

# General Biology II (101-HTK) Cell Signaling and Communication Concepts and Learning Outcomes

Topic	Concept	Learning Outcomes
<b>Overview of cell communication</b>	<ol style="list-style-type: none"> <li>1. Cells receive signals from physical environment and from other cells and respond to them.</li> <li>2. Cells communicate with other cells using chemical signals (cell signaling).</li> <li>3. Cell-to-cell signaling involves signal (1) synthesis and release by cells, (2) reception (binding to receptors) by target cells, (3) transduction (processing) (message sent intracellularly and amplified), (4) response (changes in cellular activity in response to signal), and (5) deactivation (termination of response to signal).</li> </ol>	<ol style="list-style-type: none"> <li>1. Outline how cells communicate by describing the 5 main sequences of events essential for cell-cell communication</li> </ol>
<b>Types of internal signaling systems</b>	<ol style="list-style-type: none"> <li>4. In large multicellular organisms, there exist 3 types of signaling systems: (1) autocrine (signals generated by the same cells/cell type upon which they act), (2) paracrine (signals diffuse to and affect nearby cells), and (3) endocrine (signals travel in the blood/body fluids and act on distant target cells).</li> </ol>	<ol style="list-style-type: none"> <li>2. Compare the 3 types of cell signaling that exist in multicellular organisms</li> </ol>
<b>Signal reception</b>	<ol style="list-style-type: none"> <li>5. Signal reception involves the <b>binding</b> of chemical signals to <b>receptors</b>, which are proteins/glycoproteins that recognize specific signaling molecules.</li> <li>6. A <b>ligand</b> is a signaling molecule that binds to a specific receptor. This binding causes a change in <b>receptor configuration</b>, leading to a cellular response.</li> <li>7. Receptors bind ligands according to the <b>law of mass action</b>, and thus the binding is reversible: <math>R + L \leftrightarrow RL</math>.</li> </ol>	<ol style="list-style-type: none"> <li>3. Name the type of molecules involved in recognizing and binding chemical signals and outline the mechanism that makes this reception a highly specific process</li> </ol>
<b>Receptor</b>	<ol style="list-style-type: none"> <li>8. Receptors are classified by location and function.</li> </ol>	<ol style="list-style-type: none"> <li>4. Compare the 2 types of receptors that are classified based on</li> </ol>

<b>classification: cytoplasmic and transmembrane receptors</b>	<p>By location, there are 2 general types of receptors: (1) cytoplasmic receptors, which bind small and/or nonpolar molecules that can cross the plasma membrane (eg, steroids), and (2) plasma membrane (transmembrane) receptors, which bind large and/or polar molecules that cannot cross the plasma membrane (eg, insulin).</p> <p>9. Three well-studied types of transmembrane receptors exist in complex eukaryotes: (1) Ion channel receptors (convert chemical signals to electrical signals), (2) Protein kinase receptors (enzyme-linked receptors), and (3) G protein-linked receptors (signal transduction activation via an effector protein; involves the production of 2<sup>nd</sup> messengers).</p>	<p>location in the cell</p> <p>5. Compare the 3 types of transmembrane receptors in terms of mode of action</p>
<b>Signal transduction</b>	<p>10. Signal transduction is the process by which an <b>extracellular message</b> is converted into a greatly <b>amplified intracellular</b> message that carries information throughout the cell and induces a cell response.</p>	<p>6. Define signal transduction, signal amplification, and second messenger</p> <p>7. Using diagrams, outline the sequence of events in signal transduction pathways involving a phosphorylation cascade and the production of second messengers</p>
<b>Signal Effects: Changes in Cell Function</b>	<p>11. The effects of signals on cell function can be categorized under 3 primary forms: (1) opening of ion channels (eg, nerve cell stimulation), (2) changes in the activities of enzymes, and (3) differential gene expression (eg, steroid hormones and protein synthesis).</p>	<p>8. Outline the 3 general types of changes that cells generate as responses to chemical signals</p>
<b>Signal deactivation / regulation</b>	<p>12. Signal transduction can be regulated in different ways; activation-deactivation balance determines the ultimate cellular response to signals.</p>	<p>9. Describe 3 mechanisms by which cells regulate and/or terminate responses to chemical signals</p>
<b>Direct Intercellular Communication</b>	<p>13. Some cells can communicate with one another by allowing chemical signals and ions to pass <b>directly through pores</b>, known as <b>gap junctions</b> (animal cells) and <b>plasmodesmata</b> (plant cells), in their plasma membranes and cell walls.</p>	<p>10. Describe the 2 types of direct intercellular communication that occur in animal and plant cells</p>