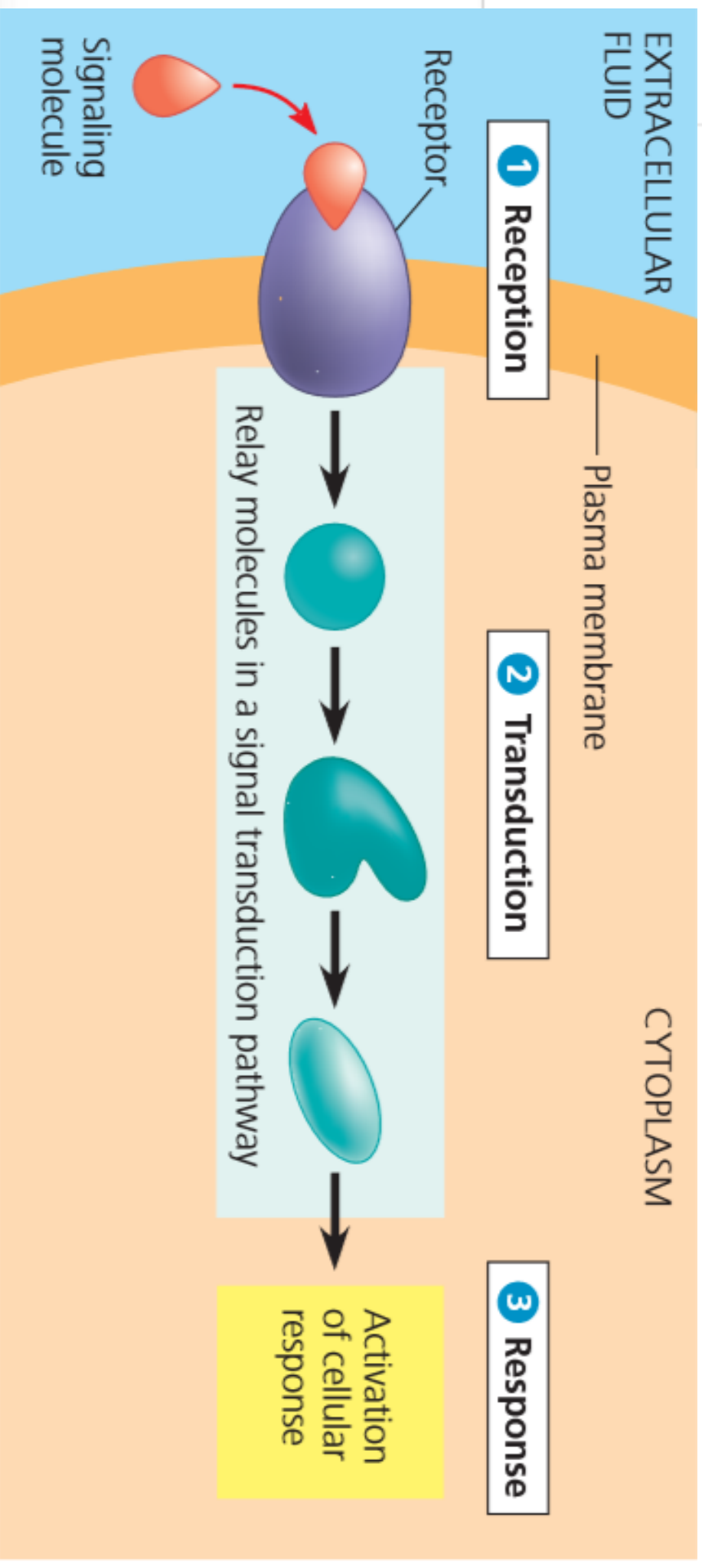


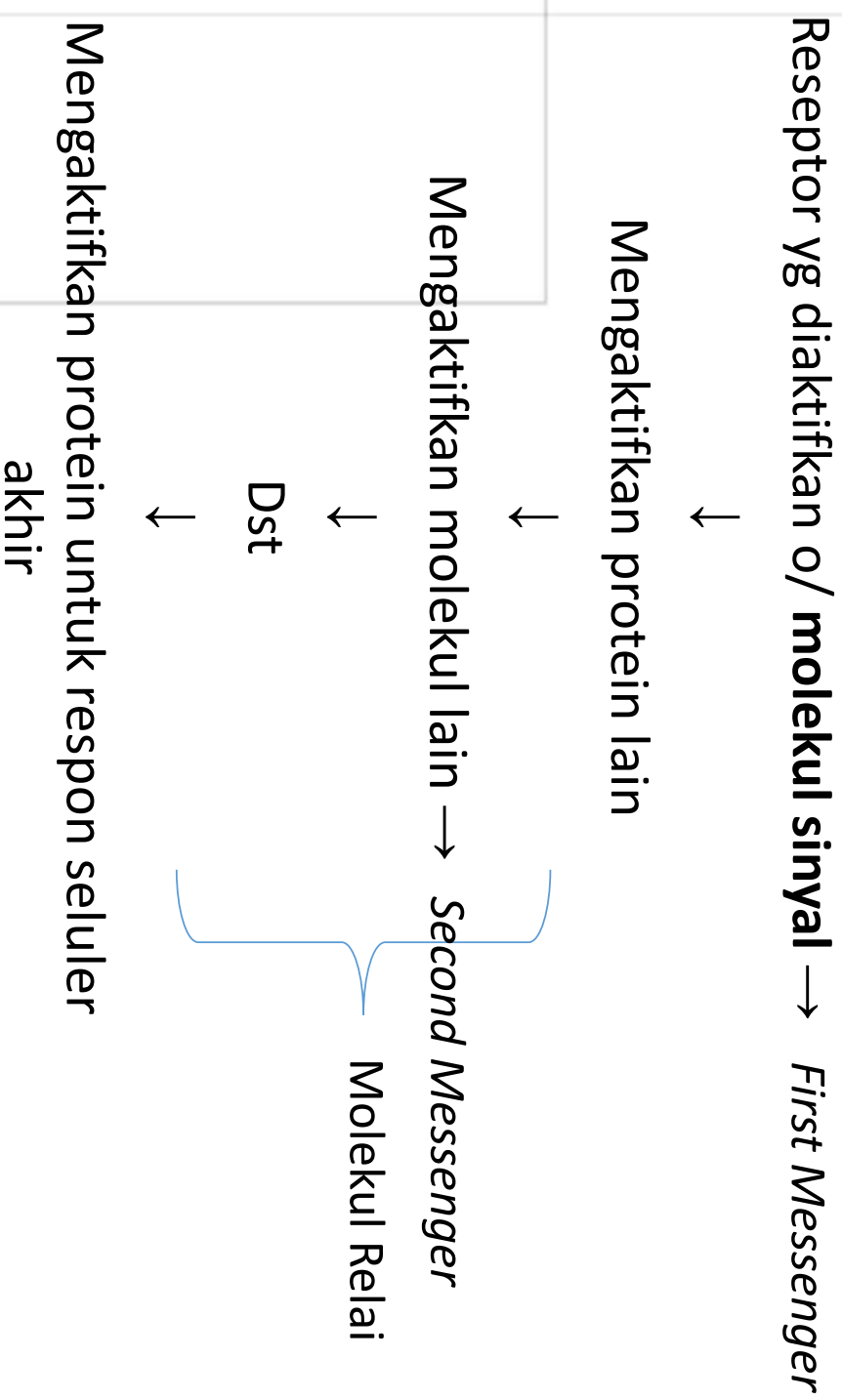
# Jalur Persinyalan

Tyas Putri Utami, S.Pd., M.Biomed.

# Persinyalan Sel

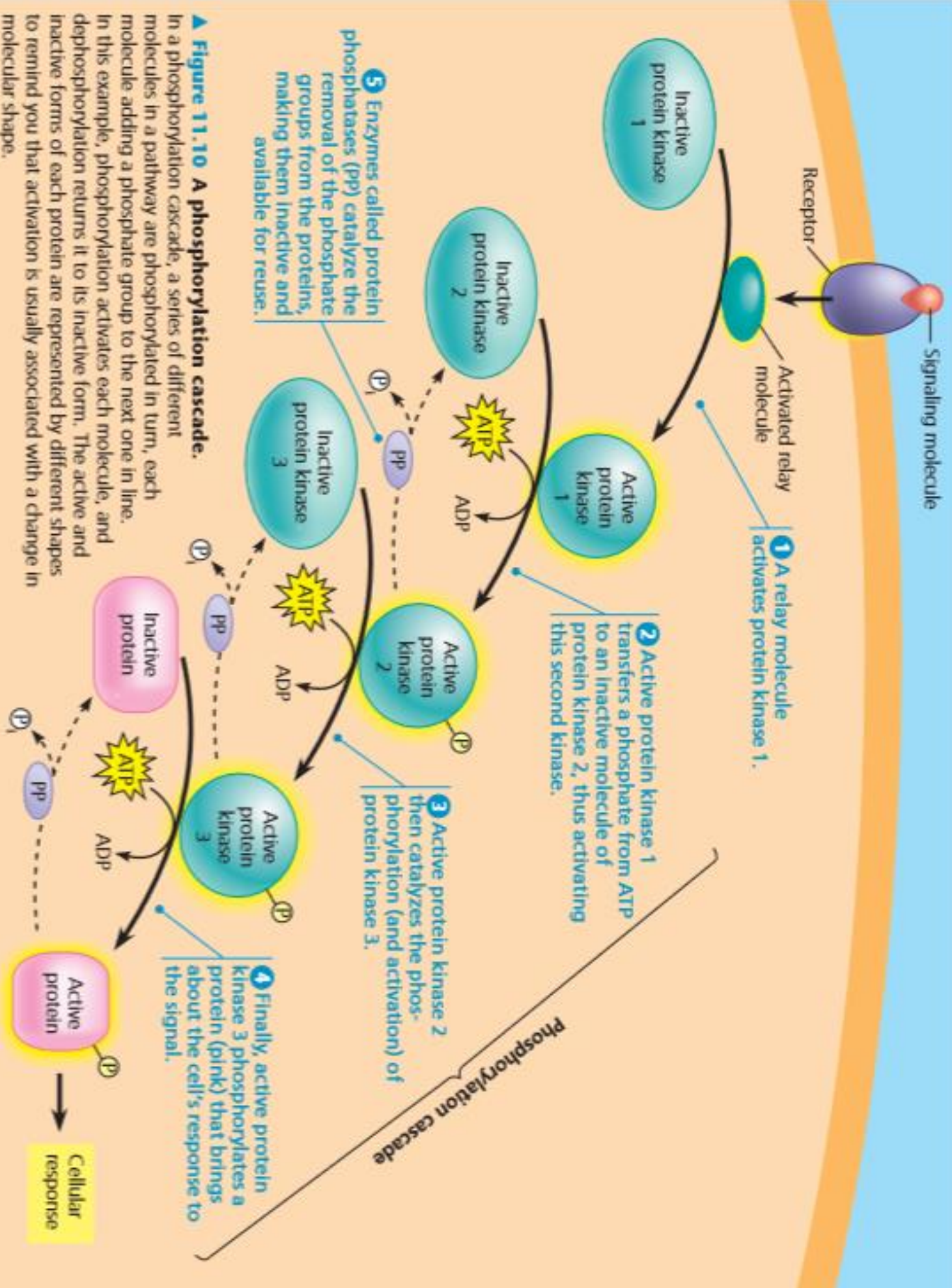


# Jalur Transduksi Sinyal



# Mekanisme umum: Fosforilasi Protein

- Protein kinase → mentransfer gugus fosfat dari ATP ke suatu protein (serine/threonine/tyrosine)
- Interaksi gugus fosfat dgn aa polar atau bermuatan → konformasi protein berubah (inaktif → aktif: umum)
- Protein fosfatase → mengeluarkan gugus fosfat dari protein
- Aktivitas protein yg difosforilasi bergantung pada keseimbangan kinase aktif dan fosfatase aktif dlm sel

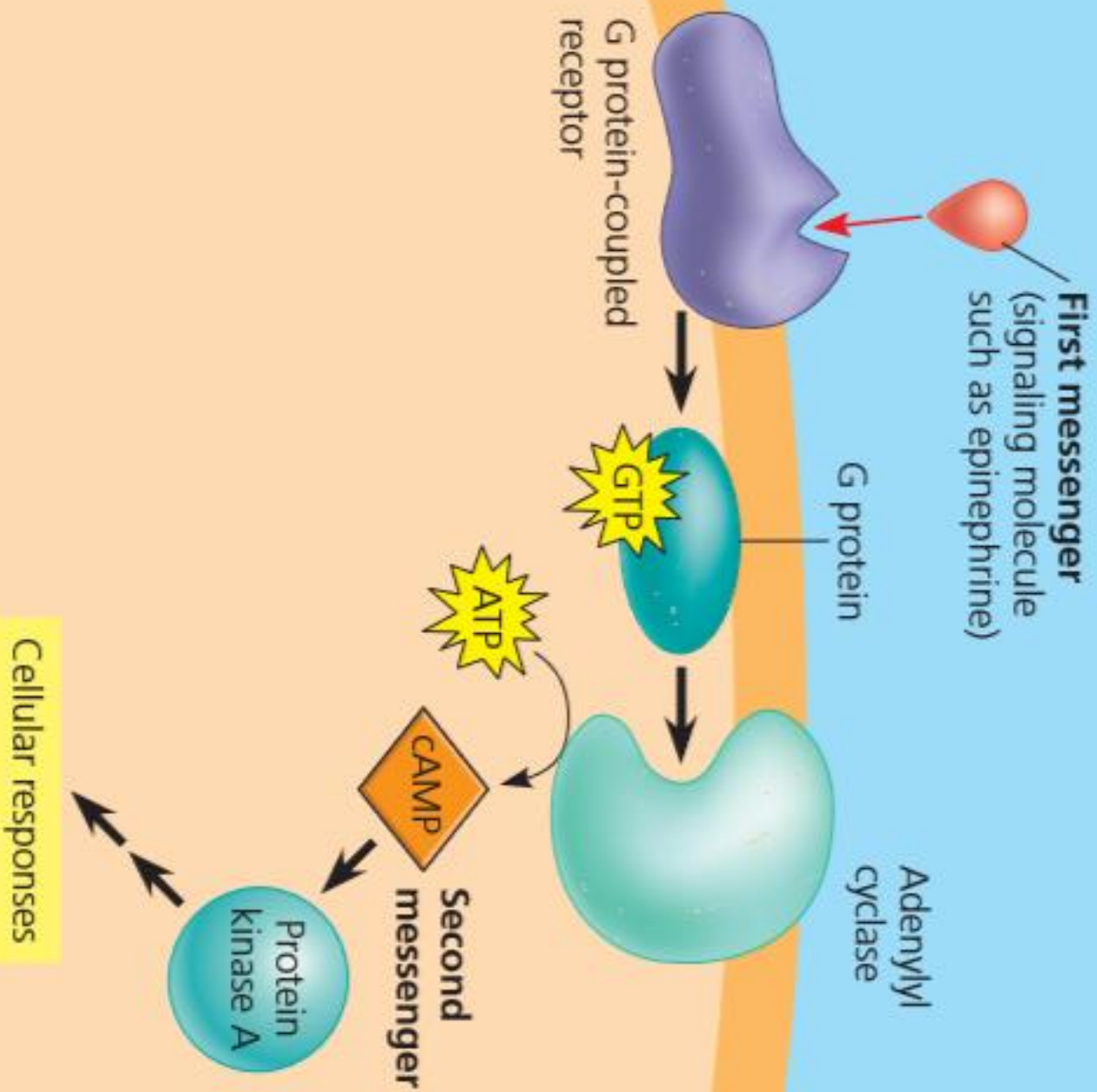


**▲ Figure 11.10 A phosphorylation cascade.**

In a phosphorylation cascade, a series of different molecules in a pathway are phosphorylated in turn, each molecule adding a phosphate group to the next one in line. In this example, phosphorylation activates each molecule, and dephosphorylation returns it to its inactive form. The active and inactive forms of each protein are represented by different shapes to remind you that activation is usually associated with a change in molecular shape.

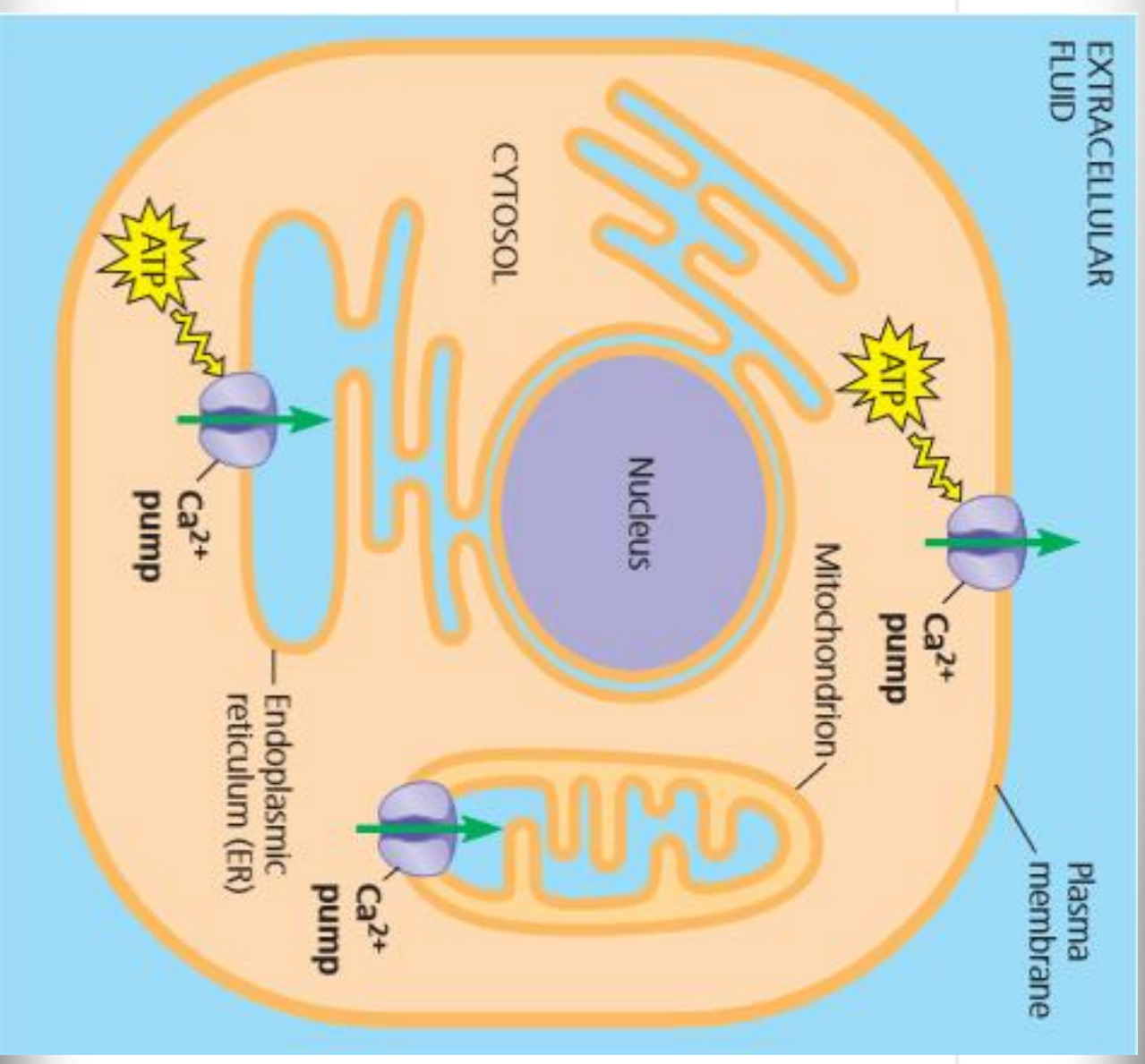
# Second messenger

- Molekul yg terlibat dalam transduksi sinyal di dalam sel
- Sifat: kecil & larut air → berdifusi menyebar
- Contoh: cAMP dan  $\text{Ca}^{2+}$



Cellular responses

# Konsentrasi $\text{Ca}^{2+}$

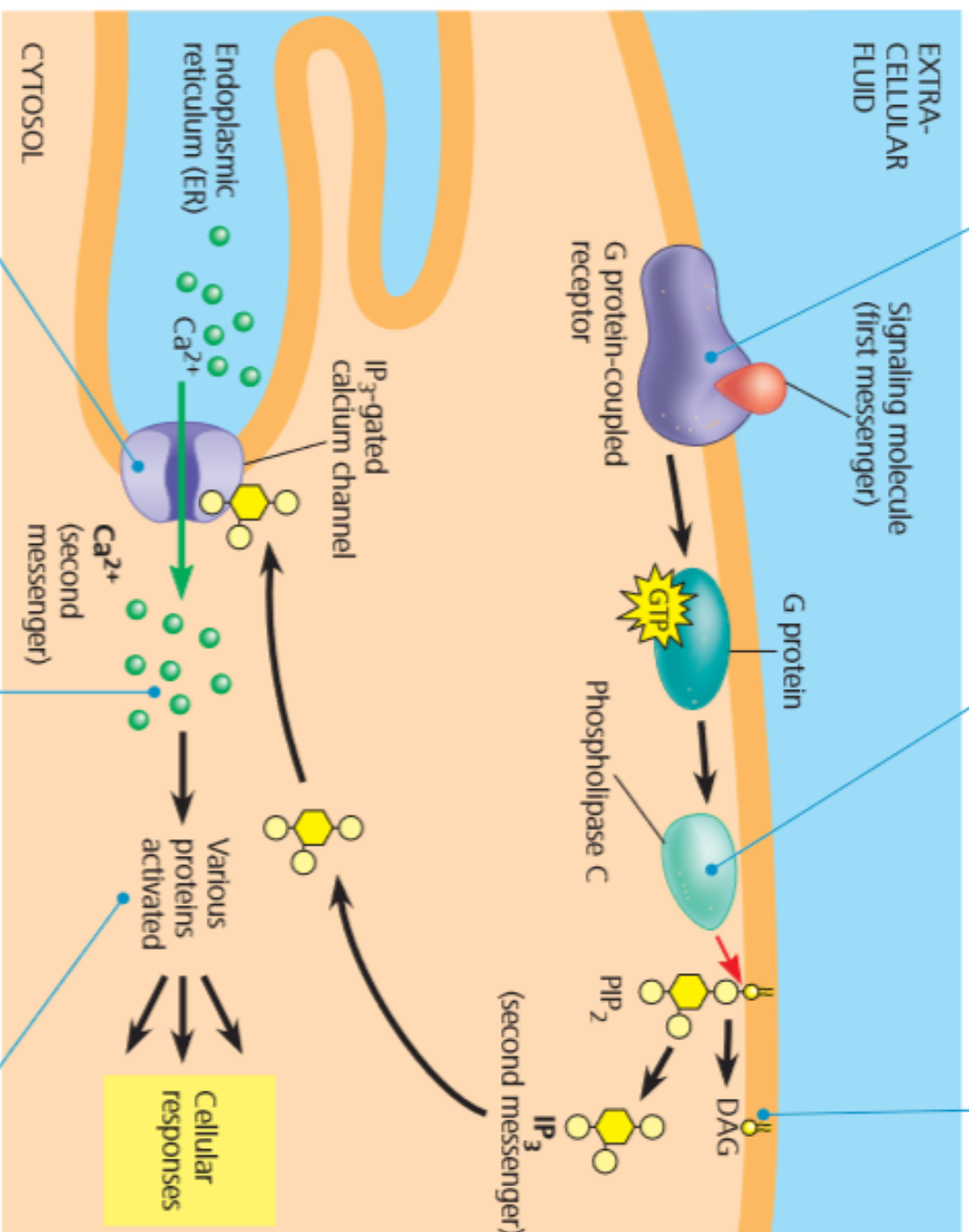




**1** A signaling molecule binds to a receptor, leading to activation of phospholipase C.

**2** Phospholipase C cleaves a plasma membrane phospholipid called PIP<sub>2</sub> into DAG and IP<sub>3</sub>.

**3** DAG functions as a second messenger in other pathways.



**4** IP<sub>3</sub> quickly diffuses through the cytosol and binds to an IP<sub>3</sub>-gated calcium channel in the ER membrane, causing it to open.

**5** Calcium ions flow out of the ER (down their concentration gradient), raising the Ca<sup>2+</sup> level in the cytosol.

**6** The calcium ions activate the next protein in one or more signaling pathways.

# Respon Sinyal

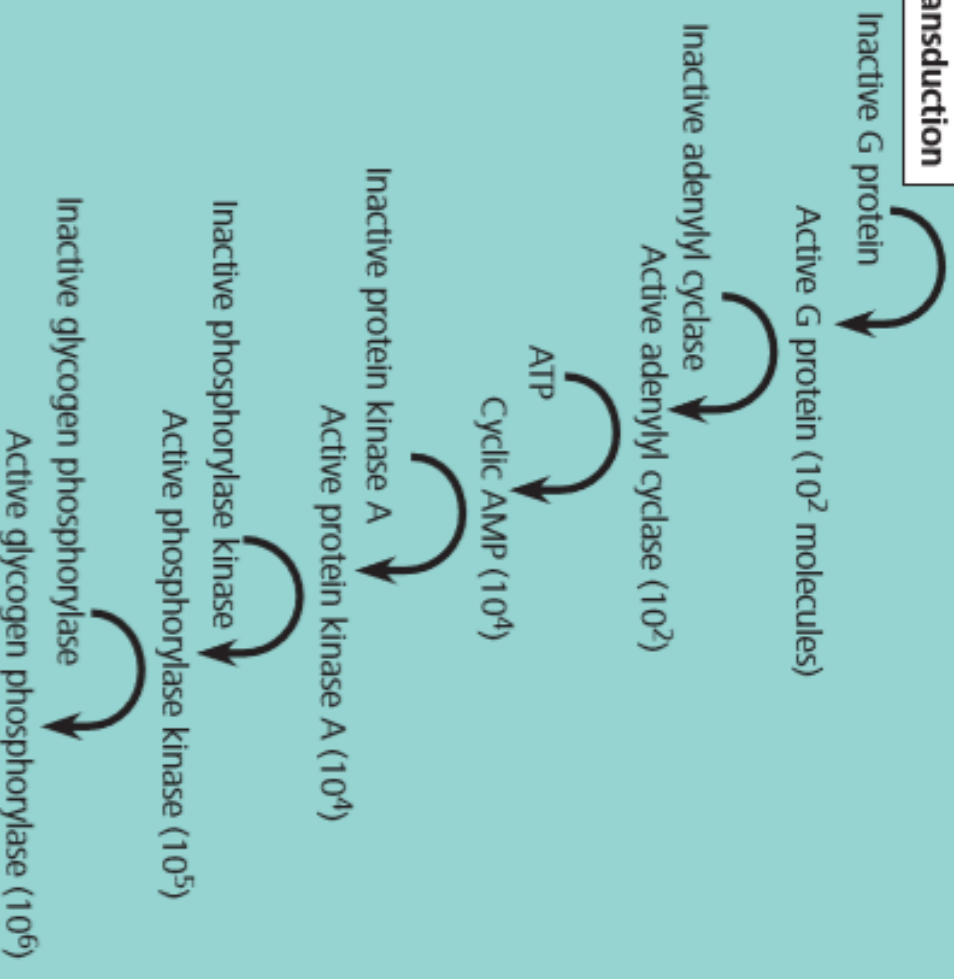
- Respon sinyal dapat terjadi di sitoplasma ataupun di dalam nukleus

# Respon di sitoplasma

## Reception

Binding of epinephrine to G protein-coupled receptor (1 molecule)

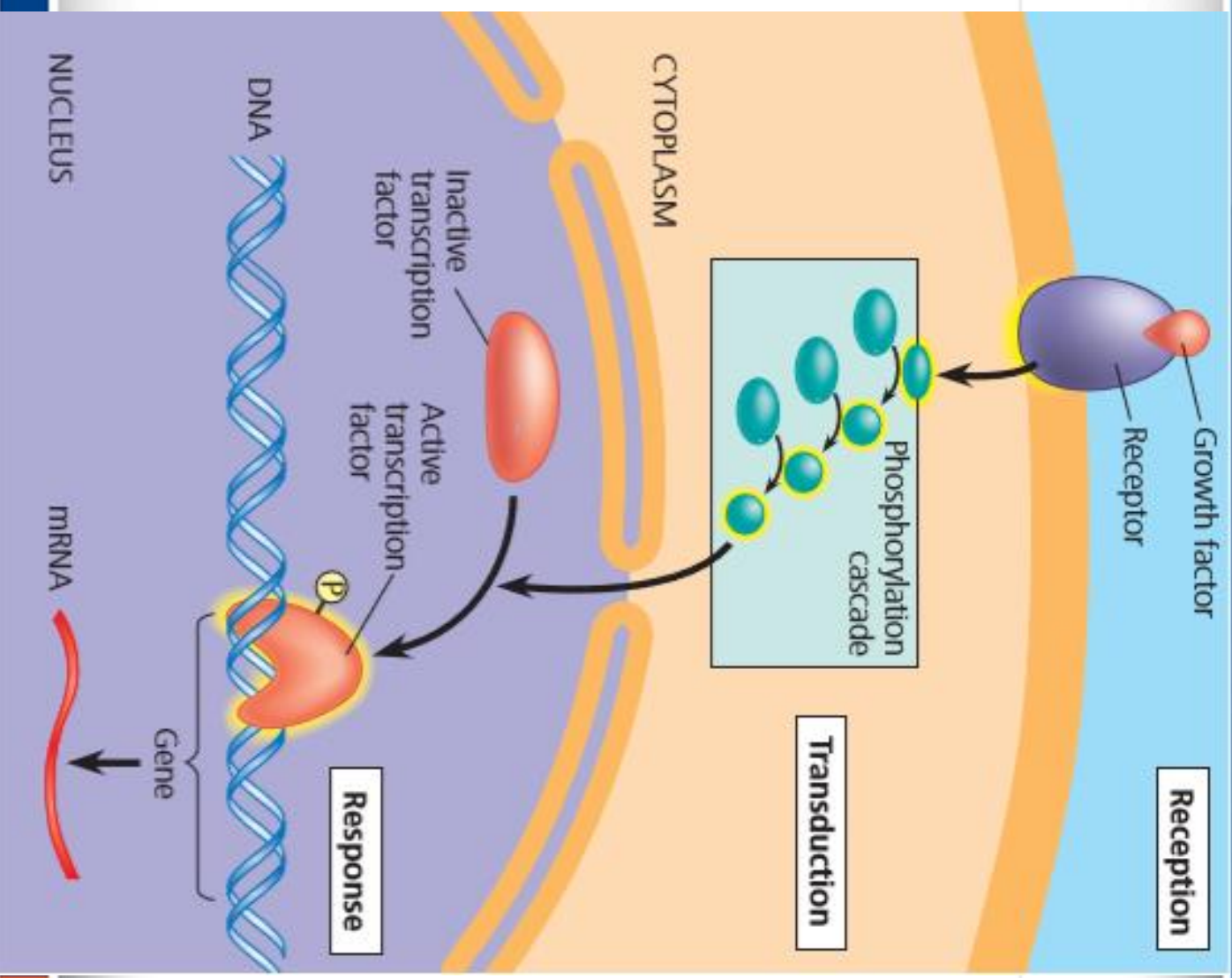
## Transduction



## Response

Glycogen  
Glucose 1-phosphate  
( $10^8$  molecules)

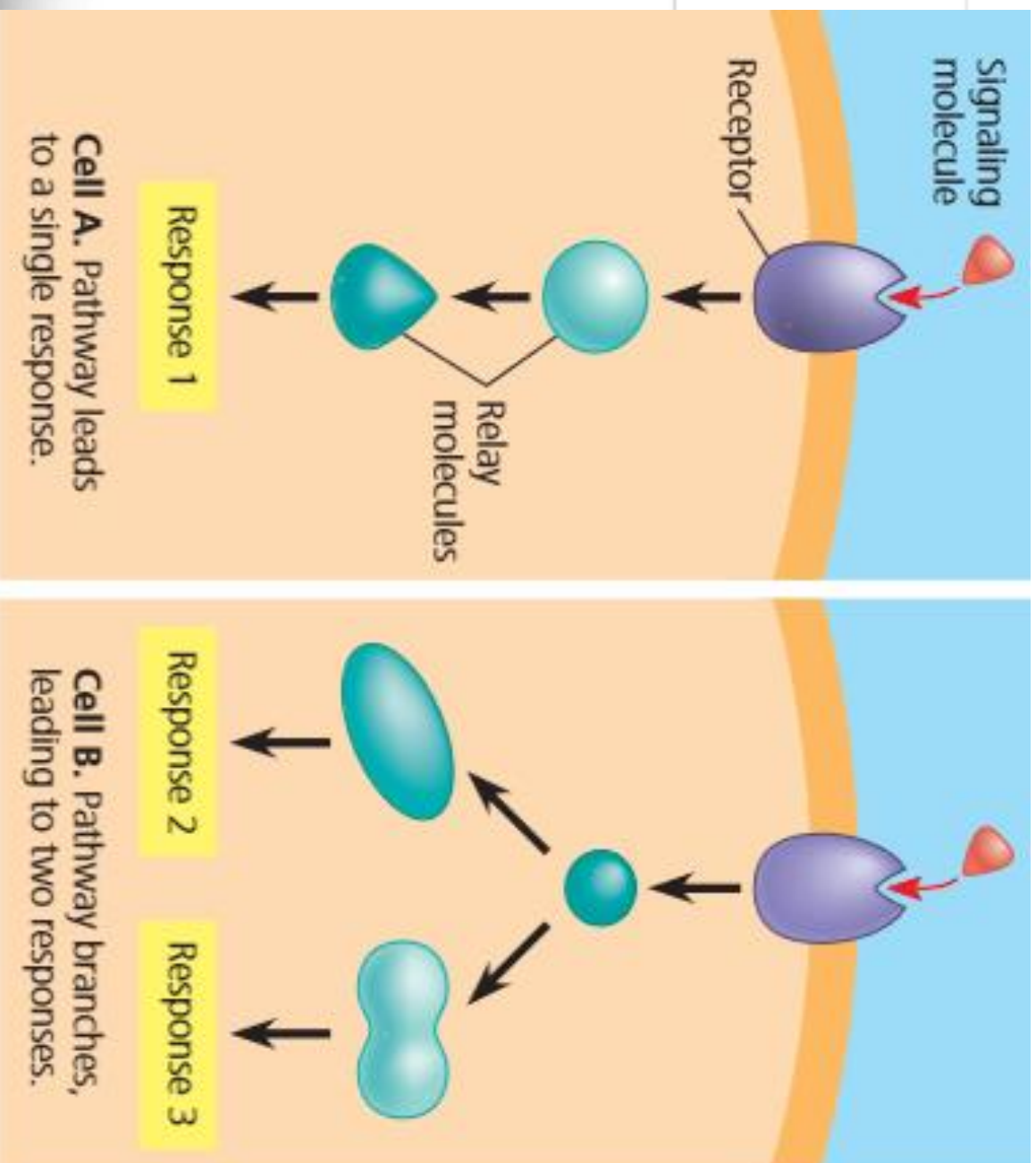
# Respon di nukleus



# Manfaat penting jalur persinyalan

- Penguatan sinyal
  - efek → sejumlah kecil molekul sinyal dapat menyebabkan respon yg besar
- Penentuan respon
  - Jenis sel yg berbeda memiliki koleksi protein yg berbeda
    - dua sel berbeda dapat merespon secara berbeda terhadap molekul sinyal yg sama

# Kekhususan persinyalalan sel



**Cell A.** Pathway leads to a single response.

**Cell B.** Pathway branches, leading to two responses.

