Cell Signaling

Cells Respond to their Environment

Signal Molecules

Two signal molecules found in plants, ethylene (a) and brassinolide (b).
Generalized Signal Reception

Ligand-Gated Ion Channels

- Integral membrane proteins
- Control passage of ions (Na⁺, K⁺, Ca²⁺, Cl⁻) in/out of cell
- May bind ligand directly ⇒ conformational change

G Protein-Linked Receptors

1. Receptor binds signal and G protein
2. GTP displaces GDP from the G protein
3. Activated G protein dissociates
4. Moves along the membrane, activates third enzyme
5. Activated final enzyme takes part in cellular reactions
Protein Kinases

Protein kinases:
- integral membrane proteins
- conformational change exposes kinase site
- phosphorylate other molecules
  ⇒ alters activity of other molecules

Ras Protein Kinase Cascade

signal is amplified, because each activated protein is able to activate many others.

Cytoplasmic Receptors

Cytoplasmic Receptors
- proteins found in cytoplasm of cell
- bind small, non-polar ligands
- when activated serve as transcription factors
Recap of Material

Signal from environment (light, temperature, nutrients, chemicals, etc.)

- receptor
  1. ion channel
  2. G protein-linked receptor
  3. cytoplasmic receptor
  4. protein kinase

Cellular response
- 1. opening of membrane channels
- 2. activation of enzymes
- 3. selective transcription of genes

Indirect Transduction: Second Messengers

Cyclic AMP (cAMP) is a common second messenger that may play many roles for the cell. Here it binds to an ion channel, causing it to open.

Other second messenger molecules include:
- Ca²⁺
- DAG and IP₃ (lipid-derived)
- nitrous oxide (NO)