



NEUROTRANSMITTERS

Dr Jayanti Pant



Properties

- Neurotransmitters must be synthesized in the neuron
- Should be stored in presynaptic endings
- Should be released at the synapse
- Should have specific receptors
- Should be disposed off by a specific mechanism



Classification

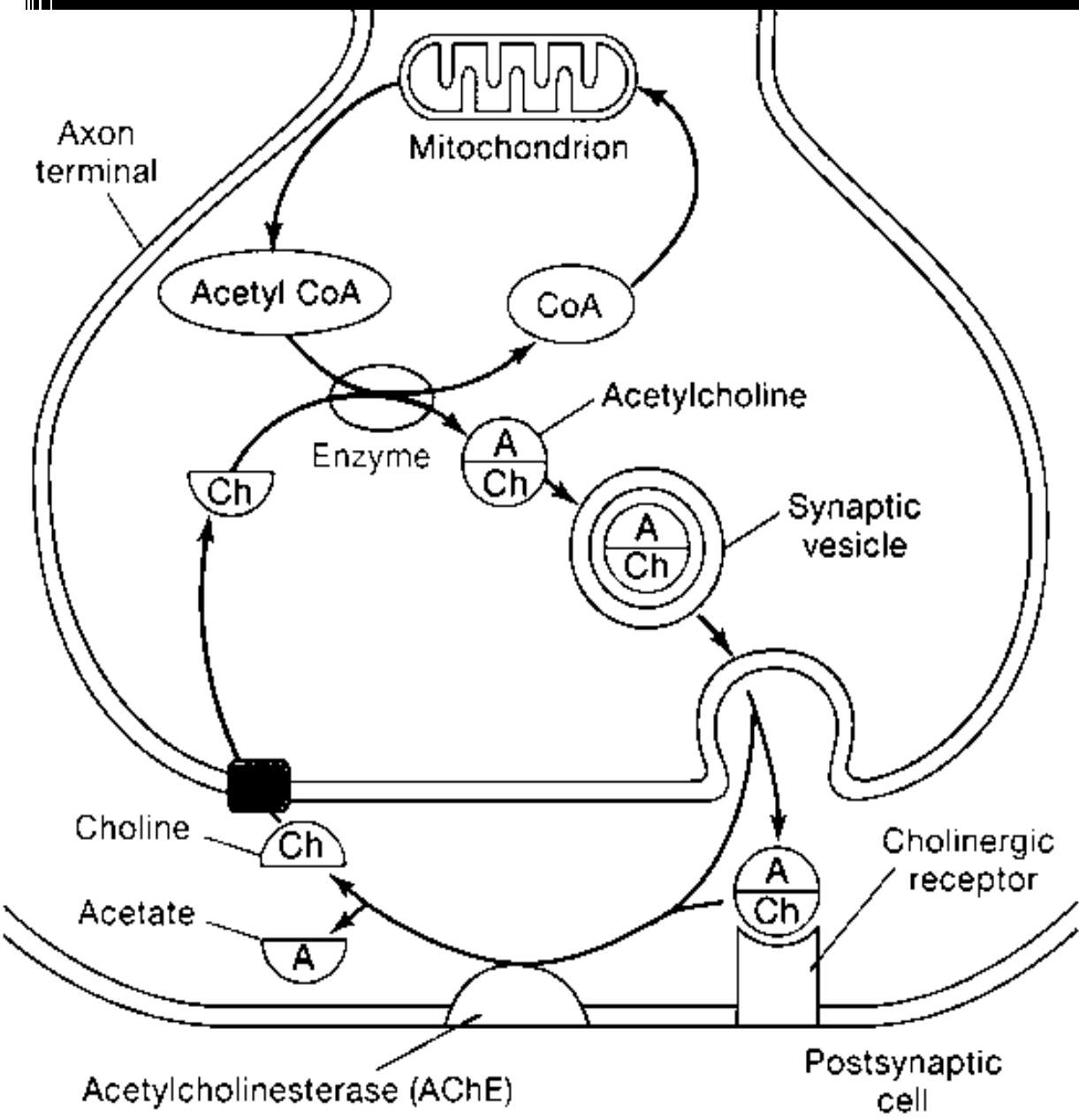
- **Acetylcholine**
- **Amines** – NE, Epinephrine, DA, Serotonin, Histamine
- **Amino Acids-**

Excitatory: Glutamate, Aspartate

Inhibitory: Glycine, GABA

- **Polypeptides** – ADH, Subs P, NPY, Endorphins, Enkephalins, SST

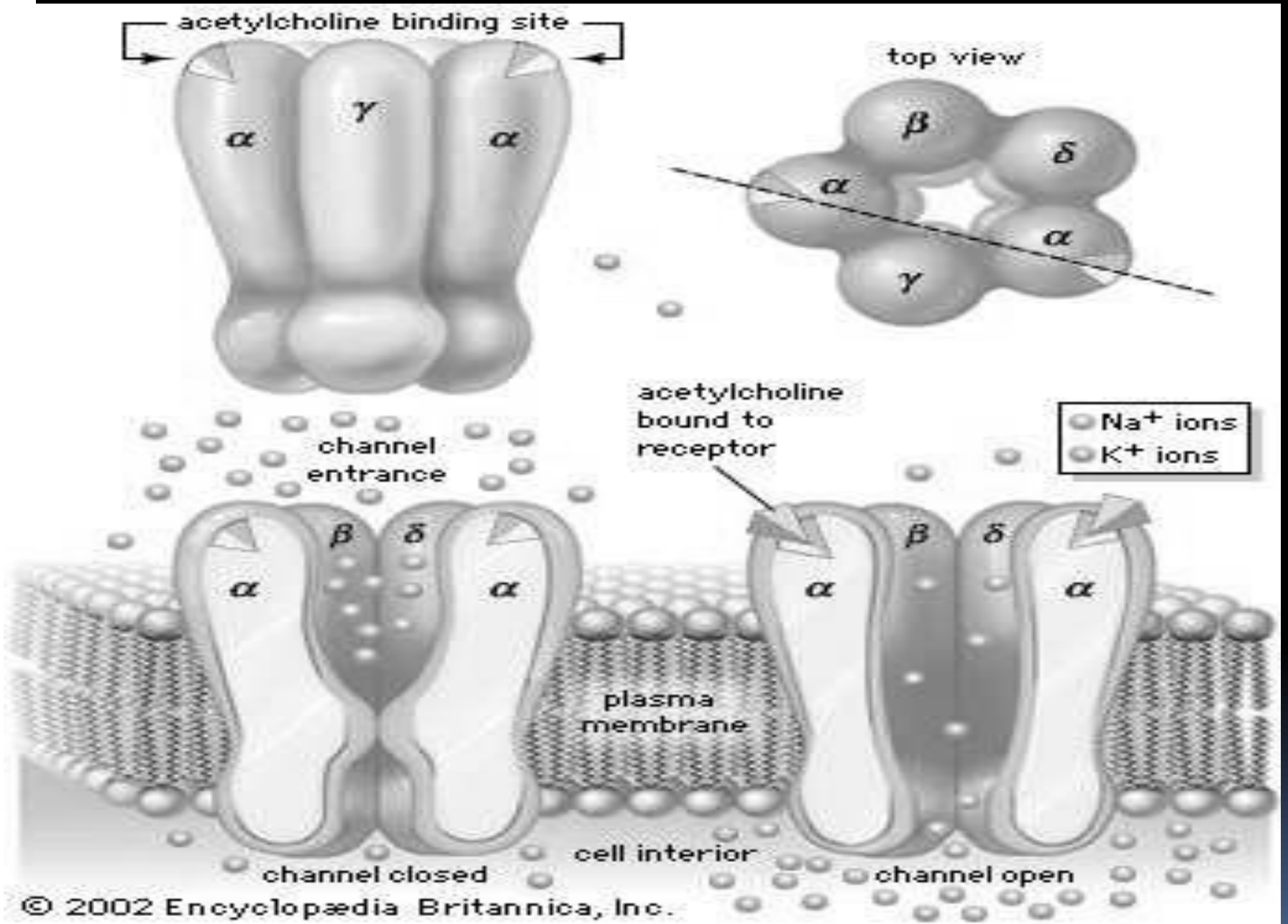
- 
- **Purines-** ATP, Adenosine
 - **Gases** – NO, CO
- 

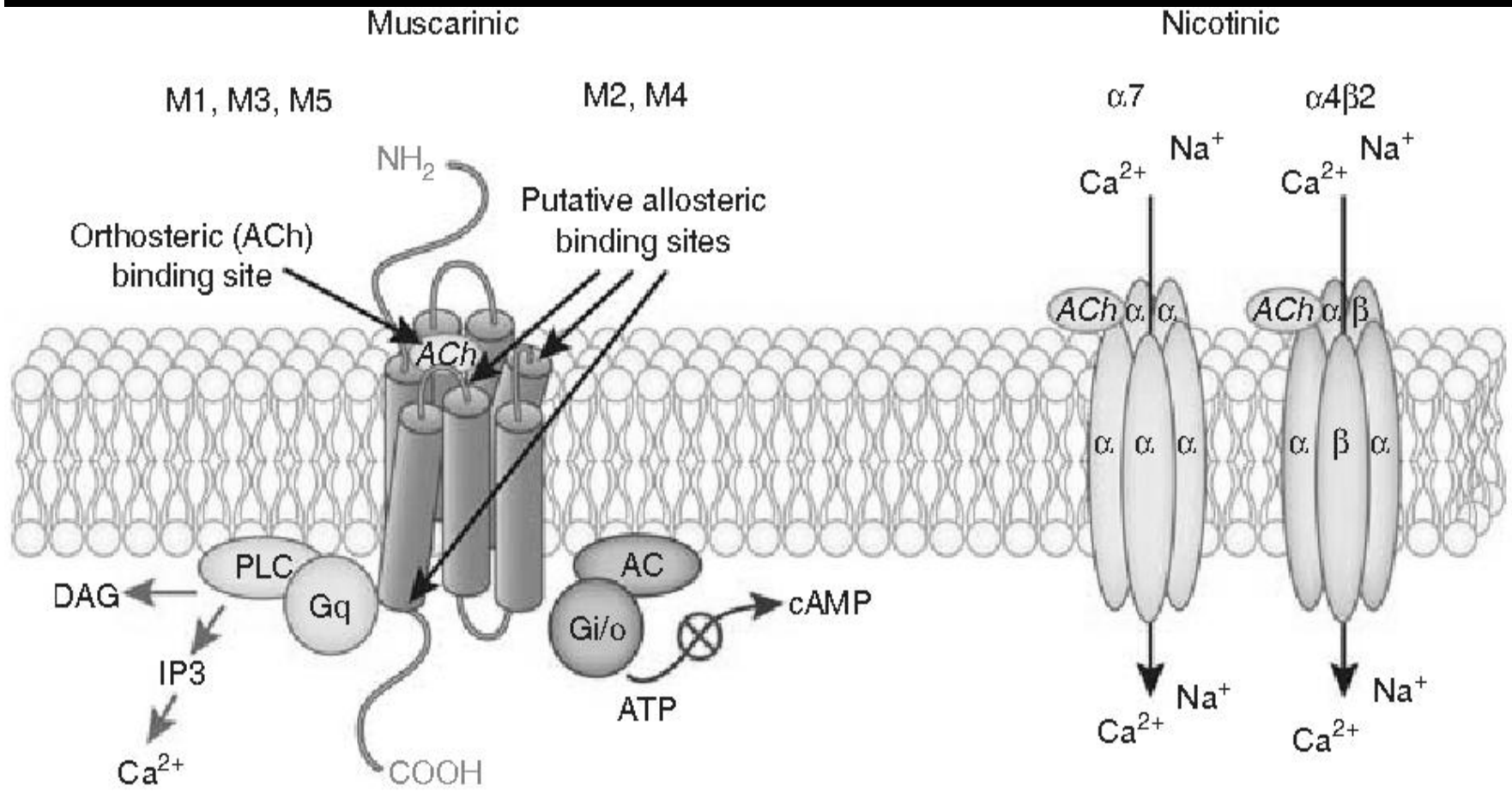


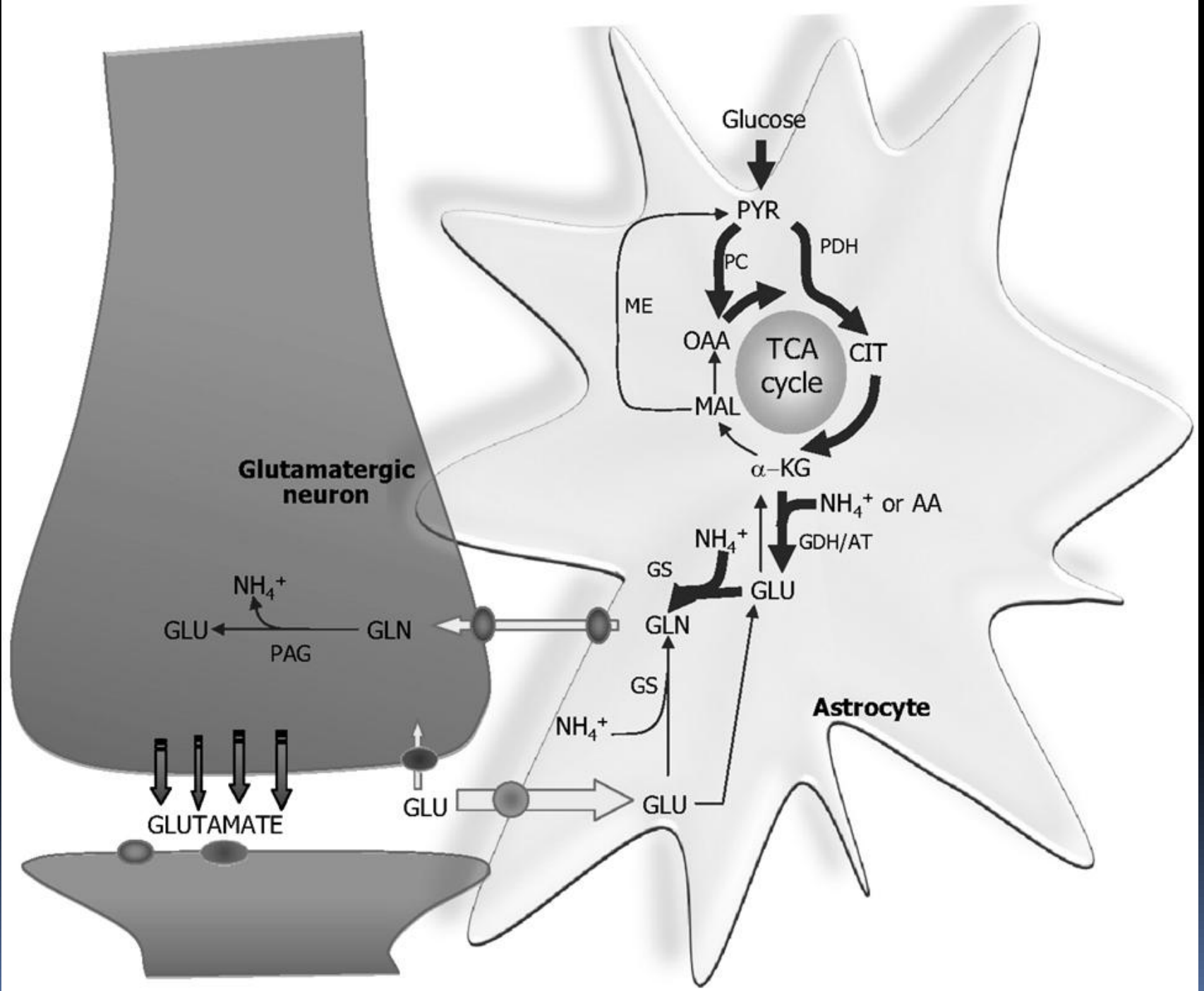
Acetylcholine (ACh) is made from choline and acetyl CoA.

In the synaptic cleft ACh is rapidly broken down by the enzyme **acetylcholinesterase**.

Choline is transported back into the axon terminal and is used to make more ACh.

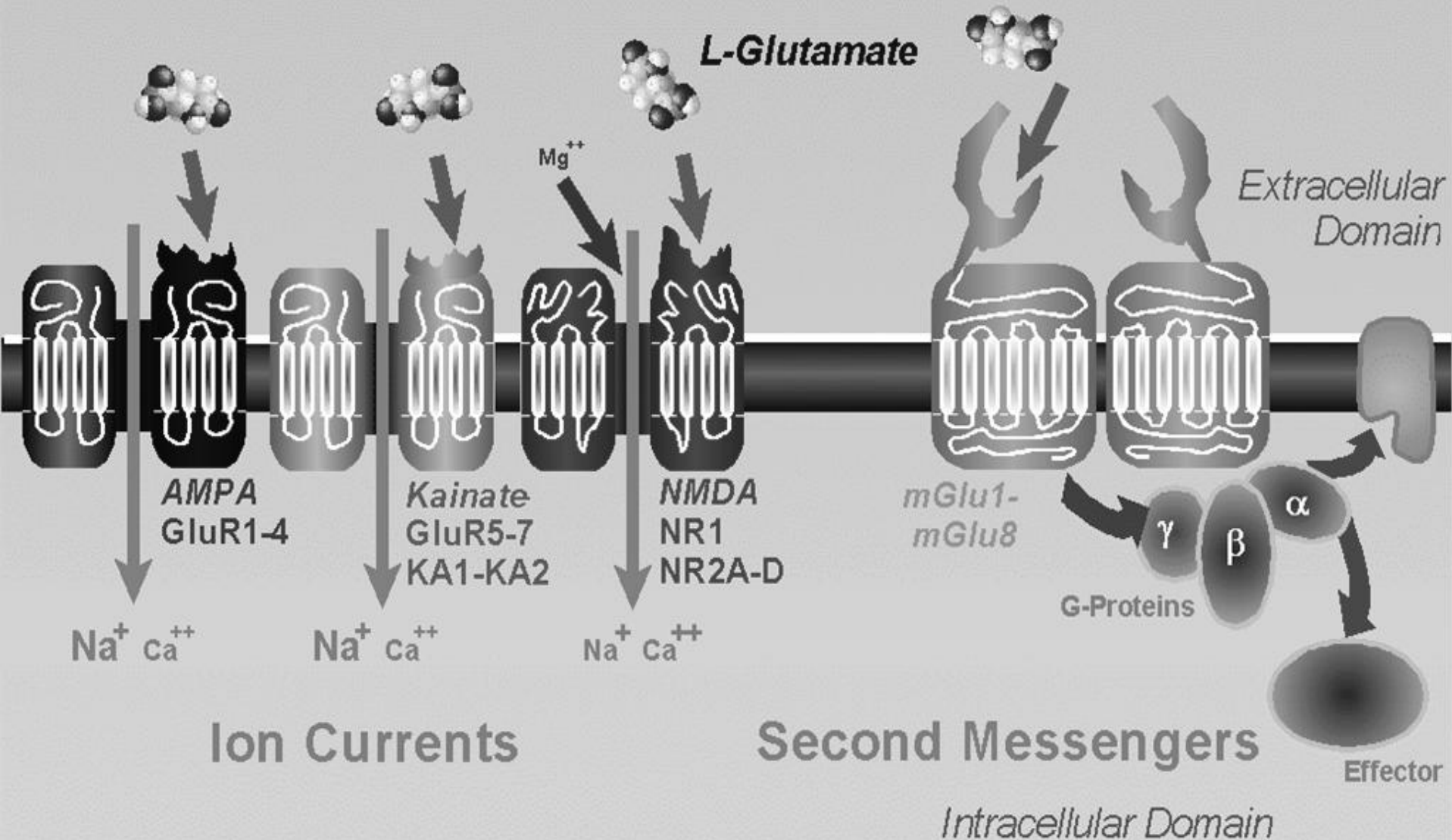






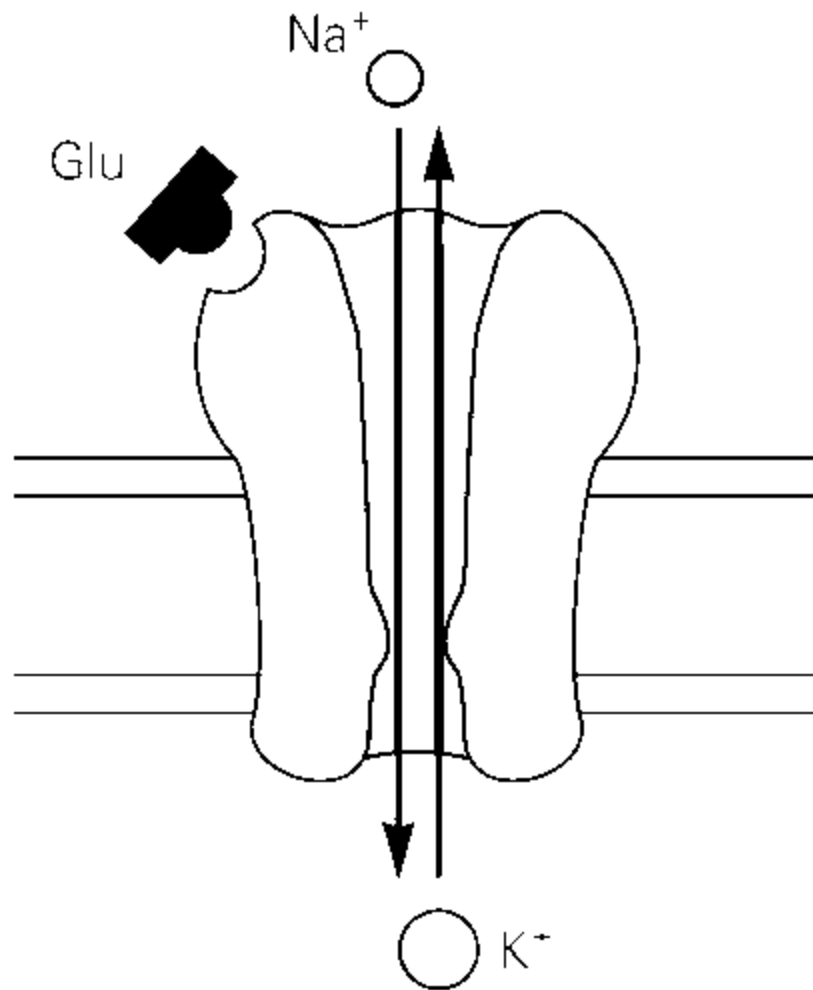
IONOTROPIC GLUTAMATE RECEPTORS

METABOTROPIC GLUTAMATE RECEPTORS

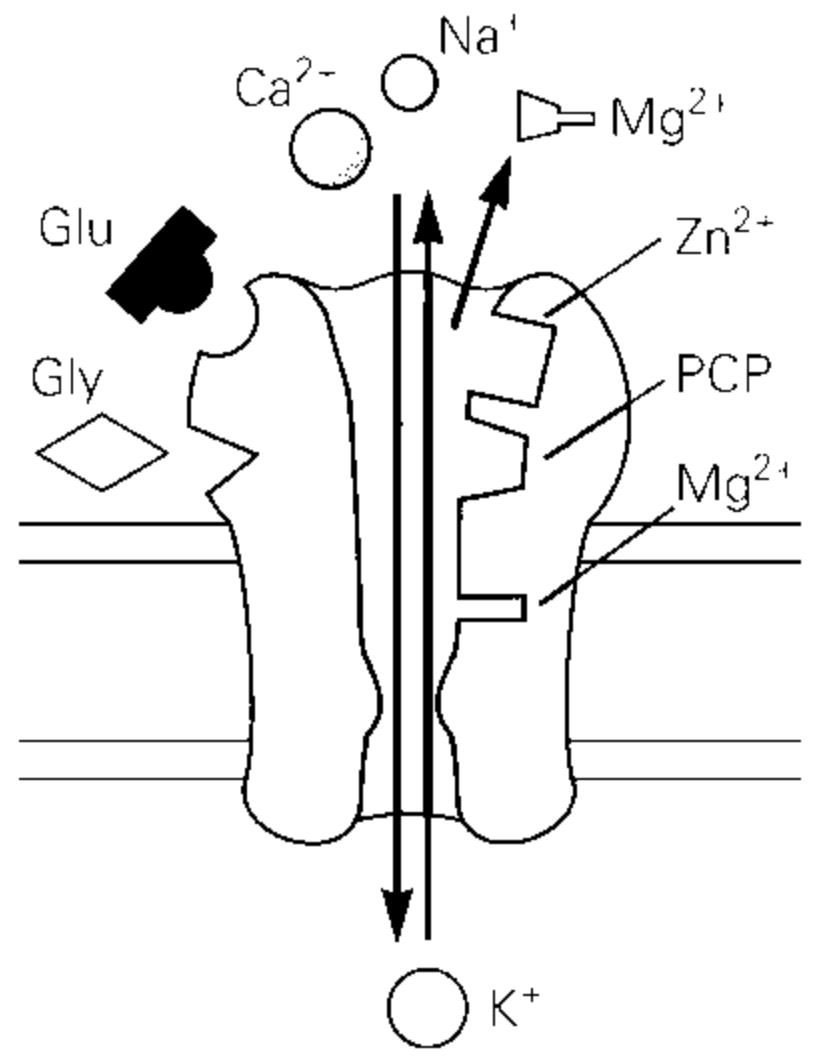


A Ionotropic glutamate receptor

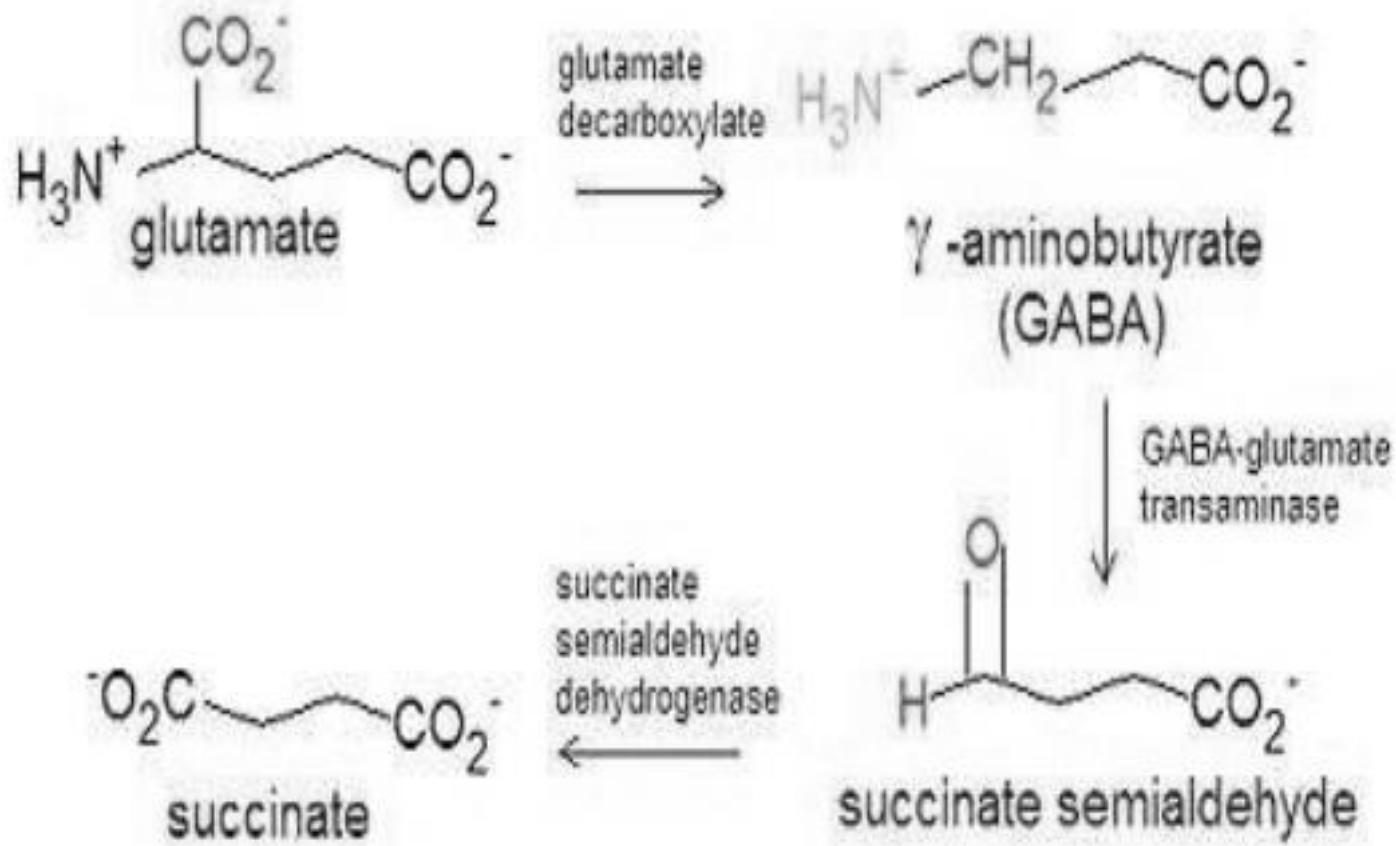
AMPA or Kainate



NMDA

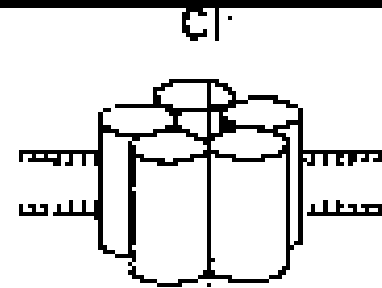


SYNTHESIS OF GABA



GABA_A

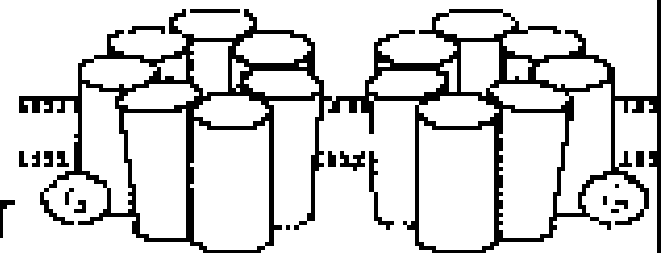
- * Ligand-gated ion channel



Subunits:
α1-6, β1-3, γ1-3, δ, ε, θ and π

GABA_B

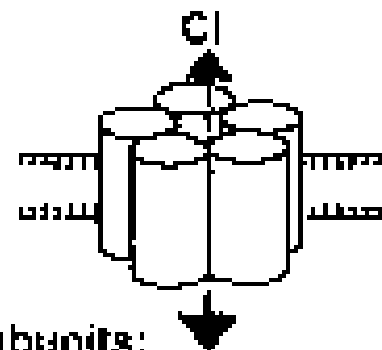
- * G protein-coupled receptor



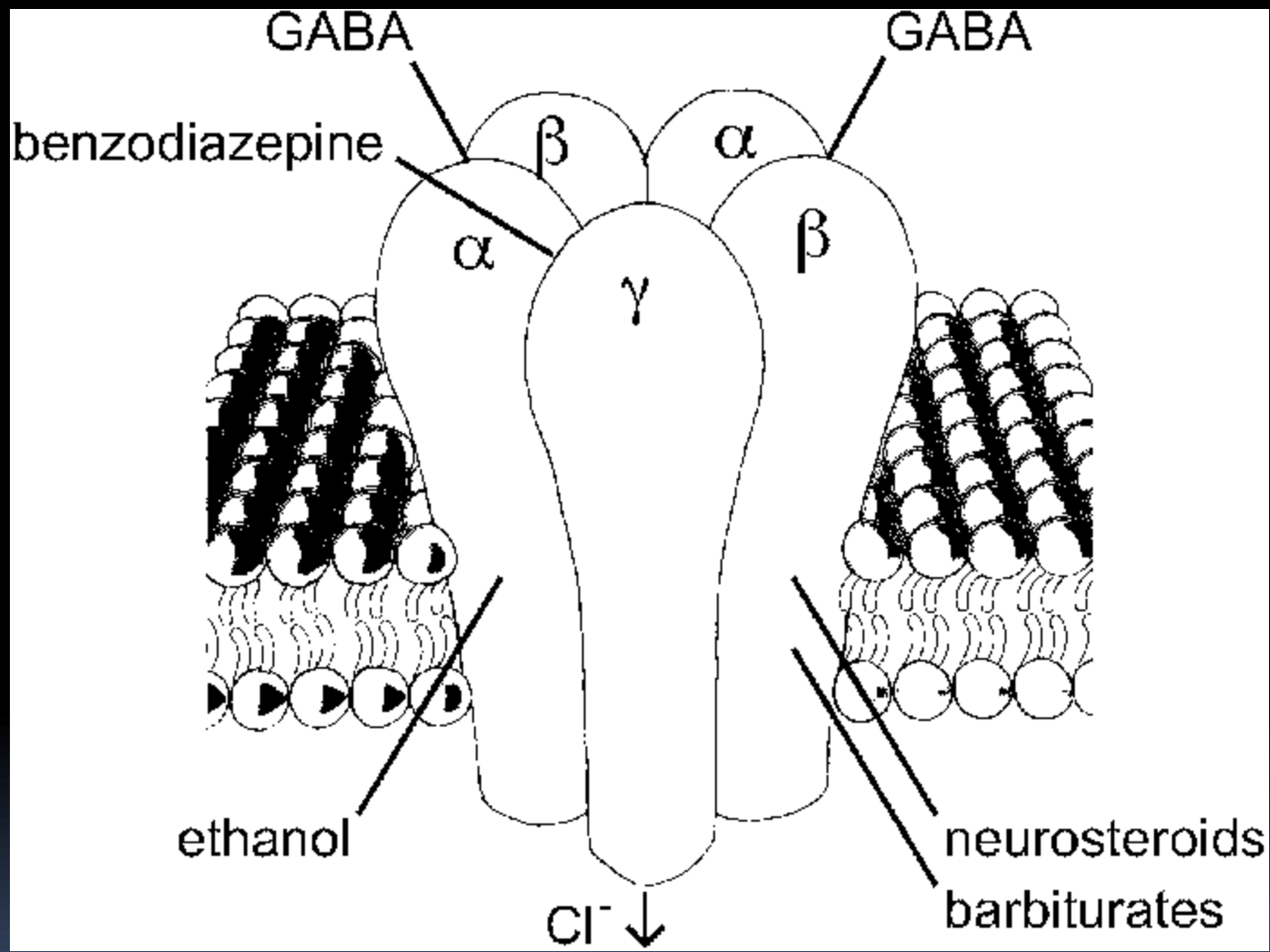
Subunits:
R1a, R1b and R2

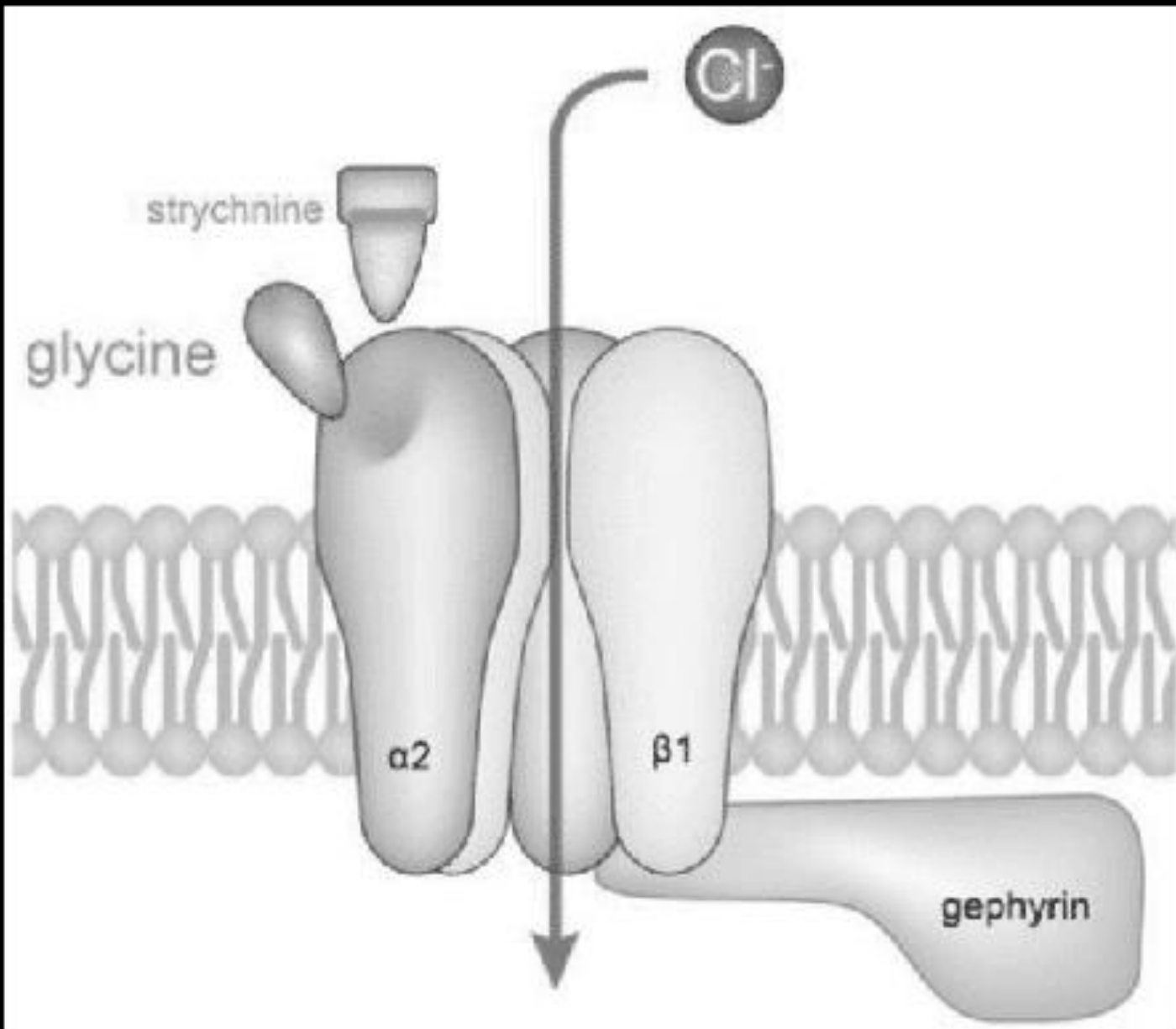
GABA_C

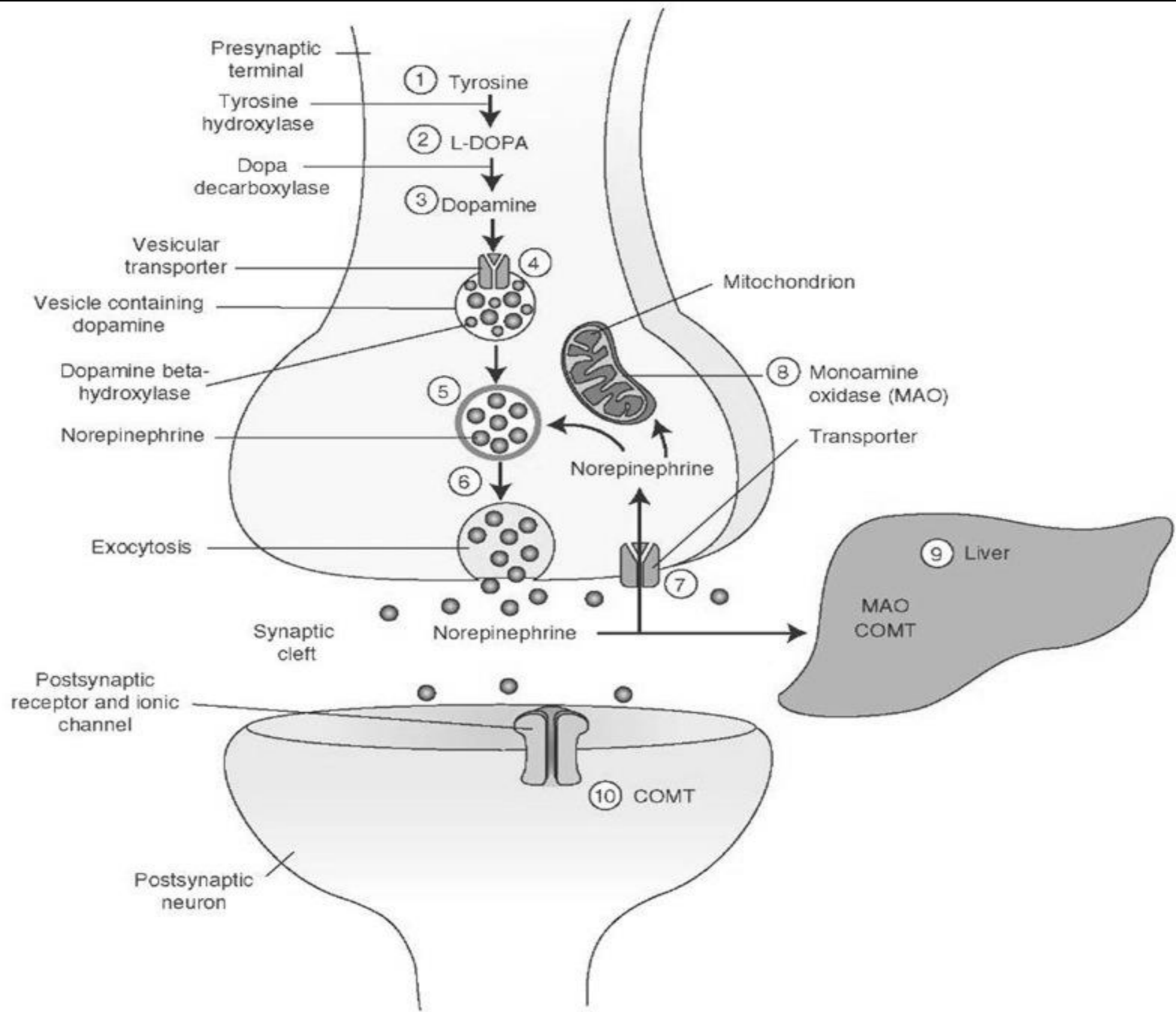
- * Ligand-gated ion channel



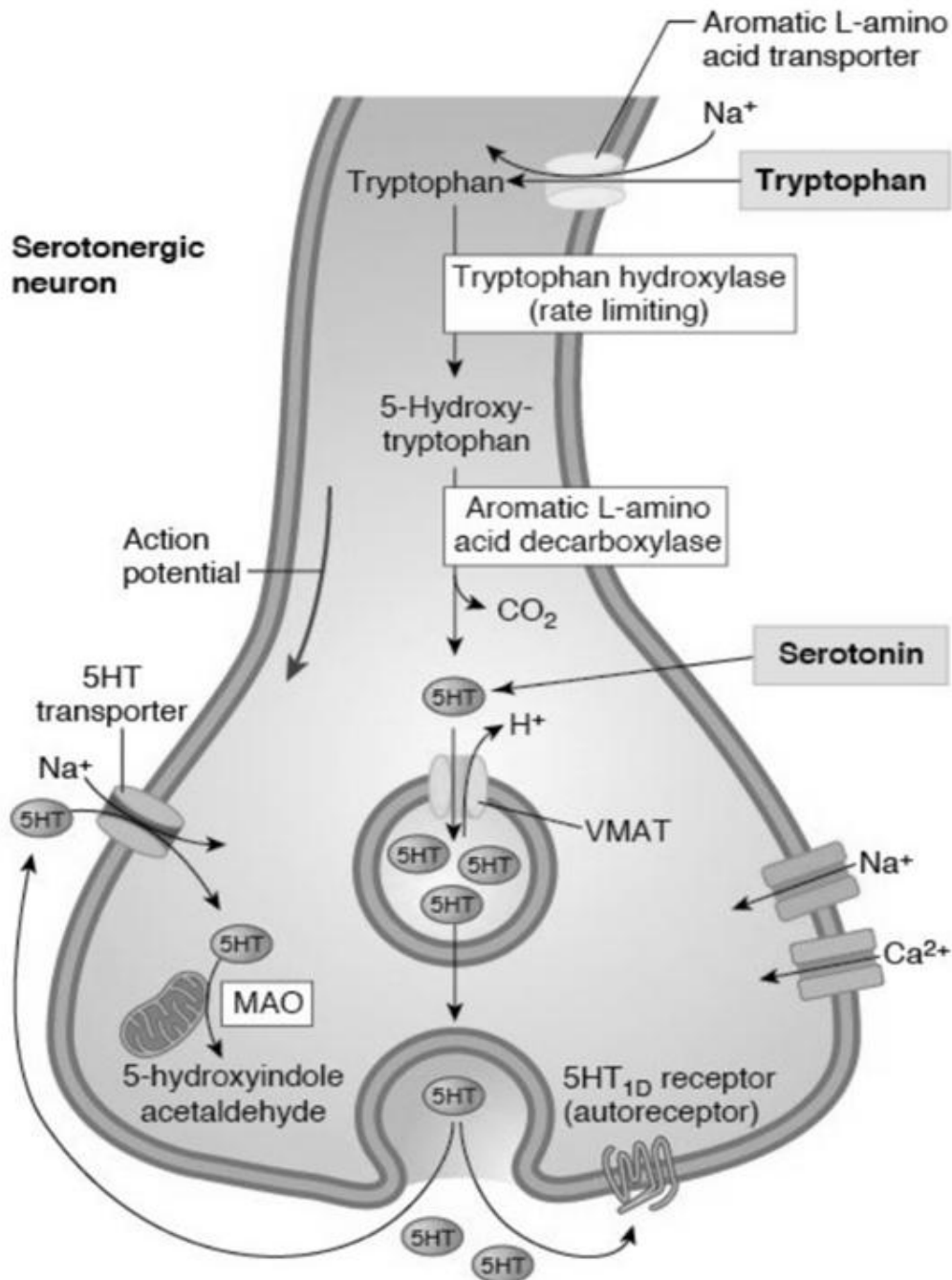
Subunits:
ρ1-3







Serotonin Synthesis



Like norepinephrine, serotonin is synthesized within nerve termini and released upon depolarization.

Tryptophan hydroxylase is the rate-limiting enzyme in serotonin synthesis.

Serotonin is also taken up into presynaptic nerve termini using serotonin transporters.

SSRIs, or selective serotonin reuptake inhibitors, increase synaptic levels of serotonin and are utilized in the treatment of depression.

Histamine

- Histaminergic neurons found in:
- Post hypothalamus
- Gastric mucosa
- Mast cells
- Receptors- H1, H2, H3
- Arousal, sexual behavior, blood pressure, drinking, pain thresholds, regulation of ant. Pit hormones

ATP-

- Mediates synaptic response in autonomic nervous system and habenula
- Receptor- P2X, P2Y, P2U

Substance P-

- Found in intestine, peripheral nerves, CNS
- Neurokinins- NK1, NK2, NK3
- Responsible for pain, on injection causes redness and swelling, peristalsis, axon reflex


Opioid Peptides

- 2 types of ligands – met-enkephalin
- leu-enkephalin
- Brain and GIT contains receptors for opioid.
- Enkephalins are also found in substantia gelatinosa
- Endogenous opioid peptides are secreted as precursor molecules


- 
- 3 opioid receptors- μ , κ , δ
 - All are metabotropic receptors

Somatostatin –

- 
- Effects sensory input
 - Locomotor activity
 - Cognitive functions
 - 5 receptors- SSTR1-SSTR5

- 
- Neuropeptide Y-
 - Present in brain and autonomic nervous system
 - Receptors – Y1 – Y8
 - Acts to increase food intake, vasoconstriction

 - Nitric oxide (NO)-
 - Released by endothelium of blood vessels
 - Also found in brain
 - Synthesized on demand

- 
- Cannabinoids-
 - Rapidly synthesized after Calcium influx after a neuron is depolarized
 - Induces euphoria
 - Has anti-nociceptive effect
 - Ex- Anandamide and 2-arachidonyl glycerol