

Hoofdstuk 8B:
Neuronen

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Cel-tot-cel communicatie in het ZS

- Elektrische synapsen geven elektrische signalen door langs gap junctions
 - Signaal kan bidirectioneel zijn
 - Synchroniseert de activiteit van een netwerk van cellen
- Chemische synapsen gebruiken neurocristine stoffen die de synaptische spleet oversteken

Cel-tot-cel communicatie in het ZS

- Neurotransmitters en neuromodulators werken over een korte afstand (paracriene signalen)
 - Neurotransmitters werken snel
 - Neuromodulators werken traag
- Neurohormonen werken over lange afstand

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Cel-tot-cel communicatie in het ZS

- Ionotrofe neurocriste receptoren
 - Snelle responsen
 - Wijzigen de ionenstroom over membranen (specifiek/minder specifiek)
- Metabotrofe neurocriste receptoren
 - G proteïne-gemedieerde receptoren
 - Trageren responsen
 - Sommigen openen of sluiten ionenkanalen

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Cel-tot-cel communicatie in het ZS

- Alle neurotransmitters binden aan specifieke receptors
- Agonist (bootsen activiteit na) en antagonist (inhiberen activiteit door binding aan receptors)

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Cel-tot-cel communicatie in het ZS

- Zeven klassen neurocienen op basis van structuur:
 - Acetylcholine
 - Aminen
 - Amino-zuren
 - Peptiden
 - Purines
 - Gassen
 - Lipiden

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TABLE 8.4 Major Neurotransmitters				
Chemical	Receptor	Type	Receptor Location	Key Agonists, Antagonists, and Potentiators**
Acetylcholine (ACh)	Cholinergic			
	Nicotinic (nAChR)	ICR (Na ⁺ , K ⁺)	Skeletal muscles, autonomic neurons, CNS	Agonist: nicotine Antagonists: curare, α-bungarotoxin
	Muscarinic (M)	GPCR	Smooth and cardiac muscle, endocrine and exocrine glands, CNS	Agonist: muscarine Antagonist: atropine
Amines				
Norepinephrine (NE) Epinephrine (E)	Adrenergic (α, β)	GPCR	Smooth and cardiac muscle, glands, CNS	Agonists: α-receptors: argolamine, phentolamine, β-receptors: propranolol
Dopamine (DA)	Dopamine (D)	GPCR	CNS	Agonist: bromocriptine Antagonists: antipsychotic drugs
Serotonin (5-hydroxytryptamine, 5-HT)	Serotonergic (5-HT)	ICR (Na ⁺ , K ⁺), GPCR	CNS	Agonist: sumatriptan Antagonist: LSD
Histamine	Histamine (H)	GPCR	CNS	Agonists: ranitidine (Zantac®) and cimetidine (Tagamet®)
Amino Acids				
Glutamate	Glutamatergic ionotropic (iGluR)			
	AMPA	ICR (Na ⁺ , K ⁺)	CNS	Agonist: quisqualate
	NMDA	ICR (Na ⁺ , K ⁺)	CNS	Potentiator: saxine
	Glutamatergic metabotropic (mGluR)	GPCR	CNS	Potentiator: glycine
GABA (γ-aminobutyric acid)	GABA	ICR (Cl ⁻), GPCR	CNS	Antagonist: picrotoxin Potentiators: alcohol, barbiturates
Glycine	Glycine (GlyR)	ICR (Cl ⁻)	CNS	Antagonist: strychnine
Purines				
Adenosine	Purine (P)	GPCR	CNS	
Gases				
Nitric oxide (NO)	None	N/A	N/A	

*This table does not include the numerous peptides that can act as neurotransmitters.
**This list does not include many chemicals that are used as agonists and antagonists in physiological research.
iGluR = ion channel receptor; GPCR = G-protein-coupled receptor; AMPA = α-amino-3-hydroxy-5-methylisoxazole-4-carboxylic acid; NMDA = N-methyl-D-aspartate; LSD = lysergic acid diethylamide; N/A = not applicable.

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Cel-tot-cel communicatie in het ZS

- Agonisten/antagonisten

nACh®



nicotine [Ag]

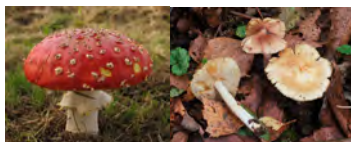


curare [Antag]

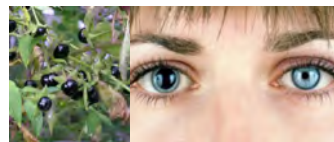


α-bungarotoxine [Antag]

mACh®



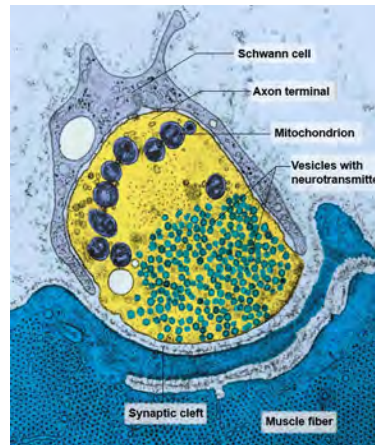
muscarine [Ag]



atropine [Antag]

NT worden vrijgesteld van vesikels

- Neurotransmitter synthese

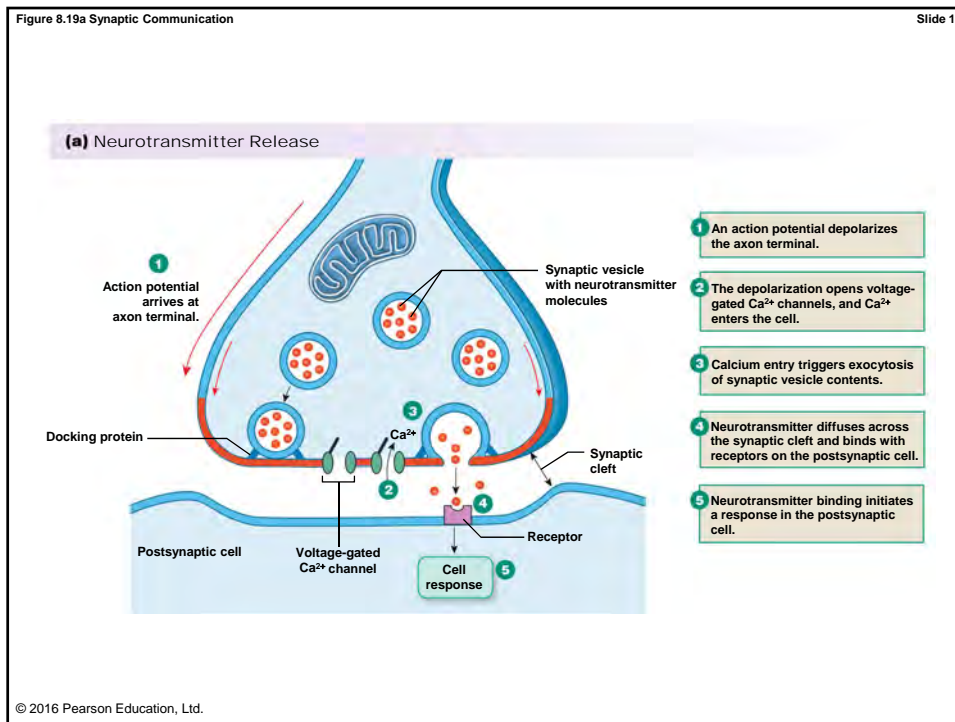


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NT worden vrijgesteld van vesikels

- Vesikel vrijgave: exocytose (toename membraan oppervlakte >> recycling)
- Kiss-and-run pathway
 - Vesikel fuseert met membraan aan de fusieporie
 - Neurotransmitters passeren langs een kanaal
 - Vesikels trekken zich terug uit de fusieporie

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NT worden vrijgesteld van vesikels

- *Clostridium botulinum*



NT worden vrijgesteld van vesikels

- Cosmetische toepassing: Botox (Alergan Inc.)



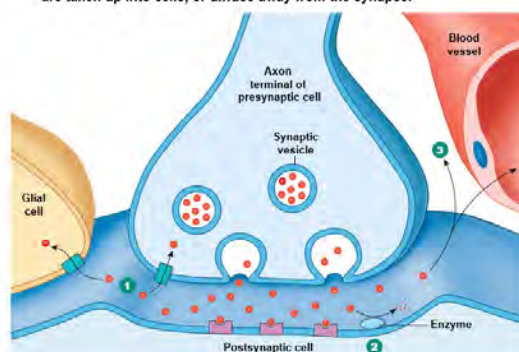
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NT worden vrijgesteld van vesikels

- Beëindigen van de NT activiteit: snelle verwijdering

(b) Neurotransmitter Termination

Neurotransmitter action terminates when the chemicals are broken down, are taken up into cells, or diffuse away from the synapse.

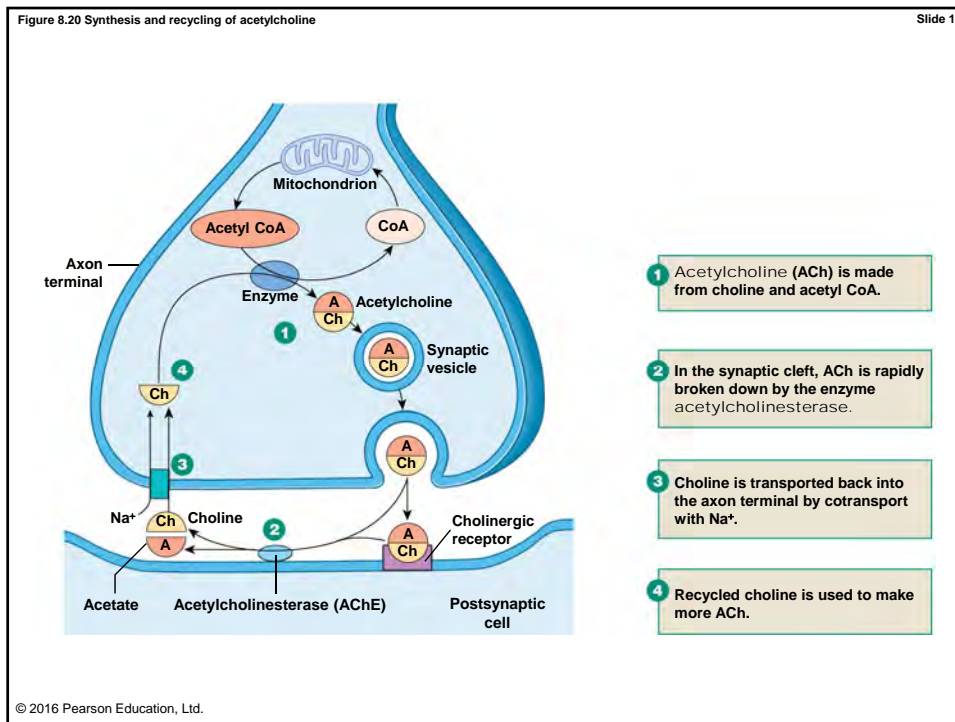


1 Neurotransmitters can be returned to axon terminals for reuse or transported into glial cells.

2 Enzymes inactivate neurotransmitters.

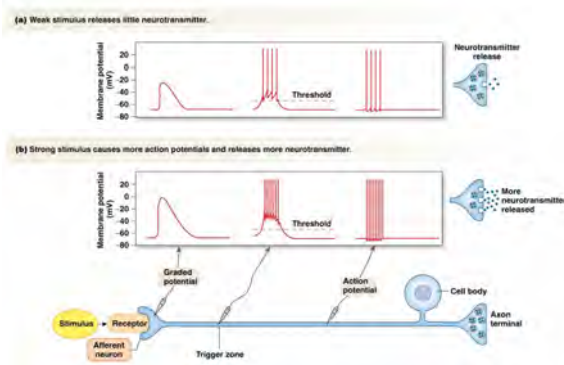
3 Neurotransmitters can diffuse out of the synaptic cleft.

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NT worden vrijgesteld van vesikels

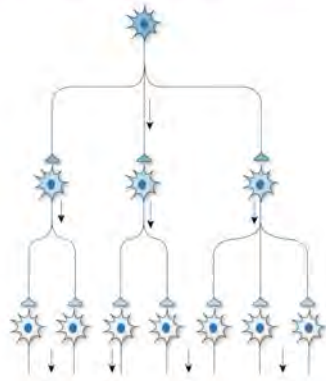
- Frequentie van AP bepaalt hoeveel NT wordt vrijgesteld



Integratie van neurale informatie transfer

- Divergente en convergente pathways thv synapsen

(a) In a **divergent pathway**, one presynaptic neuron branches to affect a larger number of postsynaptic neurons.



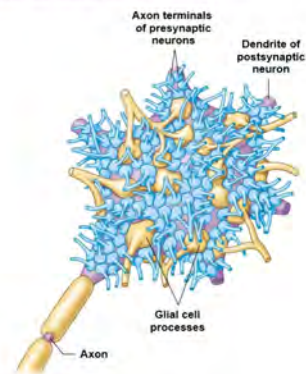
(b) In a **convergent pathway**, many presynaptic neurons provide input to influence a smaller number of postsynaptic neurons.



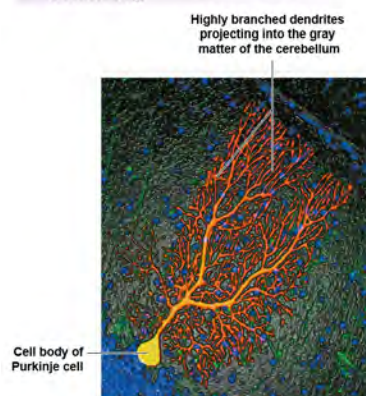
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Integratie van neurale informatie transfer

(c) The cell body of a somatic motor neuron is nearly covered with synapses providing input from other neurons.



(d) The highly branched dendrites of a Purkinje cell (neuron) demonstrate convergence of signals from many synapses onto a cell body.

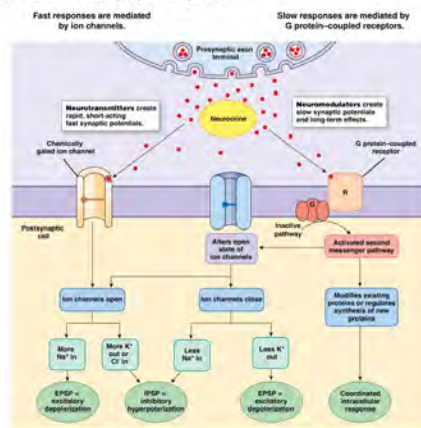


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- Postsynaptische responsen kunnen traag of snel zijn

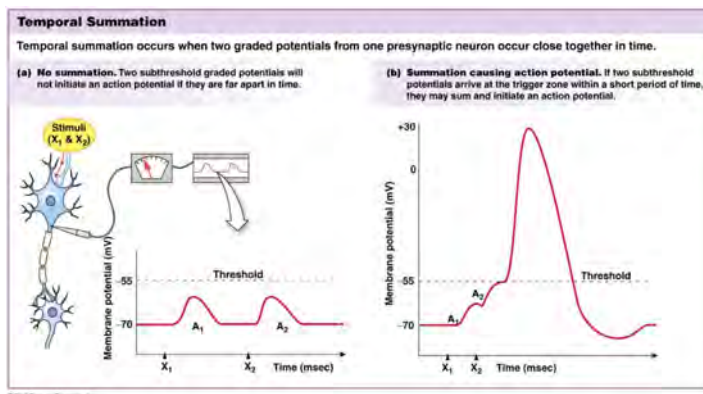
Fast and Slow Postsynaptic Responses



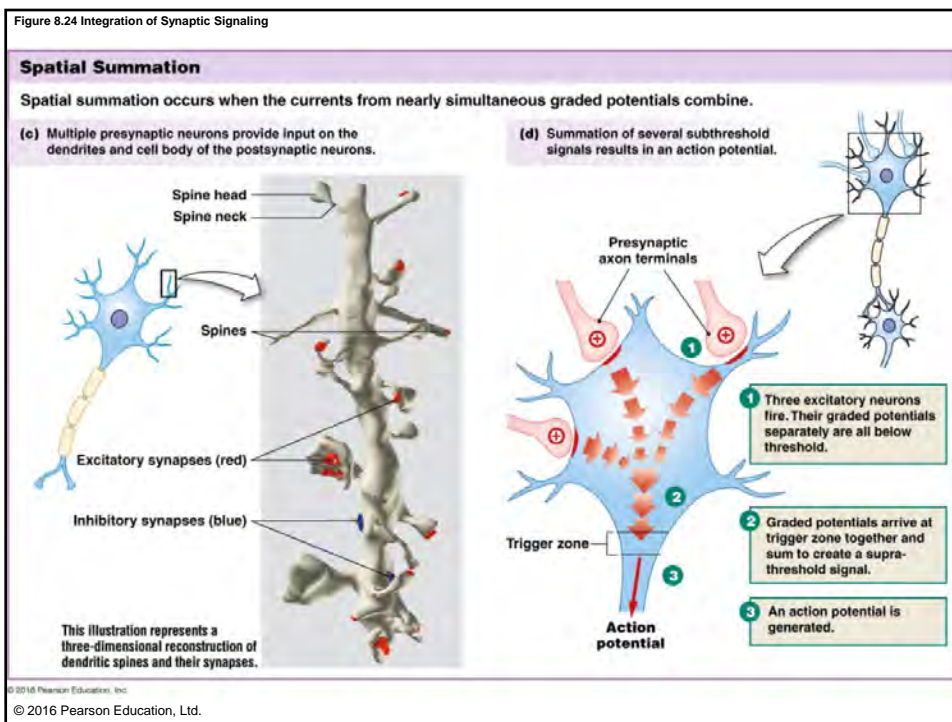
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Integratie van neurale informatie transfer

- Pathways integreren informatie van meerdere neuronen

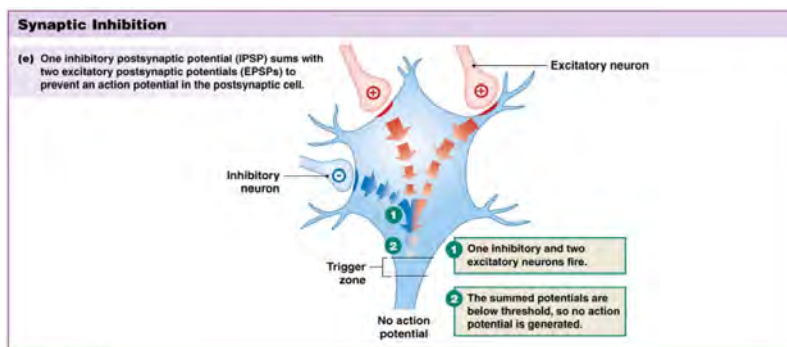


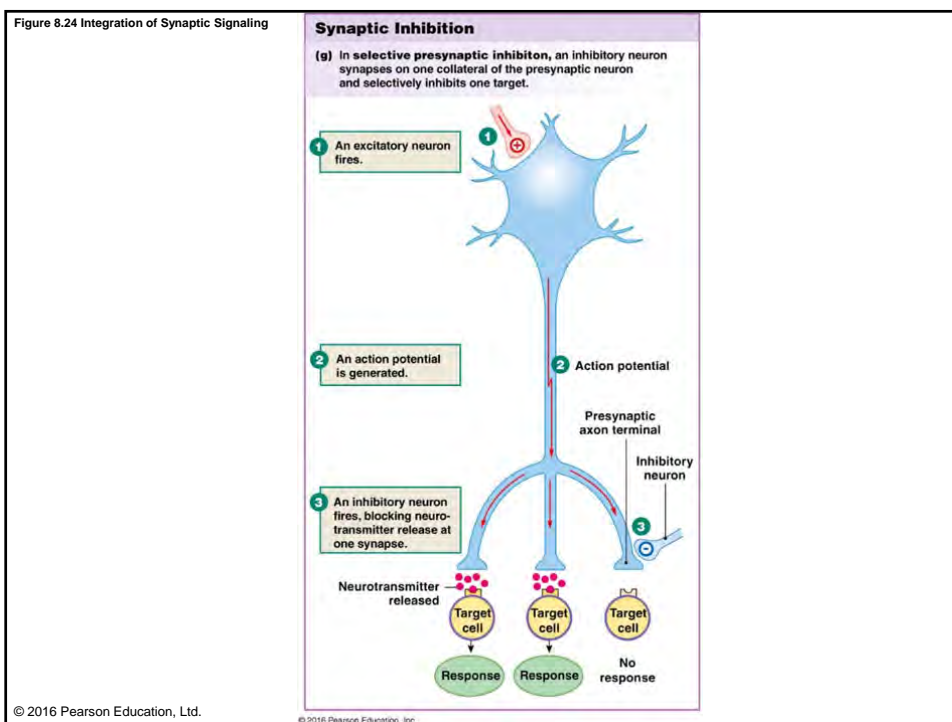
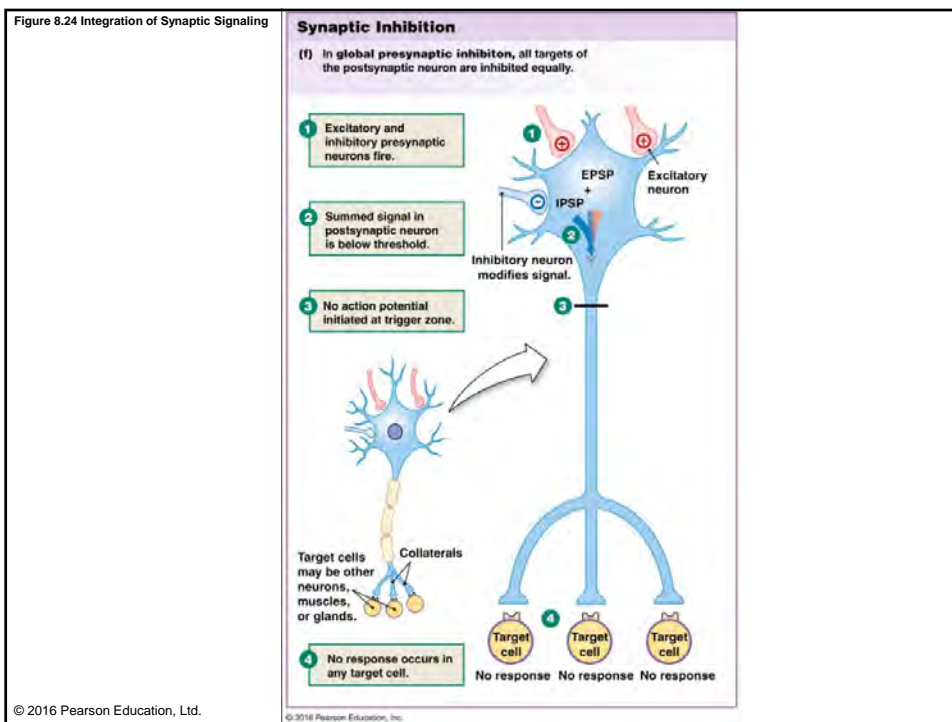
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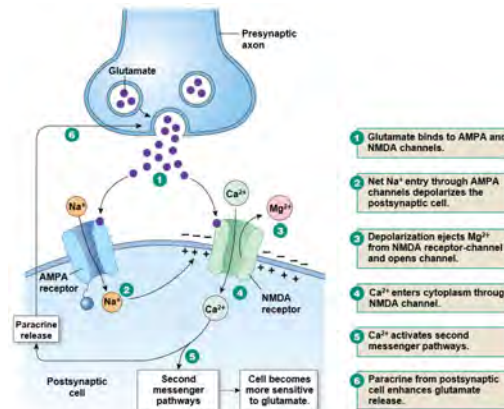
- Synaptische informatie kan gewijzigd worden





Integratie van neurale informatie transfer

- Lange-termijn potentiëatie wijzigt synapsen



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