CNS

Learning and Memory

Physiology

Nervous System Organization

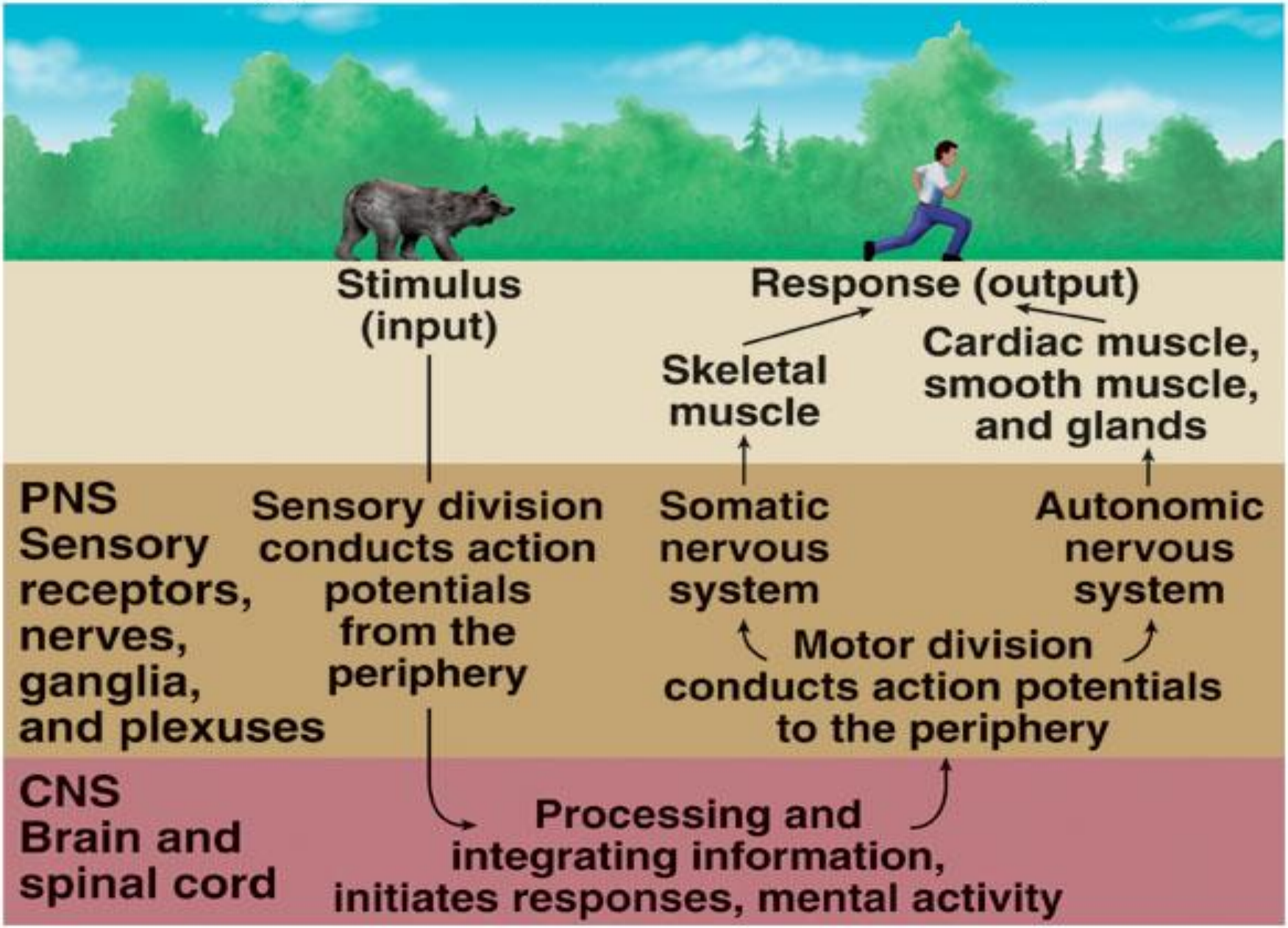
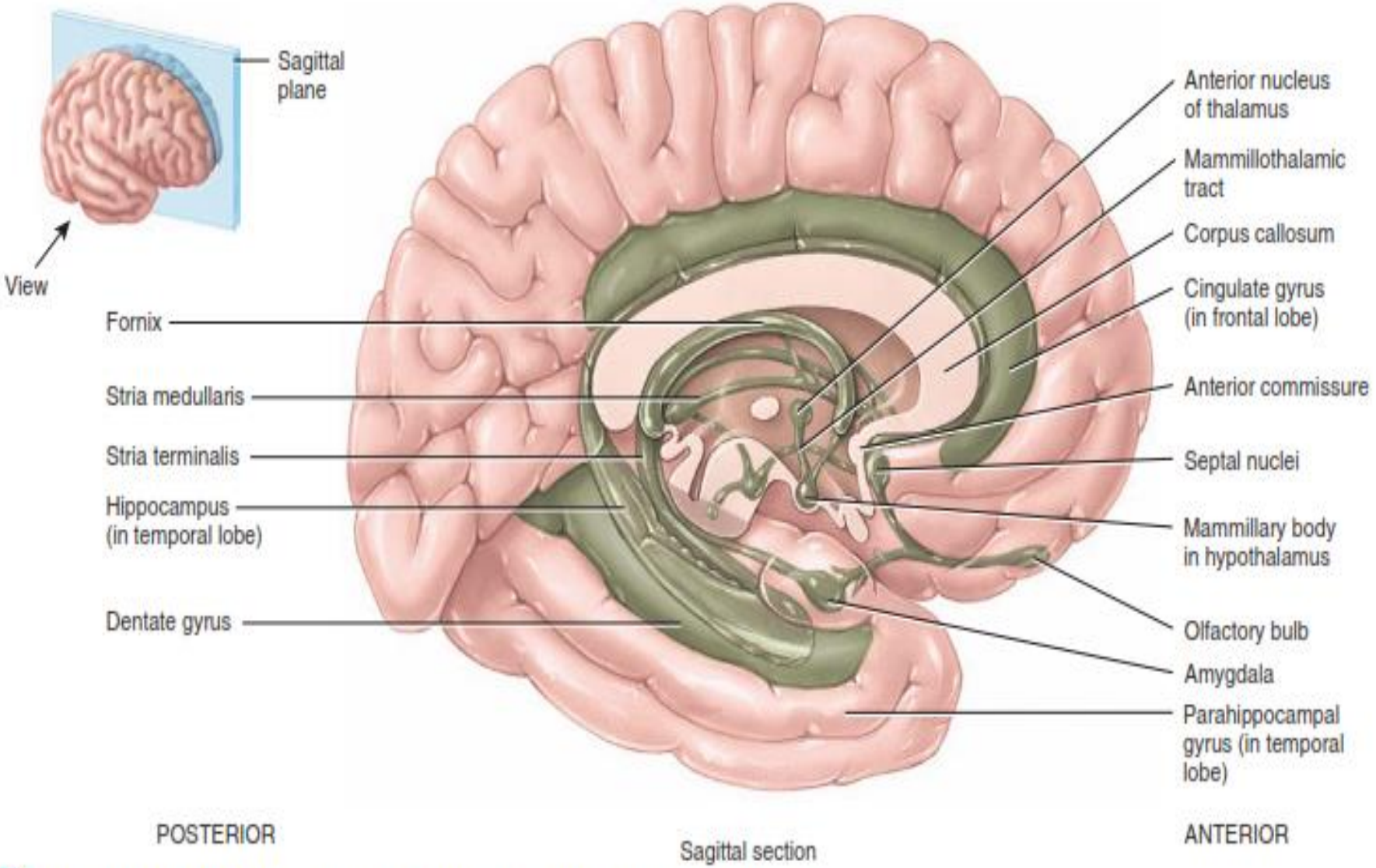


Figure 14.14 Components of the limbic system (shaded green) and surrounding structures.

The limbic system governs emotional aspects of behavior.



Which part of the limbic system functions with the cerebrum in memory?

Belajar - Memori

- Belajar → perubahan tingkah laku yang relatif menetap sebagai hasil dari pengalaman (Bloom 1988)
- Kupferman (1981) : Belajar → proses dimana manusia, hewan menyesuaikan tingkah lakunya → hasil dari pengalaman
- Memori ingatan : proses dimana informasi belajar disimpan dan dapat dibaca kembali

Complex Pathways of Learning and Memory

- **Learning** – knowledge acquisition
  - Associative
  - Non-associative
  - Including Habituation, sensitized
- **Memory** – retention & recall
  - Hippocampus & memory traces
  - Short term & working
  - Long term

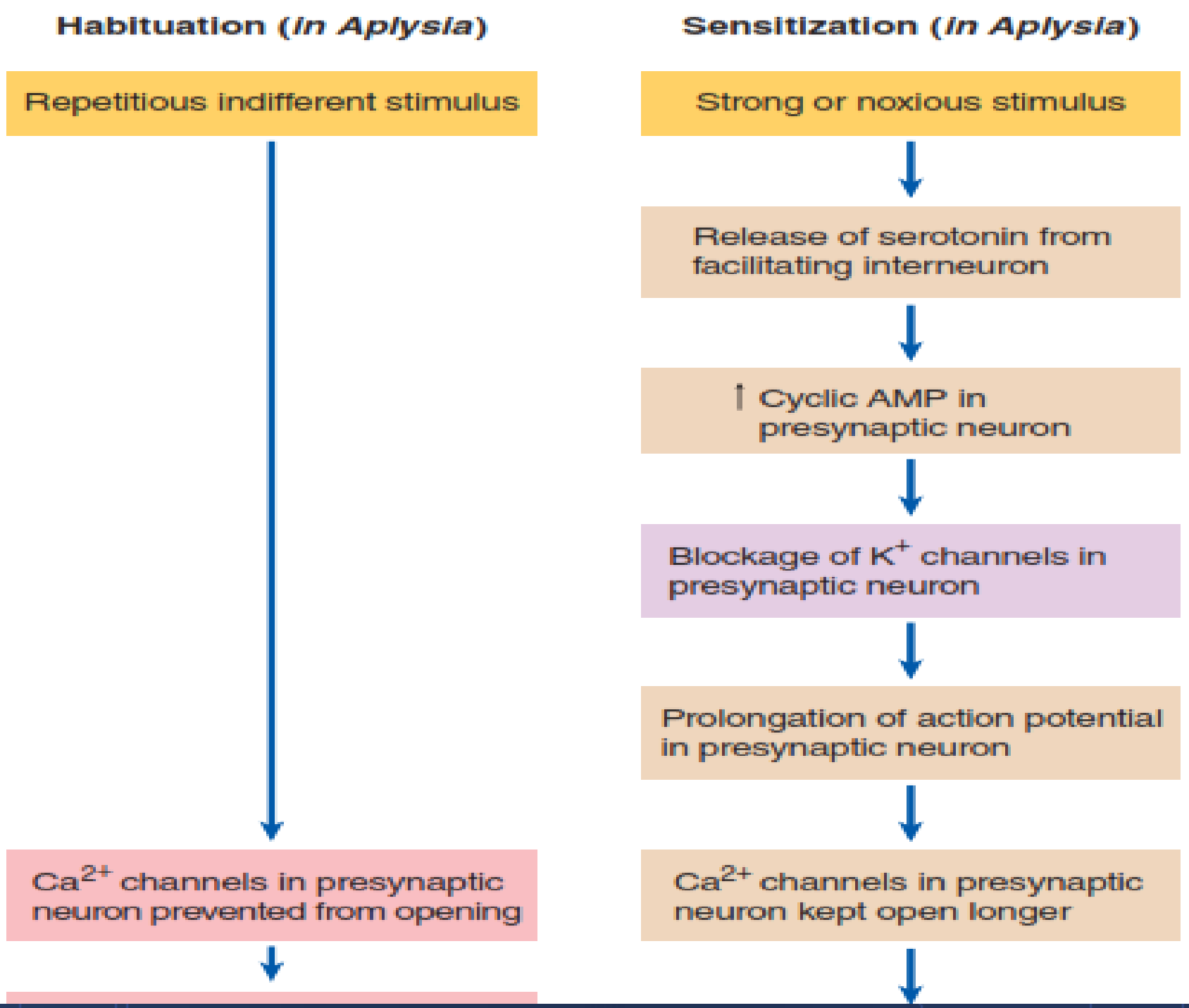
Habituasi dan sensitisasi

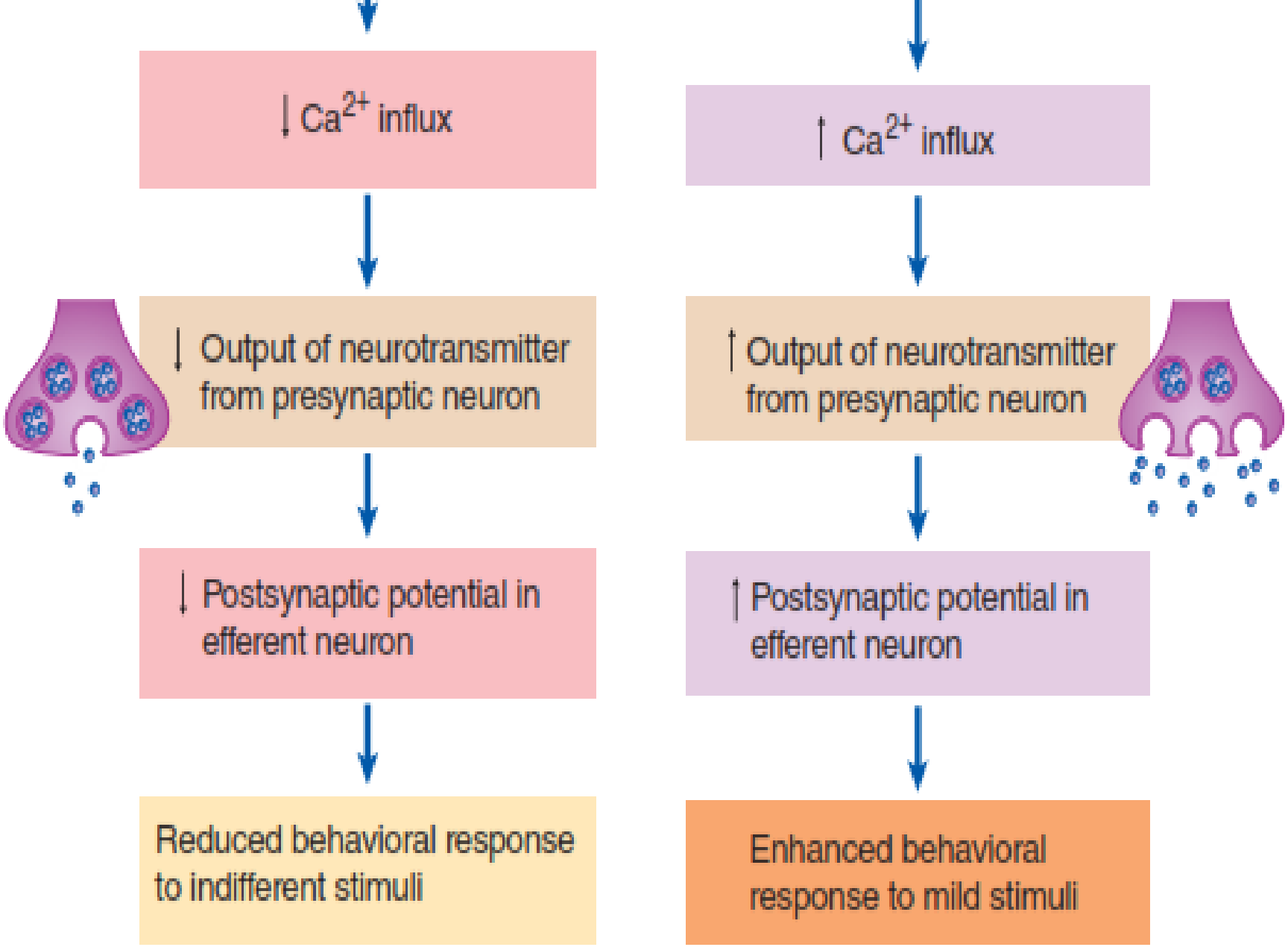
- **Habituasi : Menurunnya respon refleks tingkah laku terhadap stimulus bila stimulus diulang-ulang dan tdk menimbulkan efek berbahaya.**
- **Sensitisasi (Pseudoconditioning) : Peningkatan respon refleks terhadap rangsangan yang menimbulkan bahaya**

Aplysia

Aplysia Gill and Siphon Withdrawal Reflex

Eric Kendel,2000


Habituation (*In Aplysia*)
Repetitious indifferent stimulus
Ca^{2+} channels in presynaptic neuron prevented from opening
Sensitization (*In Aplysia*)
Strong or noxious stimulus
Release of serotonin from facilitating interneuron
↑ Cyclic AMP in presynaptic neuron
Blockage of K^+ channels in presynaptic neuron
Prolongation of action potential in presynaptic neuron
Ca^{2+} channels in presynaptic neuron kept open longer


↓ Ca^{2+} influx
↓ Output of neurotransmitter from presynaptic neuron
↓ Postsynaptic potential in efferent neuron
Reduced behavioral response to indifferent stimuli
↑ Ca^{2+} influx
↑ Output of neurotransmitter from presynaptic neuron
↑ Postsynaptic potential in efferent neuron
Enhanced behavioral response to mild stimuli

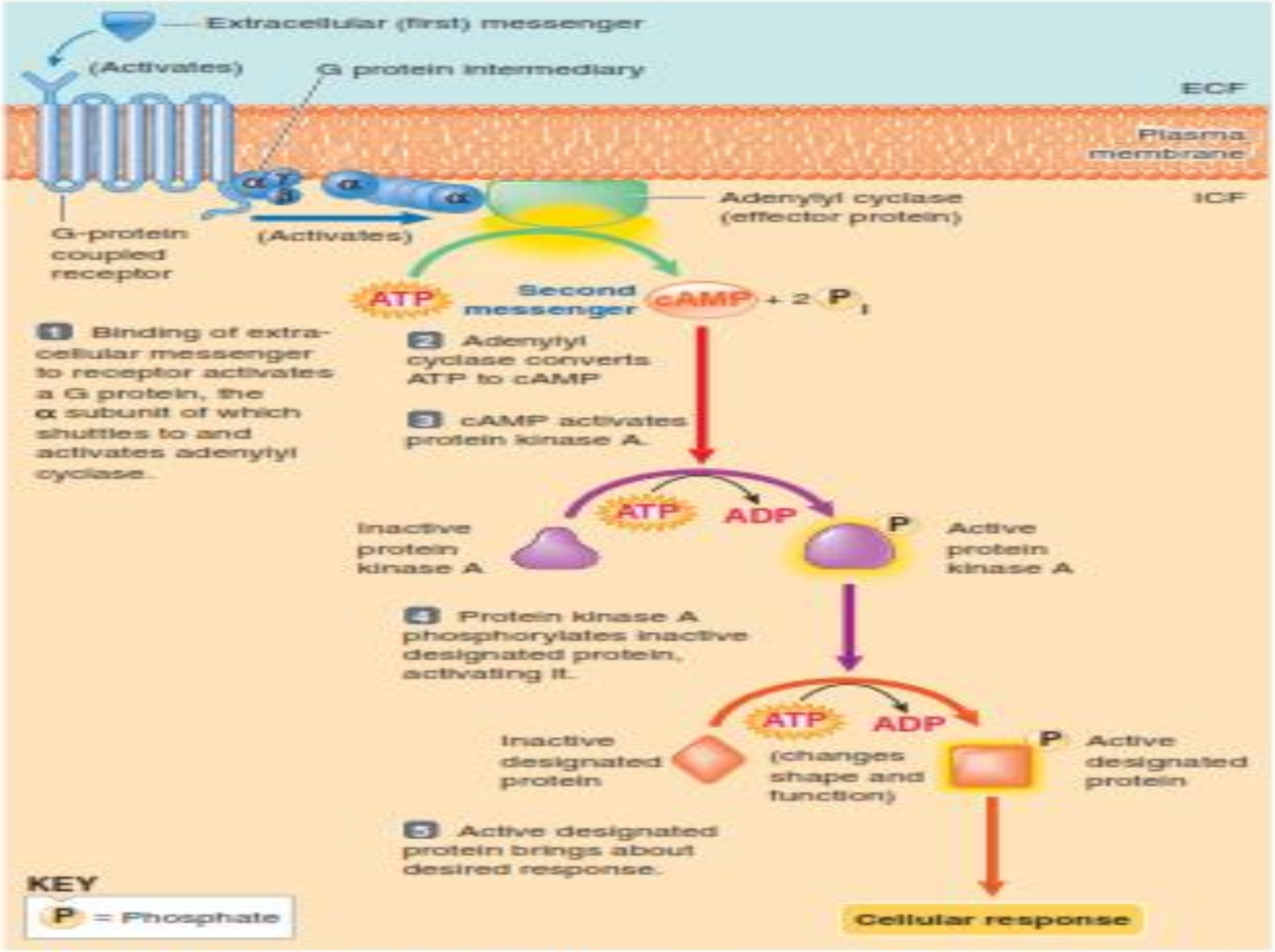


FIGURE 4-24 Mechanism of action of hydrophilic hormones via activation of the cyclic AMP second-messenger pathway.

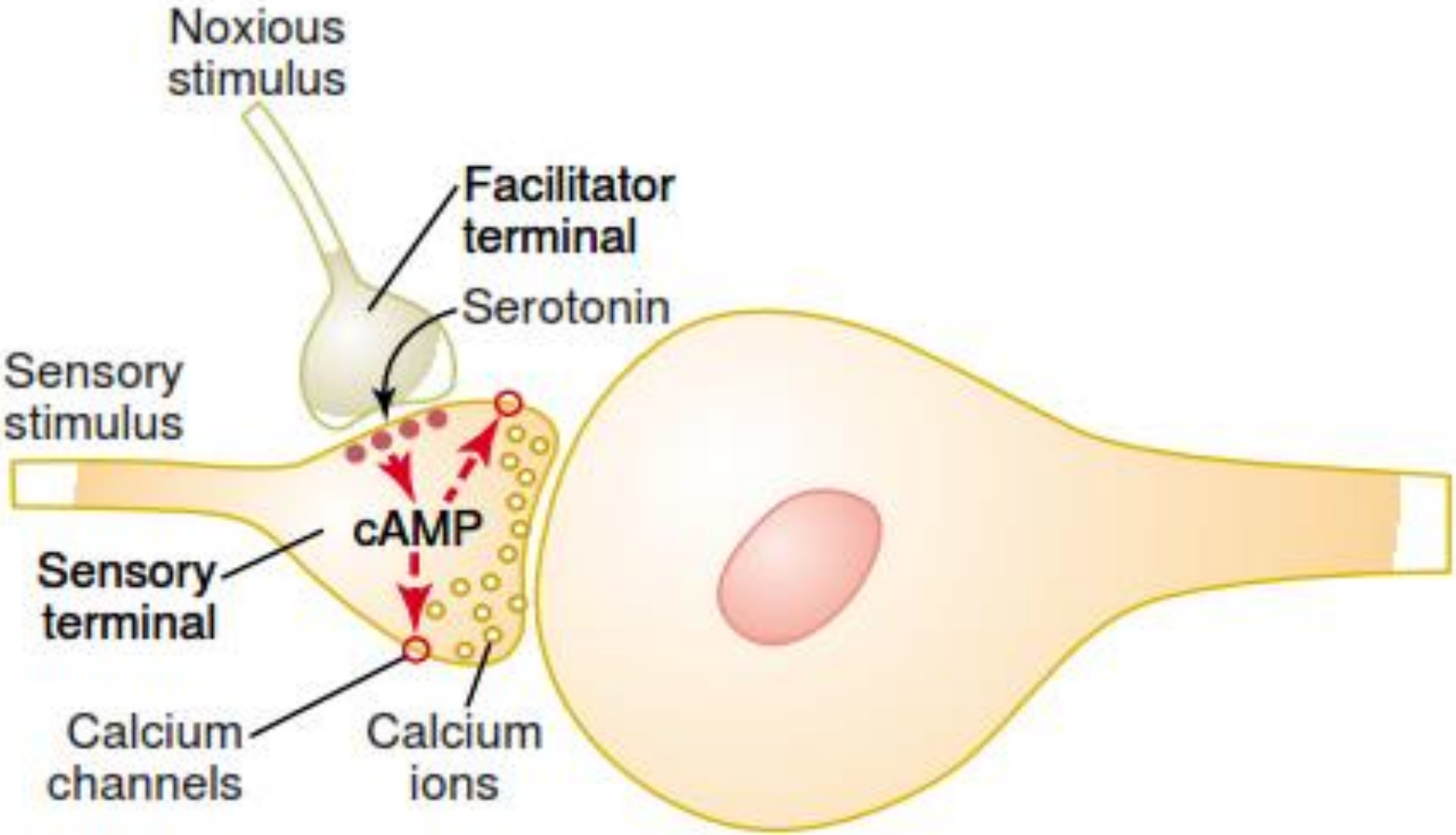
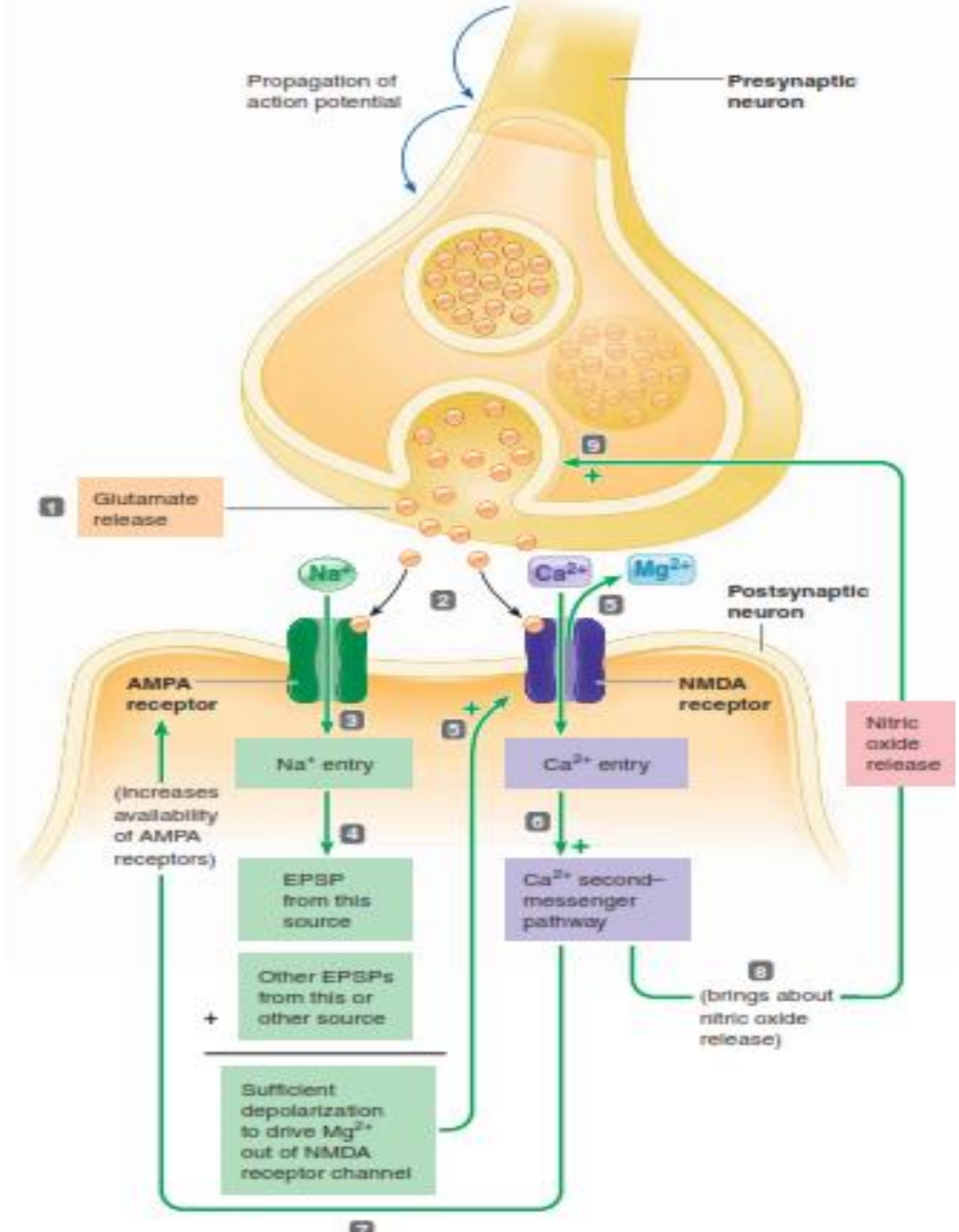


Figure 57–9

Memory system that has been discovered in the snail *Aplysia*.

Possible pathways for long-term potentiation.



1 Glutamate is released from activated presynaptic neuron.

2 Glutamate binds with both AMPA and NMDA receptors.

3 Binding opens AMPA receptor-channel.

4 Na^+ entry through open AMPA channel depolarizes postsynaptic neuron, producing EPSP.

5 Binding opens gate of NMDA receptor-channel but Mg^{2+} still blocks channel. Sufficient depolarization from this AMPA opening plus other EPSPs drives Mg^{2+} out.

6 Ca^{2+} entry through open NMDA channel activates Ca^{2+} second-messenger pathway.

7 Second-messenger pathway promotes insertion of additional AMPA receptors in postsynaptic membrane, increasing its sensitivity to glutamate.

8 Second-messenger pathway also triggers release of retrograde paracrine (likely nitric oxide).

9 Nitric oxide stimulates long-lasting increase in glutamate release by presynaptic neuron.

Sistem Memori Manusia

- Neurobiologi – 4 prinsip dasar (Bloom 1988)

1. Ingatan memiliki beberapa tahap & selalu berubah.
2. Ingatan jangka panjang → perubahan fisik pd otak
3. Jejak ingatan didistribusikan di seluruh sistem saraf.
4. Hipokampus dan lobus temporal memiliki fungsi unik → proses ingatan manusia

TAHAP INGATAN

- Ingatan Jangka Pendek : suatu proses aktif dan terbatas, tdk meninggalkan bekas. Diperantarai oleh Post tetanic potensiation (inhibisi presinaptik) → detik/jam
- Ingatan Jangka Panjang : dihasilkan oleh perubahan struktur pd sistem saraf karena aktivasi berulang terhadap lingkaran neuron : dari korteks →thalamus / hipokampus → korteks : hari s/d tahun

Jejak Ingatan (Memory Trace)

- Ingatan → mendapat informasi, menahan/menyimpannya → mengeluarkannya

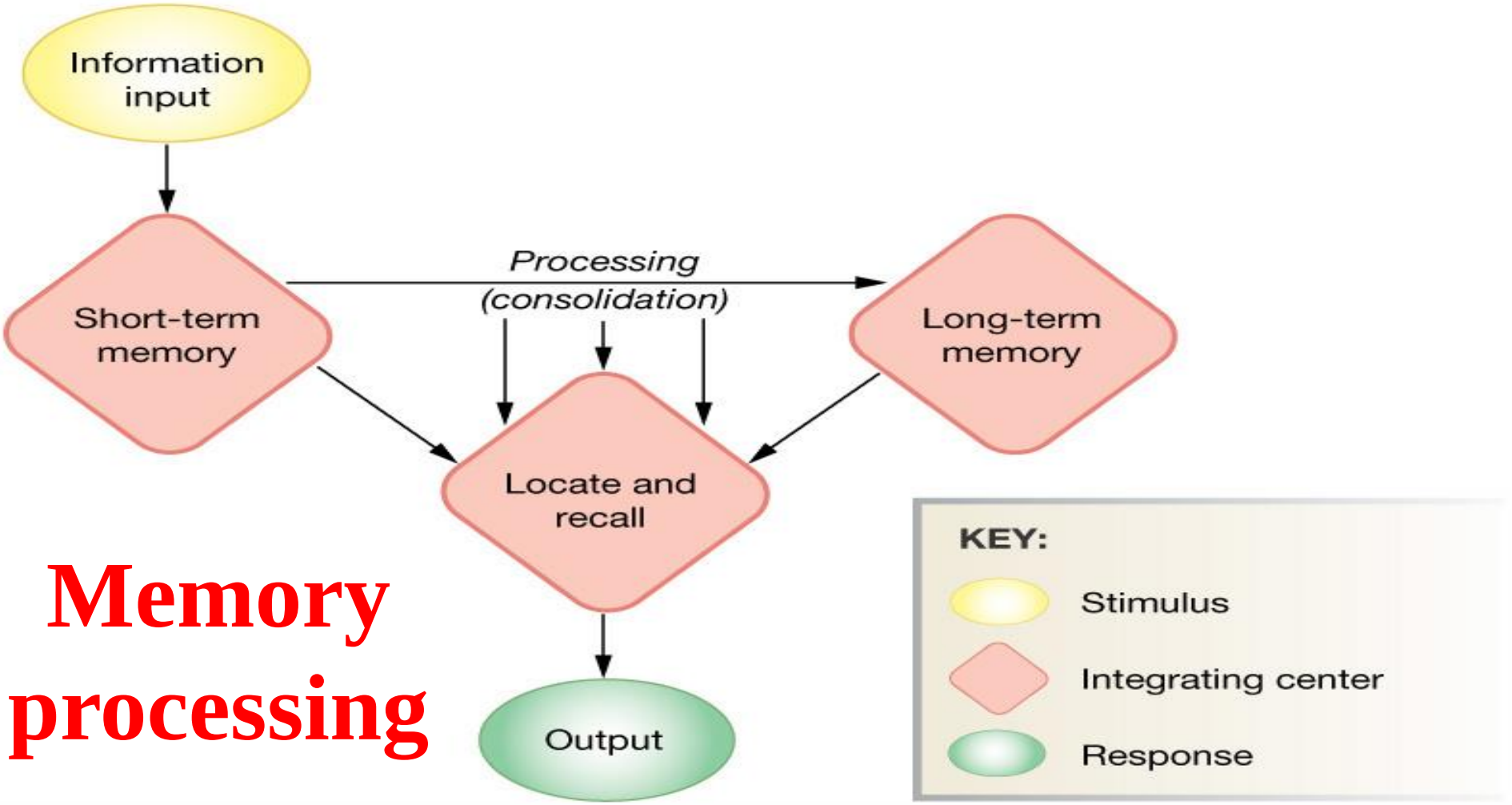
Kalau lupa → gangguan

Memory trace : Pengetahuan saraf yang berperan dalam retensi (penyimpanan)

Konsolidasi

- Proses pemindahan dan fiksasi jejak ingatan jangka pendek → Jangka Panjang
- Working Memori → Papan tulis pikiran : pembanding data sensorik dengan simpanan pengetahuan, memanipulasi informasi → perilaku saat ini / future →

Complex Pathways of Learning and Memory



Memory processing

TABLE 5-3 Comparison of Short-Term and Long-Term Memory

Characteristic	Short-Term Memory	Long-Term Memory
Time of Storage after Acquisition of New Information	Immediate	Later; must be transferred from short-term to long-term memory through consolidation; enhanced by practice or recycling of information through short-term mode
Duration	Lasts for seconds to hours	Retained for days to years
Capacity of Storage	Limited	Very large
Retrieval Time (remembering)	Rapid retrieval	Slower retrieval, except for thoroughly ingrained memories, which are rapidly retrieved
Inability to Retrieve (forgetting)	Permanently forgotten; memory fades quickly unless consolidated into long-term memory	Usually only transiently unable to access; relatively stable memory trace
Mechanism of Storage	Involves transient modifications in functions of preexisting synapses, such as altering amount of neurotransmitter released	Involves relatively permanent functional or structural changes between existing neurons, such as formation of new synapses; synthesis of new proteins plays a key role

Role of Specific Parts of the Brain in the Memory Process

The hippocampus is the most medial portion of the temporal lobe cortex,
where it folds first medially underneath the brain and

Hippocampi Are Not Important in Reflexive Learning.

Figure 14.14 Components of the limbic system (shaded green) and surrounding structures.

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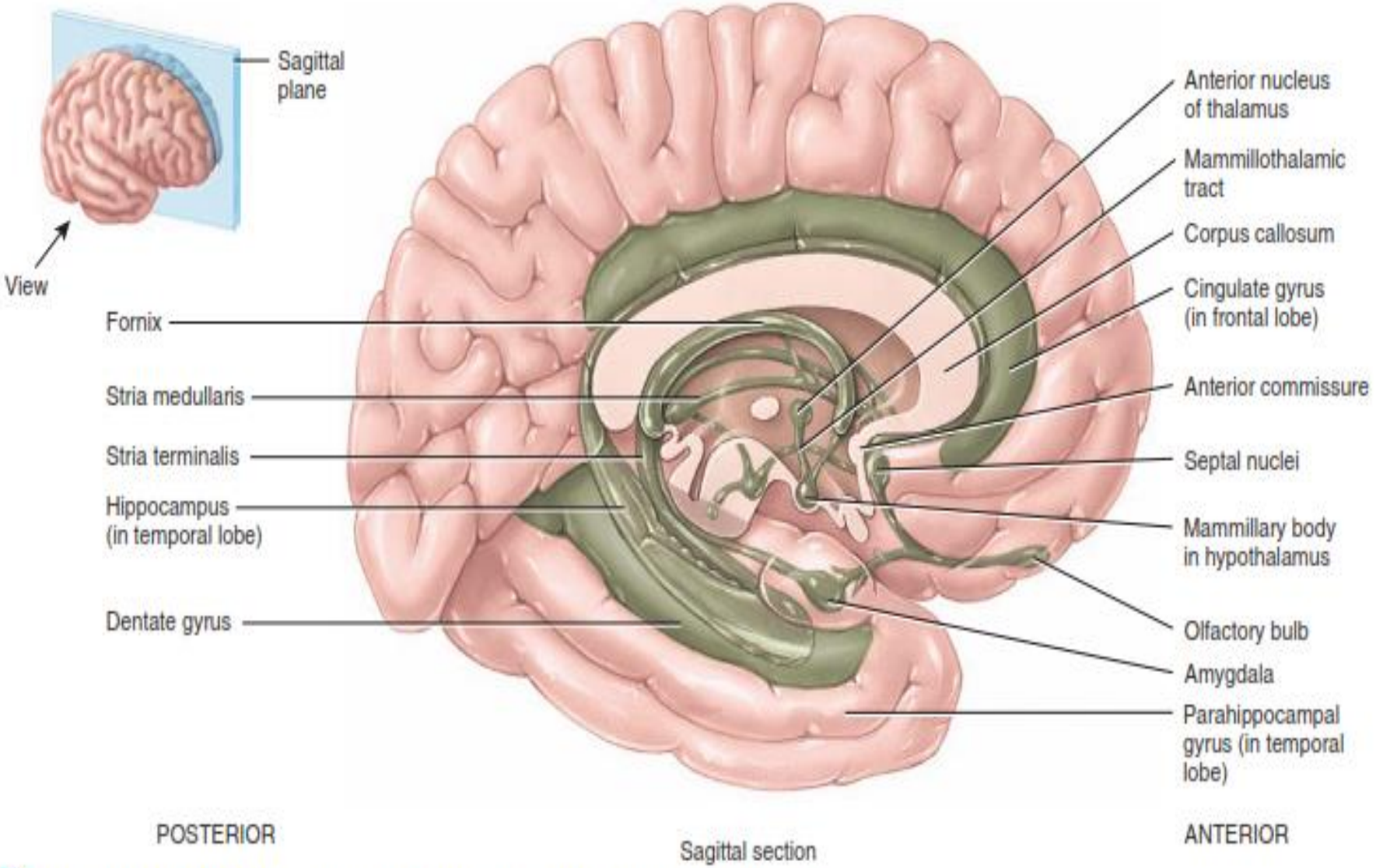


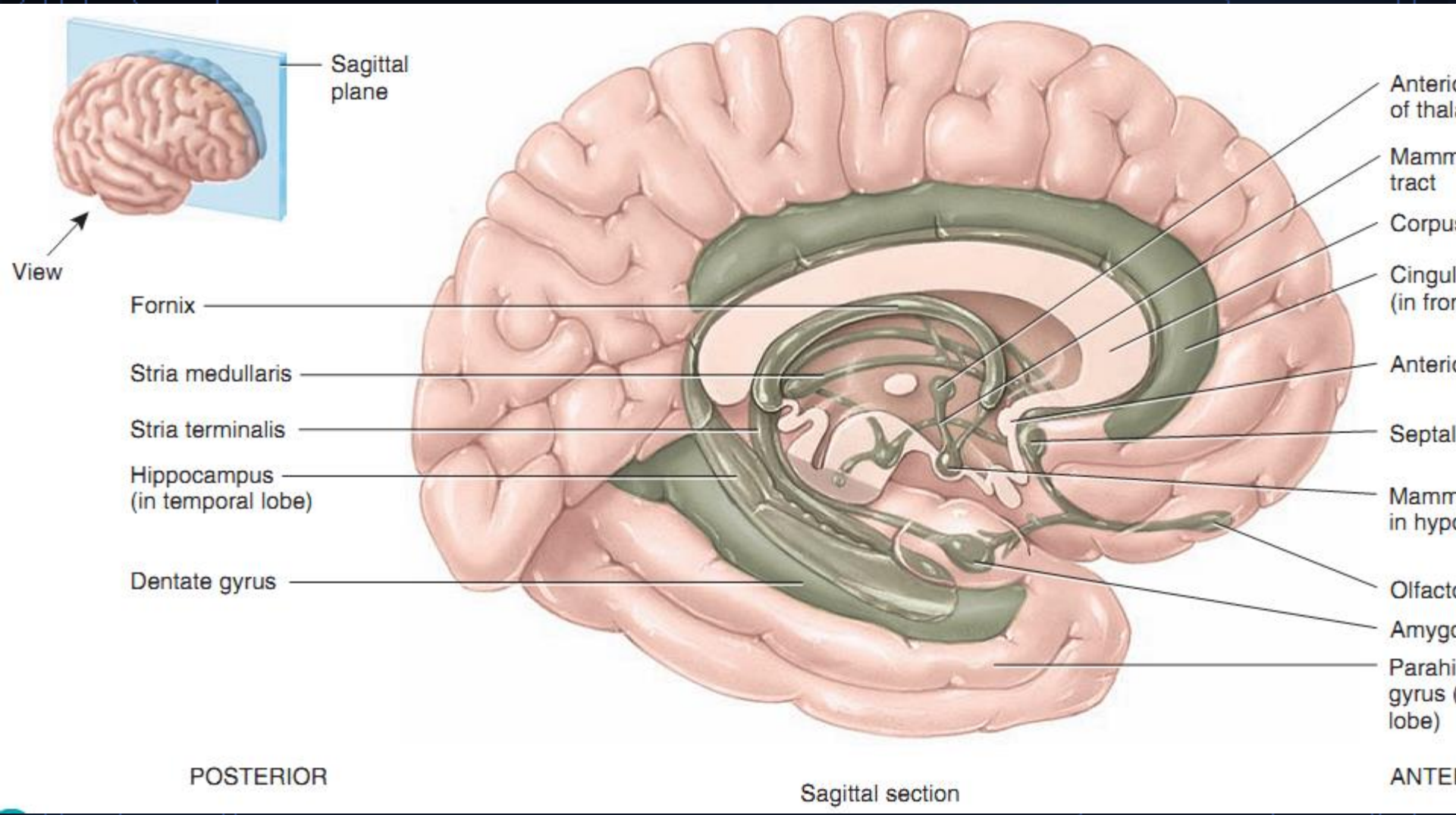
Which part of the limbic system functions with the cerebrum in memory?

Hippocampus Promotes Storage of Memories—Anterograde Amnesia After Hippocampal Lesions.

Retrograde Amnesia—Inability to Recall Memories from the Past.

- **When retrograde amnesia occurs, the degree of amnesia for recent events is likely to be much greater**

thankyou


Sagittal plane
View
Fornix
Stria medullaris
Stria terminalis
Hippocampus (in temporal lobe)
Dentate gyrus
Anteri of thal
Mamm tract
Corpus
Cingul (in fron
Anteri
Septal
Mamm in hypo
Olfacto
Amygd
Parahi gyrus lobe)
POSTERIOR
ANTE
Sagittal section