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Receptors:
key structures in cell signaling

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Signal transduction in multicellular organism

- Humoral signaling
- Neuronal signaling

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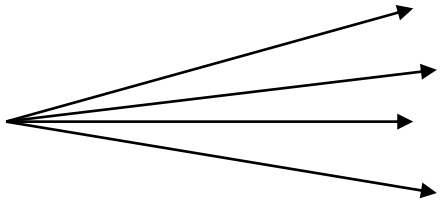
Signal transduction in multicellular organism

- Humoral signaling  ?

- Neuronal signaling

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Signal transduction in multicellular organism

- Humoral signaling
- Neuronal signaling ?

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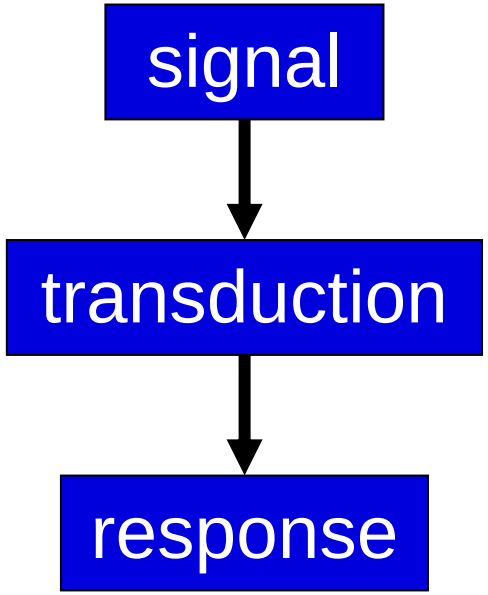
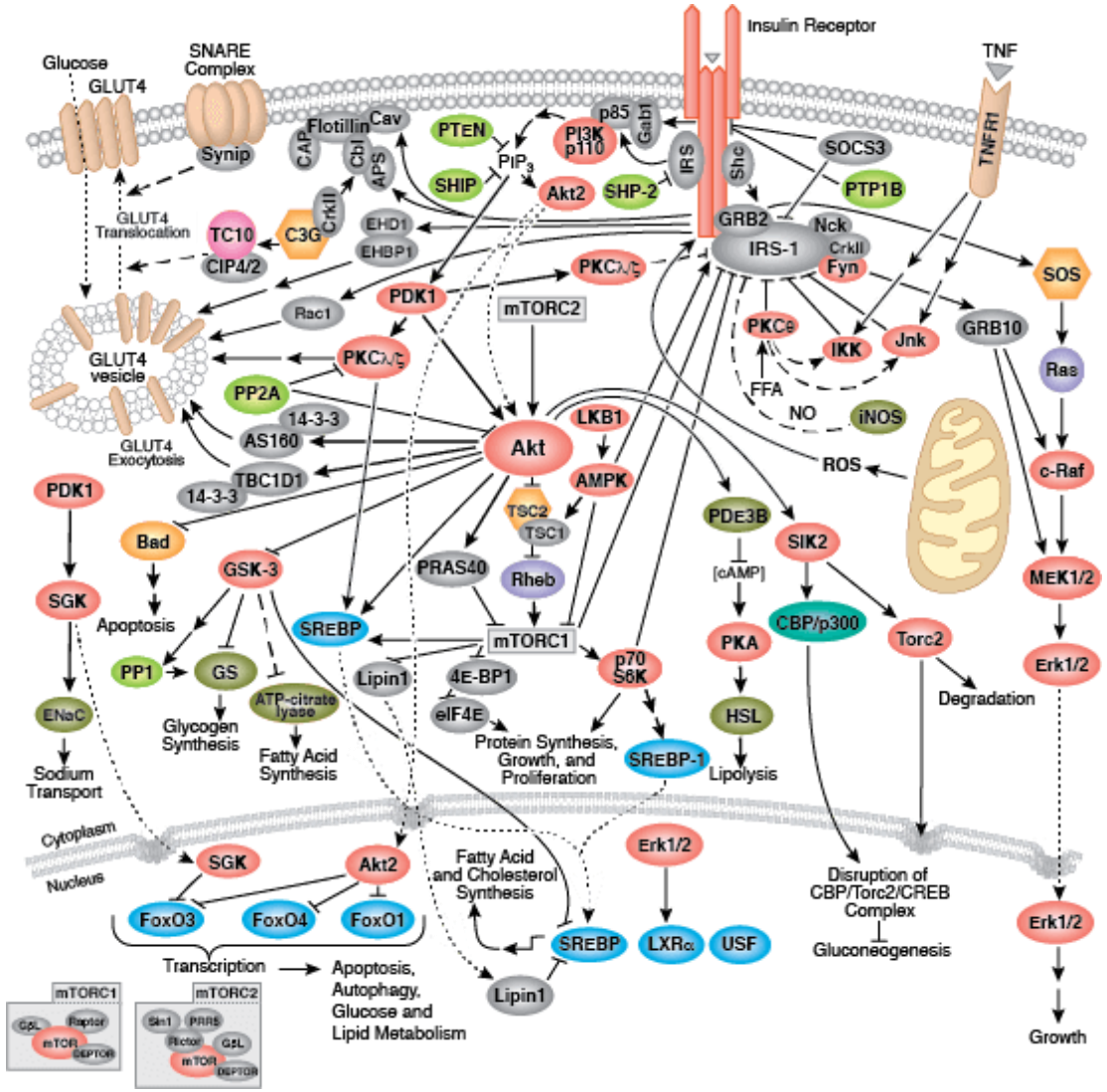
Cellular signaling





https://www.cellsignal.com/contents/science-cst-pathways-cellular-metabolism/insulin-receptor-signaling/pathways-irs

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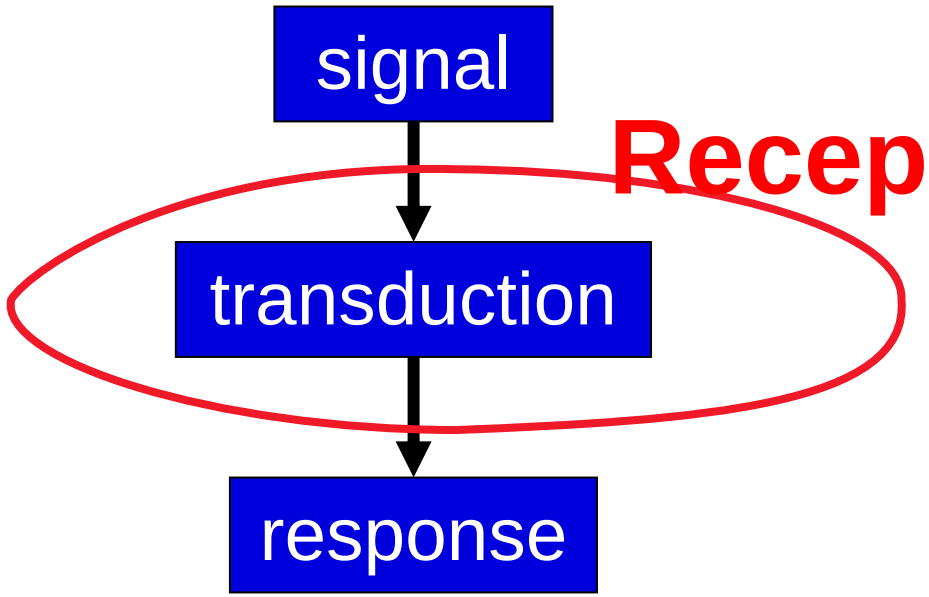
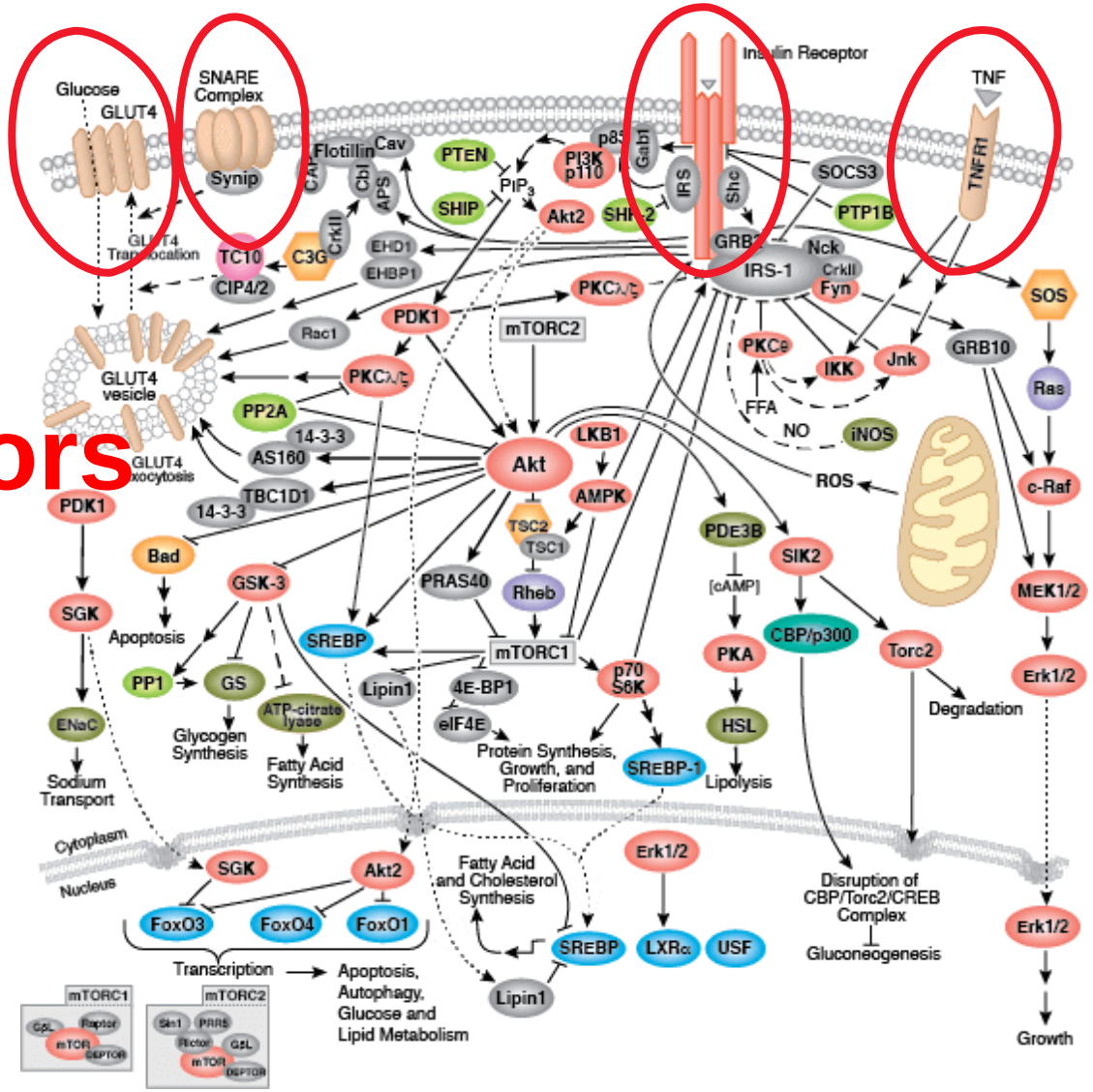
Cellular signaling



Receptors



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Receptors

- Protein-based structures
- Receive and transduce signals
- Integrated in signaling pathways

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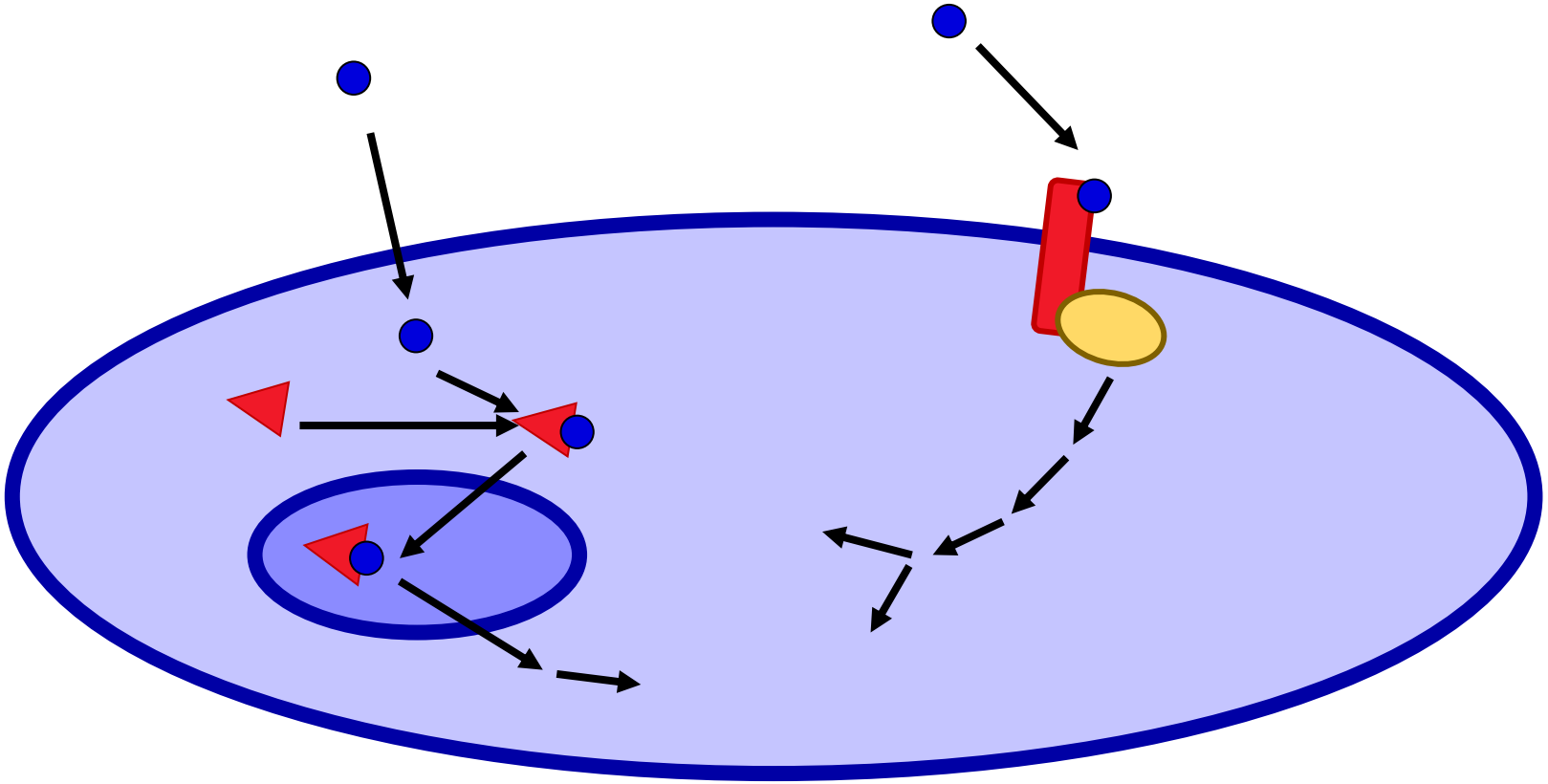
Classification

- Location:
  - Intracellular
  - Cell surface
- Function
  - Ionotropic = ligand-gated ion channels
  - G protein-coupled
  - Enzyme-linked
    Tyrosine kinases
    Histidine kinases

Intracellular vs. cell-surface receptors



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Ionotropic receptors

- Ligand-gated ion cahnnels

- Direct change of membrane voltage and/or intracellular concentration of the ion

Metabotropic receptors

- Production of second messenger

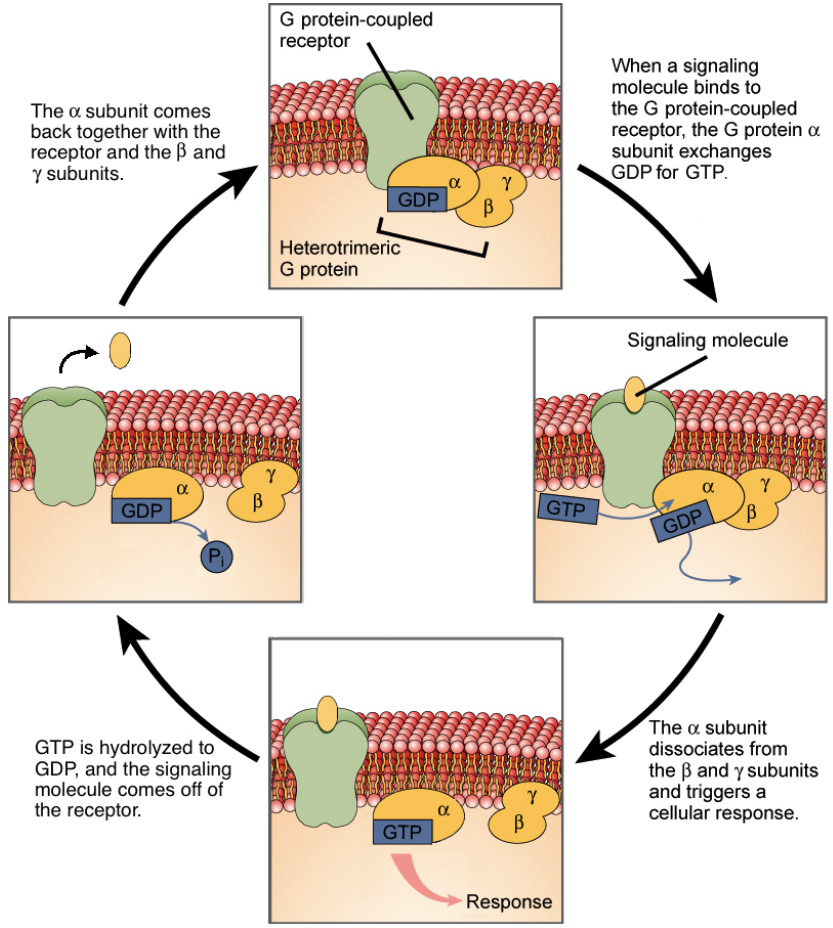
- G protein-coupled receptors
- Enzyme-linked receptors
  - Receptor Tyrosine kinases
  - Receptor Histidine kinases

G protein-coupled receptors

- Production of second messenger:

cAMP, cGMP, DAG, IP3, Ca2+

- Gs
- Gi
- Gq



https://www.khanacademy.org/science/biology/cell-signaling/mechanisms-of-cell-signaling/a/signal-perception

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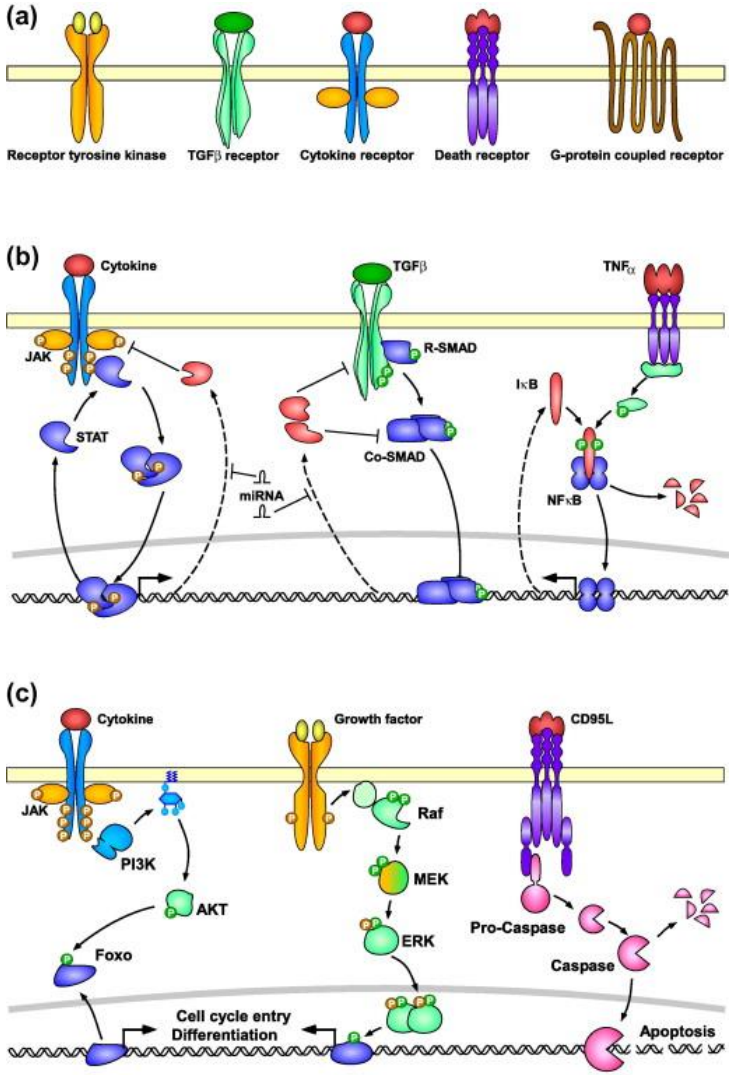
Enzyme-linked receptors



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Receptor tyrosine kinases

- Tyrosine kinase activity - phosphorilation of enzymes/other proteins

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Regulation of receptor response

Down-regulation

- Decrease of number and/or sensitivity of the receptors due to increased ligand stimulation

- Desensitisation
- Internalisation

Regulation of receptor response

Up-regulation

- Increase of number and/or sensitivity of the receptors due to decreased ligand stimulation

- (Re)sensitisation
- Externalisation
- Synthesis de novo

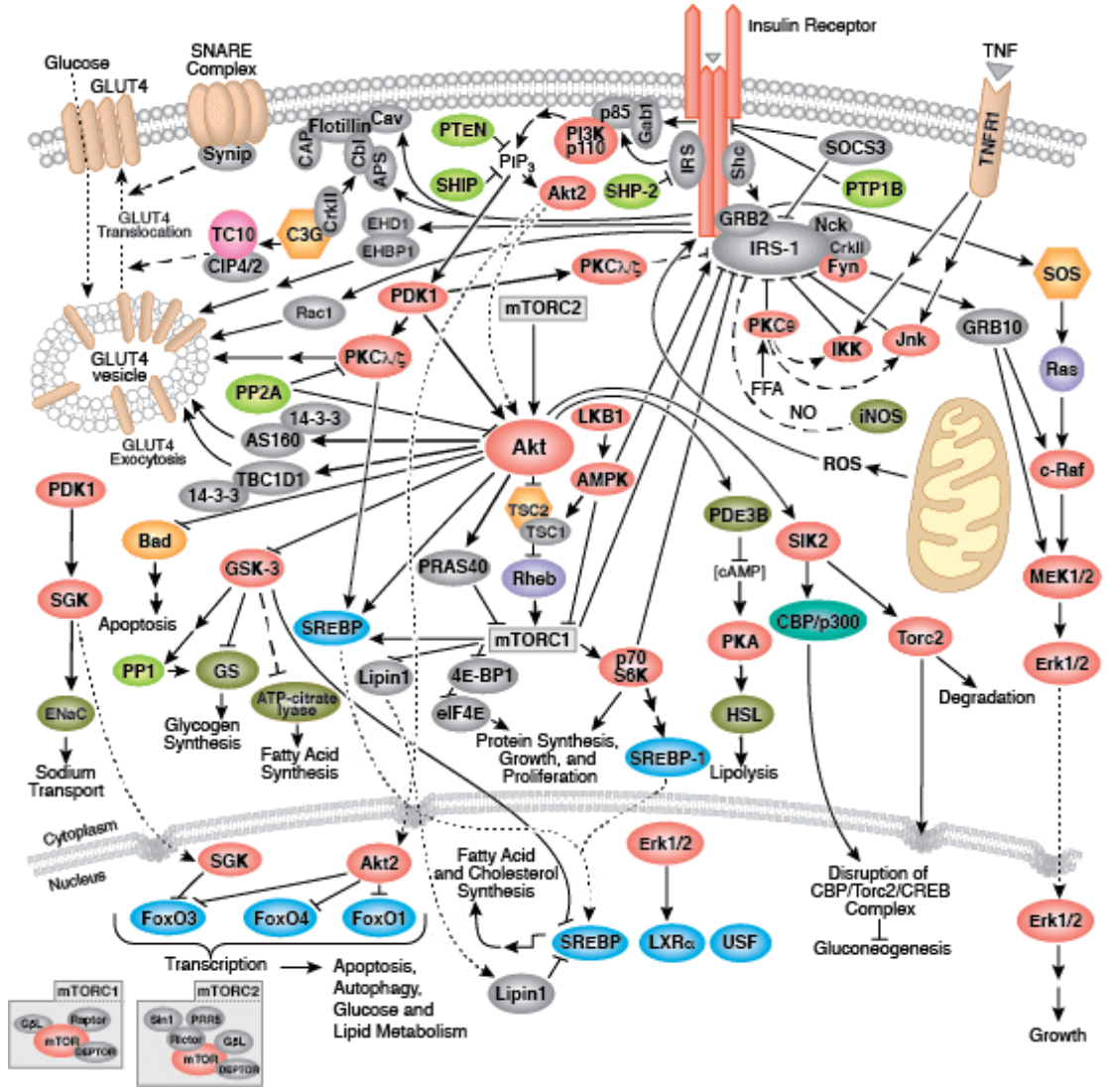
Receptor families

- Classification according to **ligand(s)**

Adrenergic receptors

- G protein-coupled receptors
- Subtypes:
  - Alpha:
    α1 (Gq) – DAG+IP3; smooth muscle contraction, mydriasis
    α2 (Gi) – cAMP; platelet activation
  - Beta (Gs) - cAMP
    β1 – heart (SA node)
    β2 – smooth muscle relaxation (bronchodilation)
    β3 – lipolysis, urination

Insuline receptors



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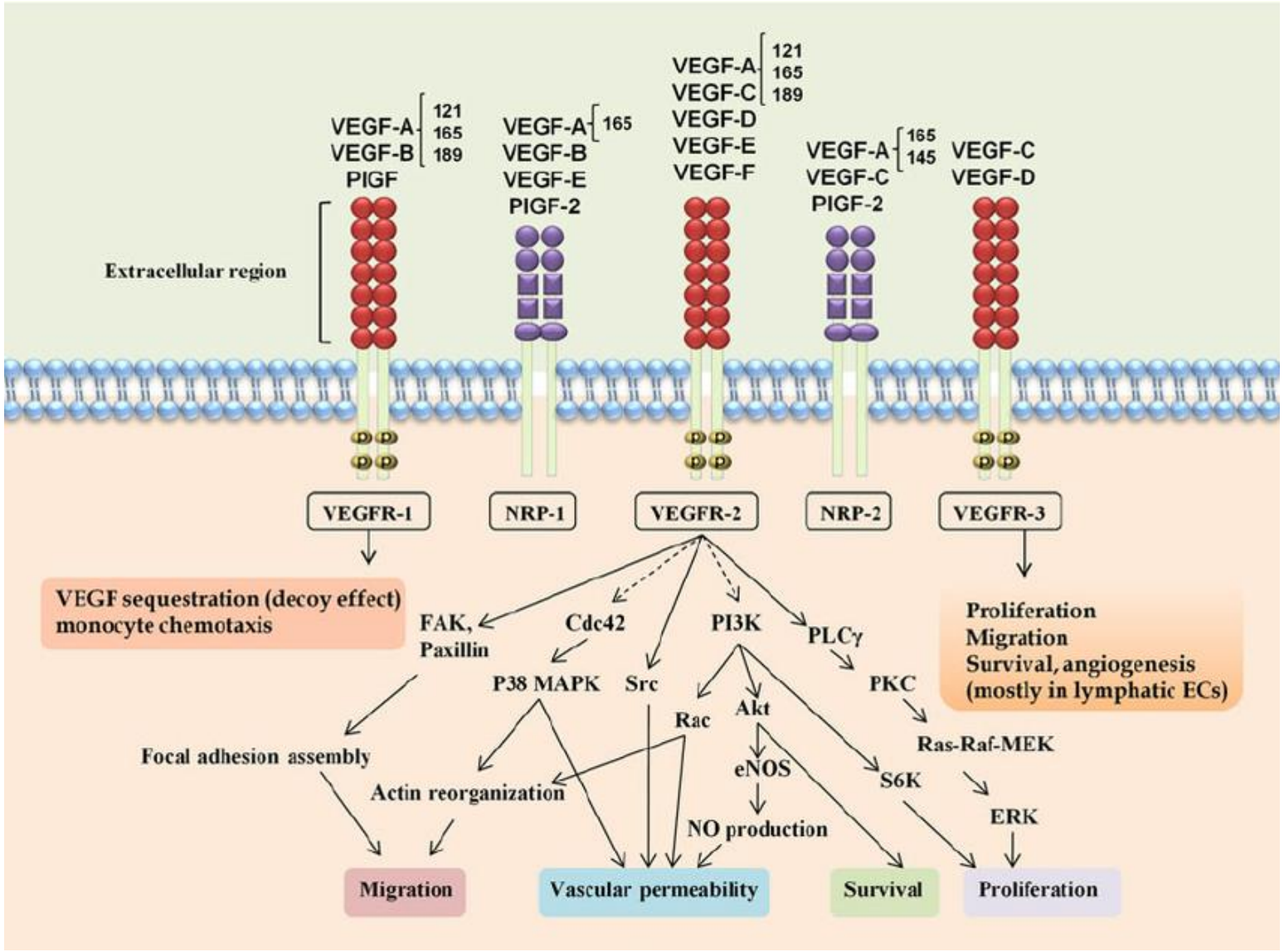
VEGFR

– Vascular endothelial growth factor receptor



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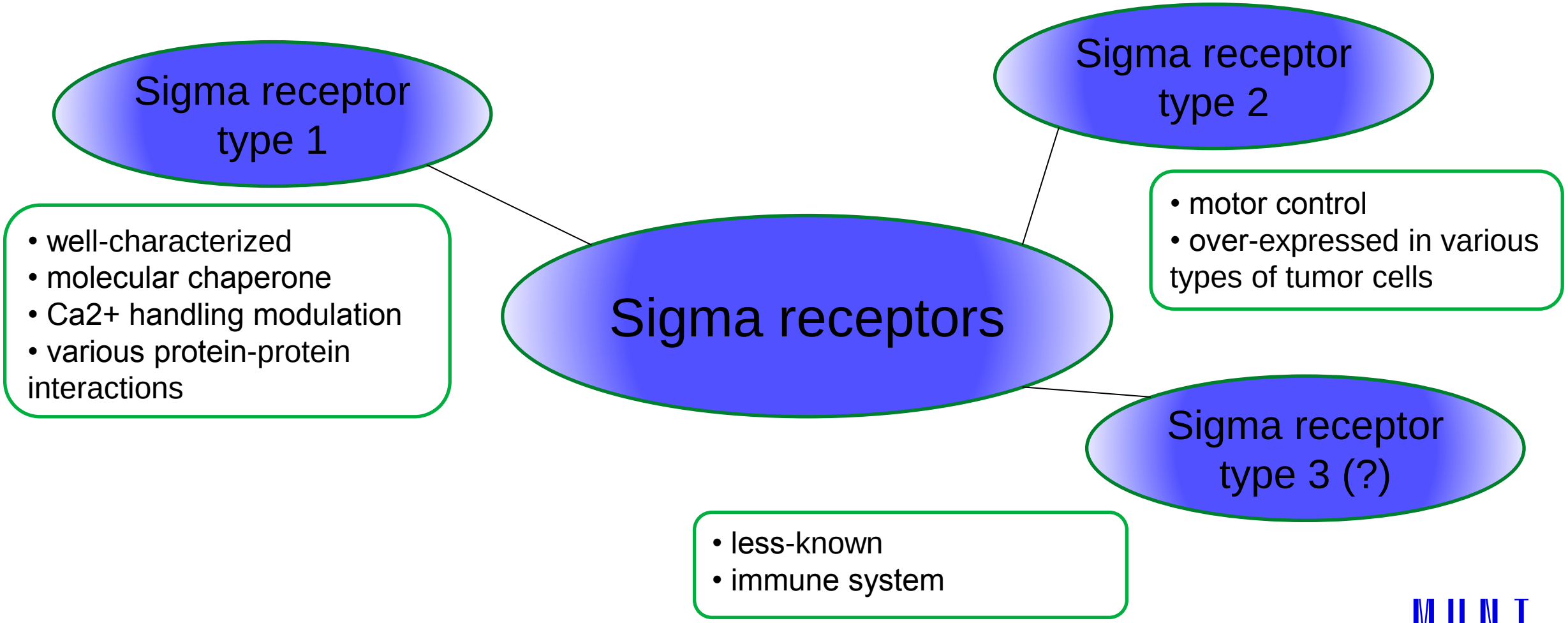
IP3 receptors

- Inositol-tris-phosphate receptors

Sigma receptors



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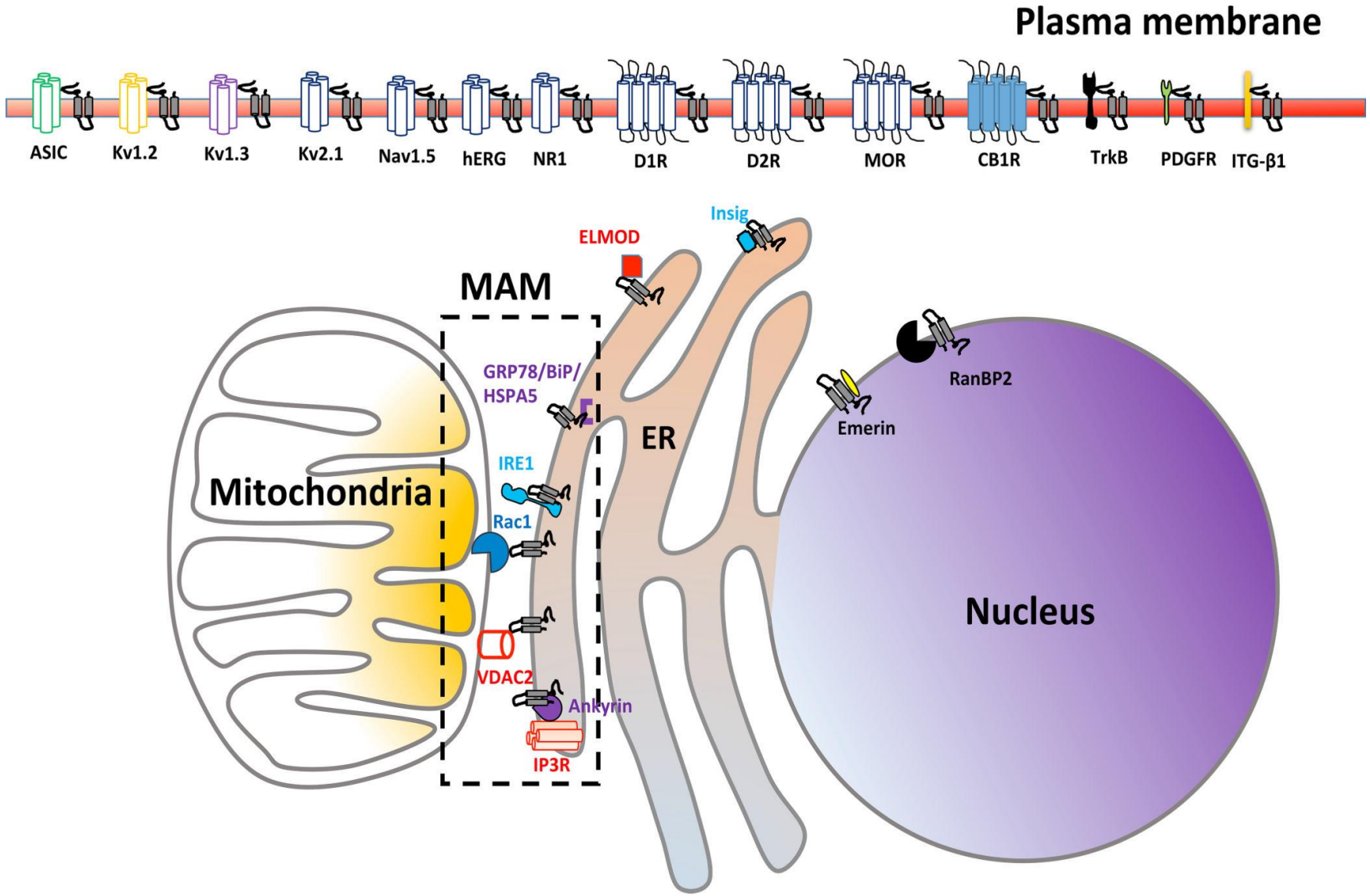
Sigma 1 R



Su et al., 2016.
Trends Pharmacol Sci. 2016; 37(4): 262–278. doi:10.1016/j.tips.2016.01.003

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Receptors

- Crucial structures in cell signaling
- Important in pathophysiology of many diseases
- Targets of pharmacotherapy

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