|  |  |  |  |
| --- | --- | --- | --- |
| Reception | Transduction | Response | Cell membrane |
| Receptor protein | Signal molecule (ligand) | | Relay molecule |
| Relay molecule | Relay molecule | Activation of proteins/genes | Inactivation of proteins/genes |
| Cellular response | Extracellular fluid | Signal transduction pathway | |

|  |  |  |  |
| --- | --- | --- | --- |
| Direct contact | Local signaling | Long distance signaling | Endocrine cell |
| Gap junctions | Plasmodesmata | Cell-cell recognition | Blood vessel |
| Paracrine signaling | Synaptic signaling | Endocrine signaling | Target cell |

|  |  |  |  |
| --- | --- | --- | --- |
| Yeast mating factors | Neurotransmitters | Increase production of aquaporins | Growth factors |
| Antidiuretic hormone | Growth toward opposite yeast mating strain | Increase rate of mitosis | Action potential |
| Contact of glycoproteins between macrophage and CD4 T helper cell | CD4 T helper cell release cytokines to activate other immune cells | Water follows potassium ion; guard cell to become flaccid | Calcium ion flows from one cardiac muscle cell to another |
| Potassium ion flows from one cell to another | Myosin fibers contract, shortening muscle cell |  |  |