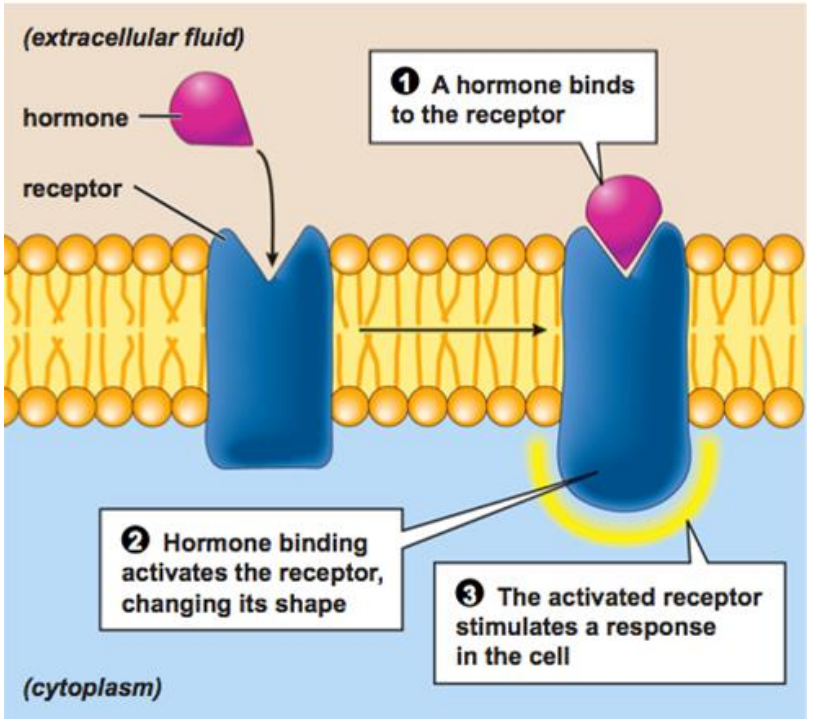
Molecules Used As Signals

* Proteins
* Peptides
* Amino Acids
* Nucleotides
* Steroids
* Fatty Acid Derivatives
* Dissolved Gases



Target Cell

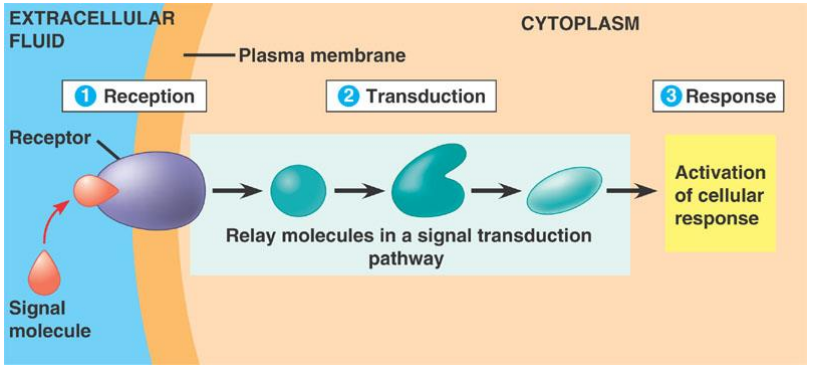
* Contain receptor proteins in the cell membrane
  * Recognizes and responds specifically to the signal molecule
  * Performs the first step in a series of **transduction processes** at the receiving end



General Steps of Cell Signaling

Three Steps

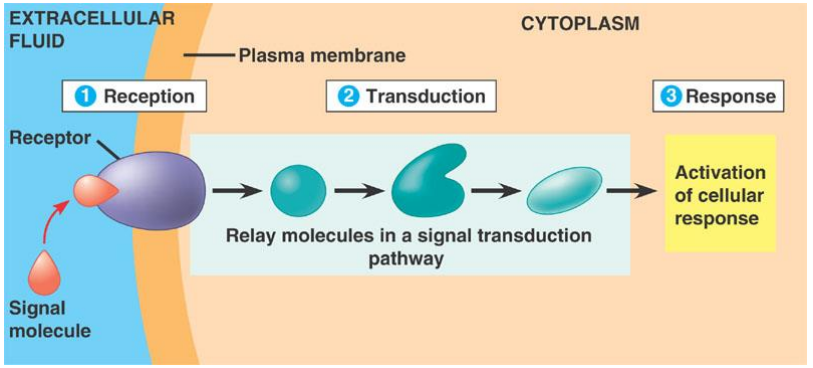
* Three Steps
  * Signal reception
  * Transduction
  * Response



Signal Reception & Types of Receptors

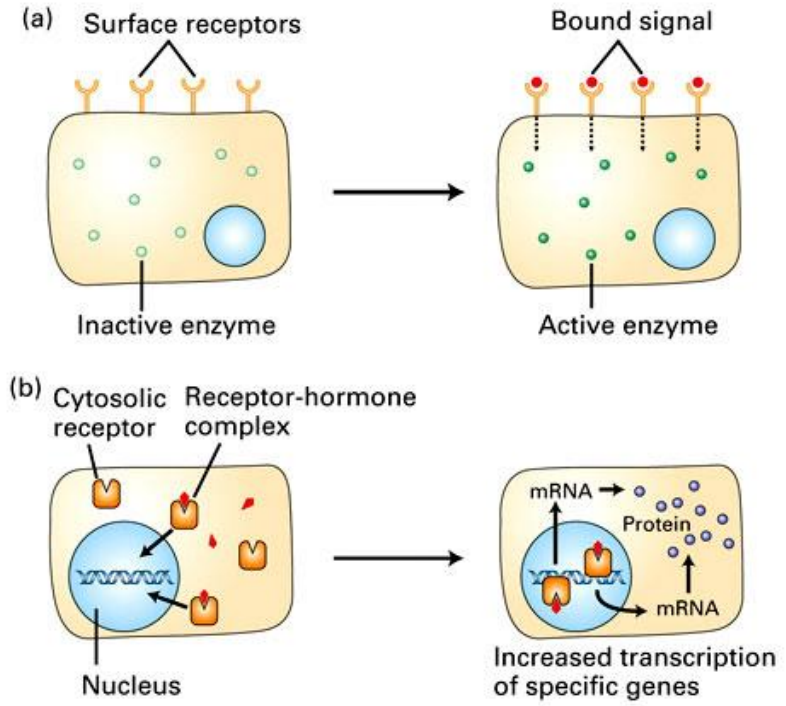
Step One
Signal Reception

* Cells are stimulated by an extracellular signal
* Signal binds to, and activates, a *receptor protein*
* Each receptor protein recognizes a *specific signal molecule*
  * Once signal is recognized, a new intracellular signal is generated.
    * This is *the first step of* ***transduction***



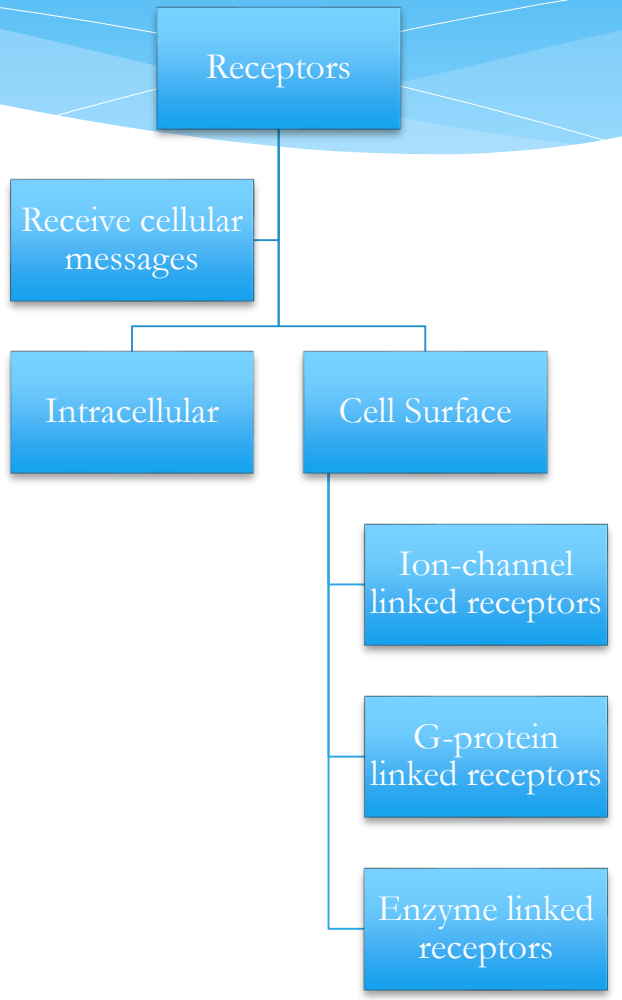
Types of Receptors I

* There are two basic mechanisms by which chemical signals cause a biologic effect within the cell
  * Hence there are two types of receptors
    * **Intracellular receptors**
      * Inside the cell
    * **Cell surface receptors**
      * Found on the surface of the cell



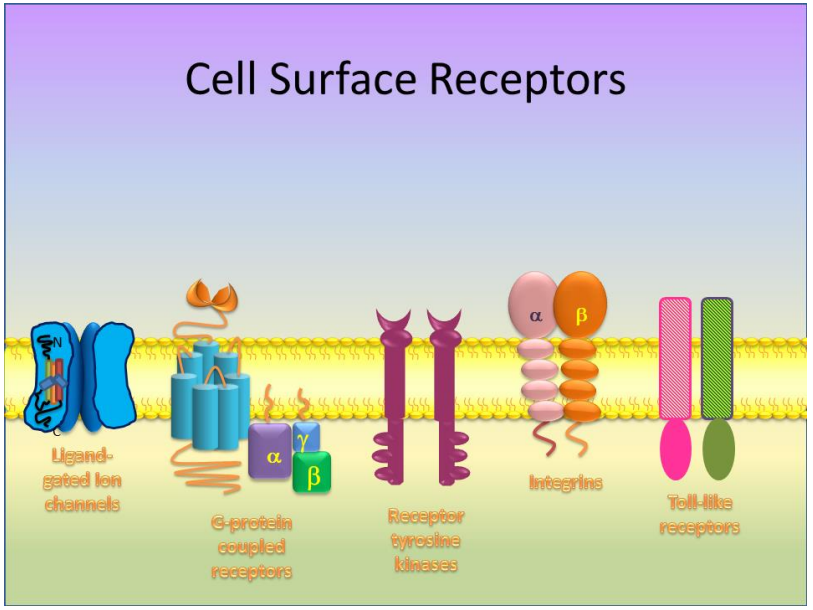
Types of Receptors II
Classes of Cell-Surface Receptors

* Three classes
  * Ion-channel linked receptor
  * G-protein linked receptor
  * Enzyme-linked receptor



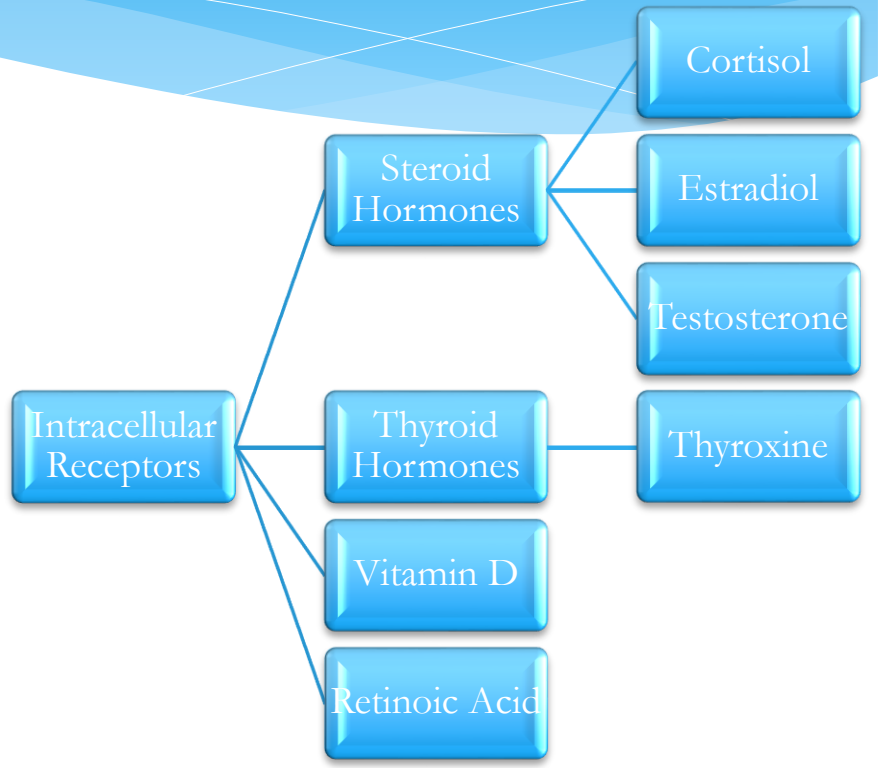
Types of Receptors III
Cell Surface Receptors

* Largest class of receptors
* Used for signals that **are too large or too hydrophillic to cross the plasma membrane**
* Lie in the plasma membrane of the cell
* Relays message across the membrane



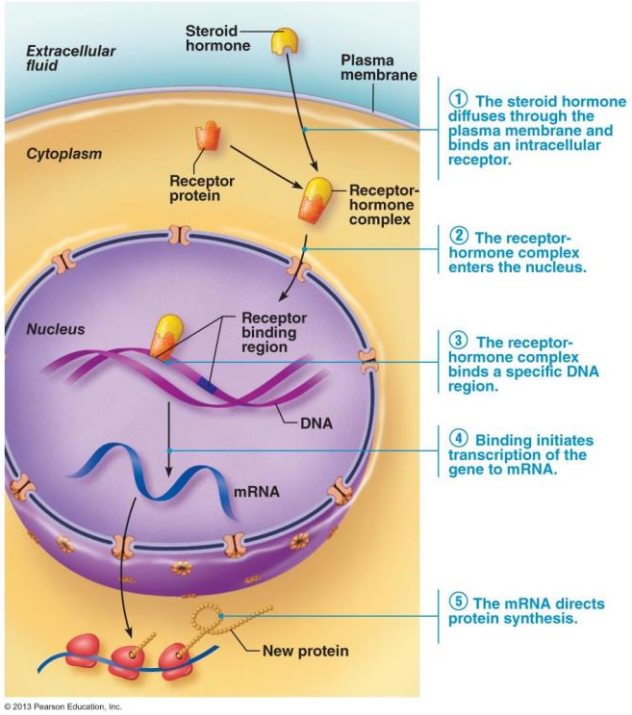
Types of Receptors IV
Intracellular Receptors I

- Used for molecules that are sufficiently **small and hydrophobic** to **diffuse across the cell membrane**
  - Best known hydrophobic signal molecules
    - **Steroid hormones**
      - Cortisol
      - Estradiol
      - Testosterone
    - **Thyroid hormones**
      - Thyroxine
    - **Vitamin D**
    - **Retinoic Acid**



Types of Receptors V Intracellular Receptors II

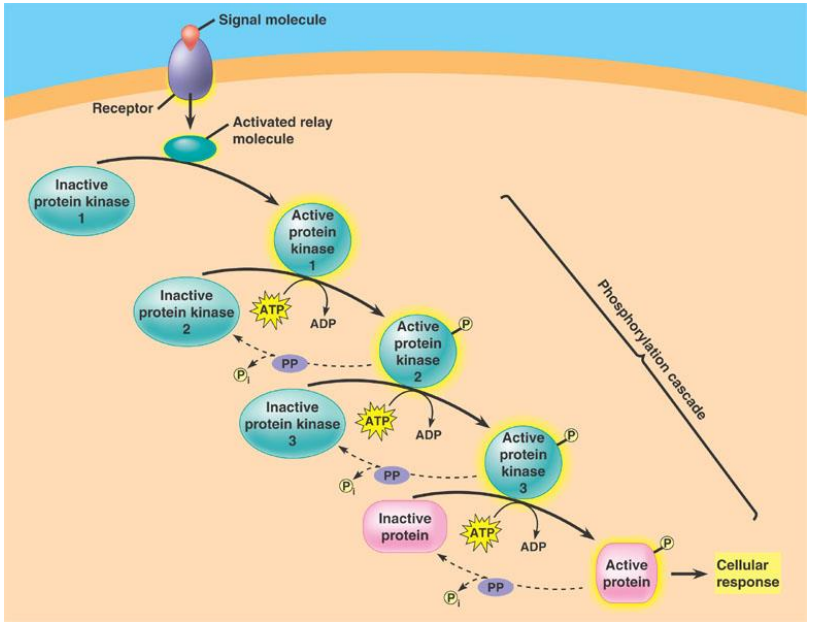
* Receptors lie in the interior of the target cell either within the cytosol or nucleus.
* More details to come later.



Signal Transduction & Transduction Pathways

Step Two
Signal Transduction

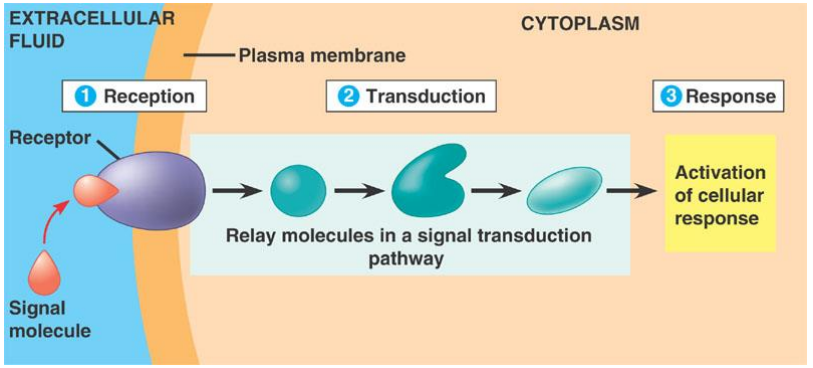
* Signal transduction is the continuation and/or conversion of signals from one form to the next.
  * The signals, although sometimes in different forms, represent the same information.
* **Unique when utilizing steroids and hormones.**



Response

Step Three
Response

* The ultimate response to the signal that started the process.



Review