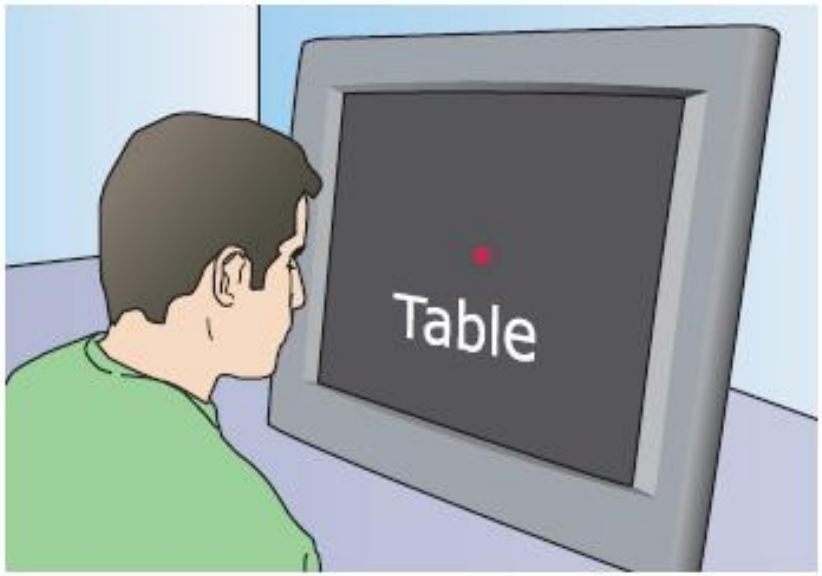
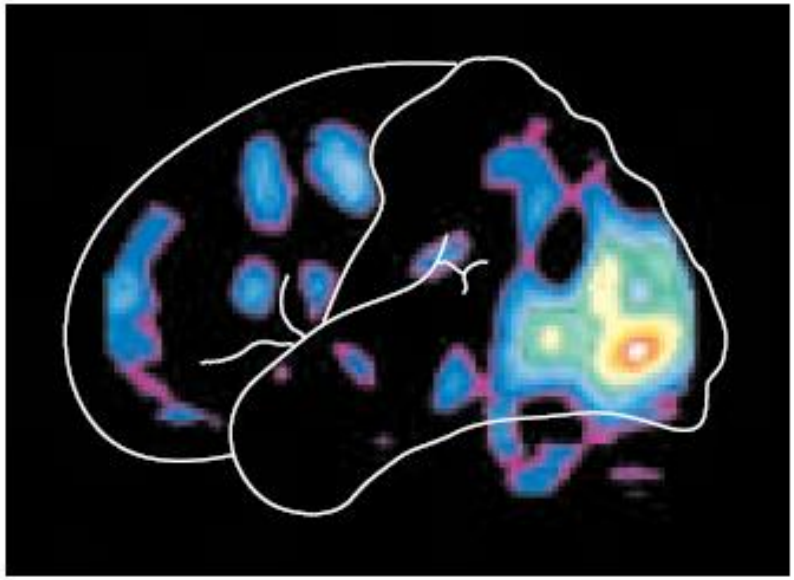
Prosody of speech

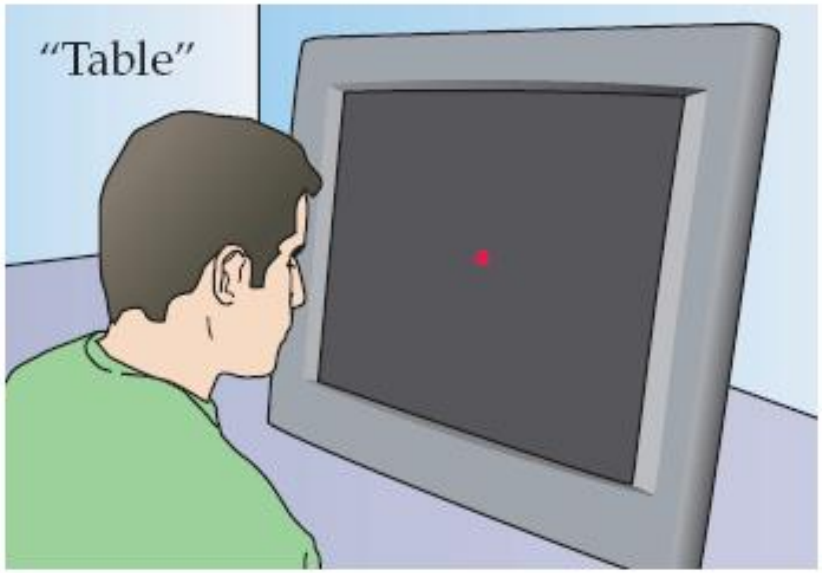
(right hemisphere)

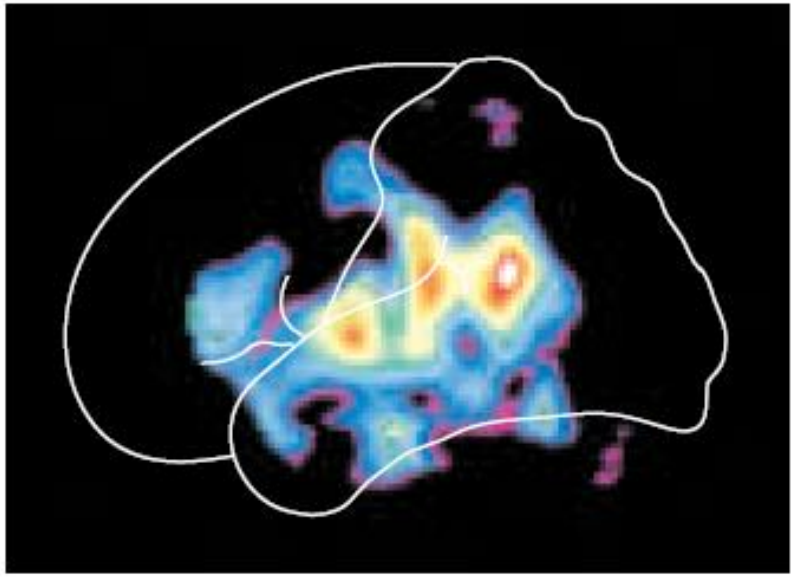
Passively viewing words



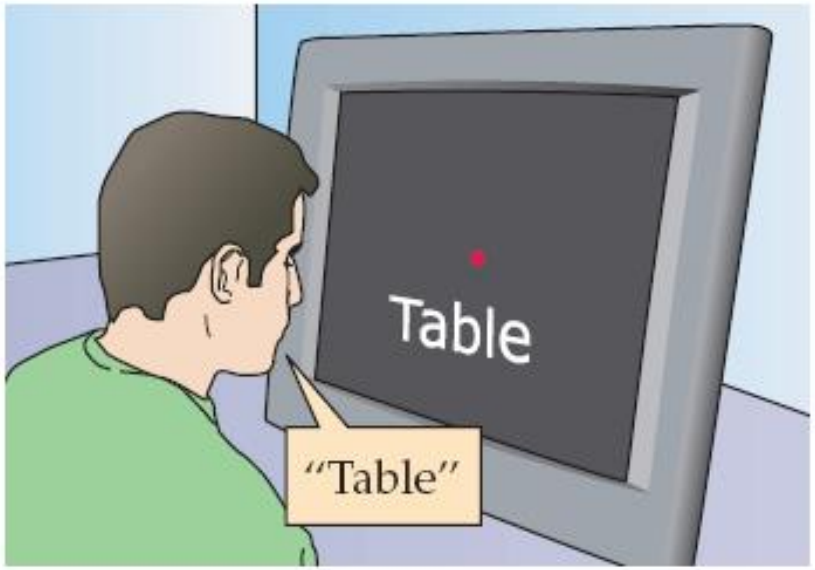


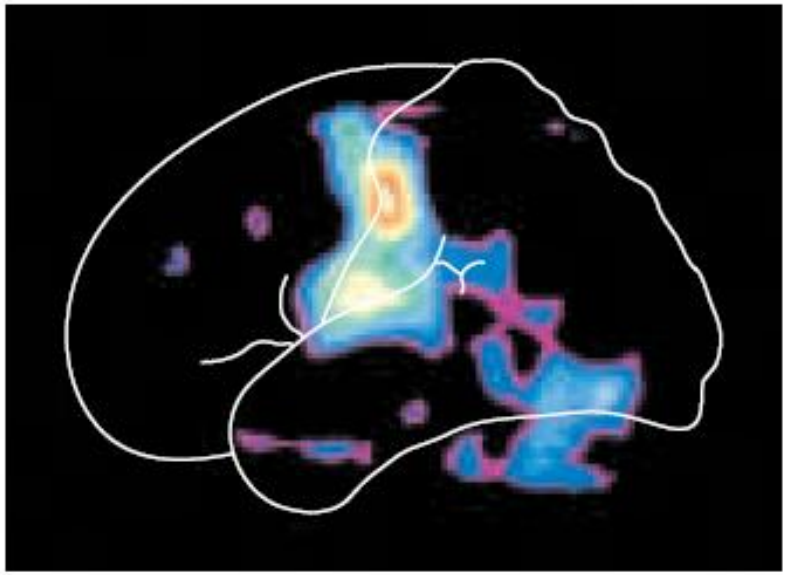
Listening to words



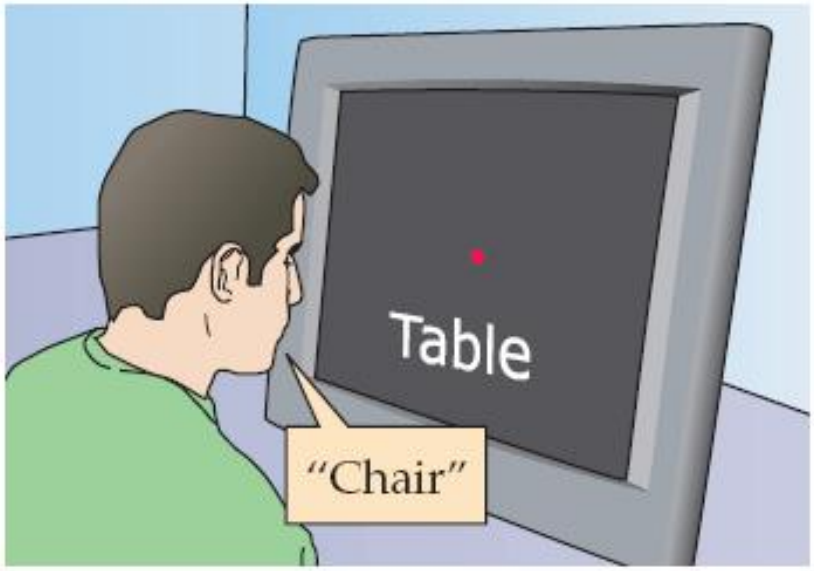


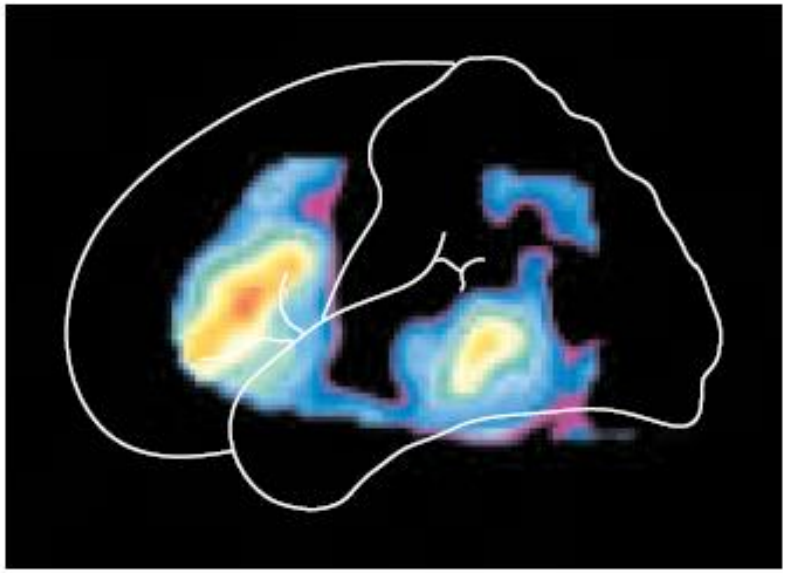
Speaking words

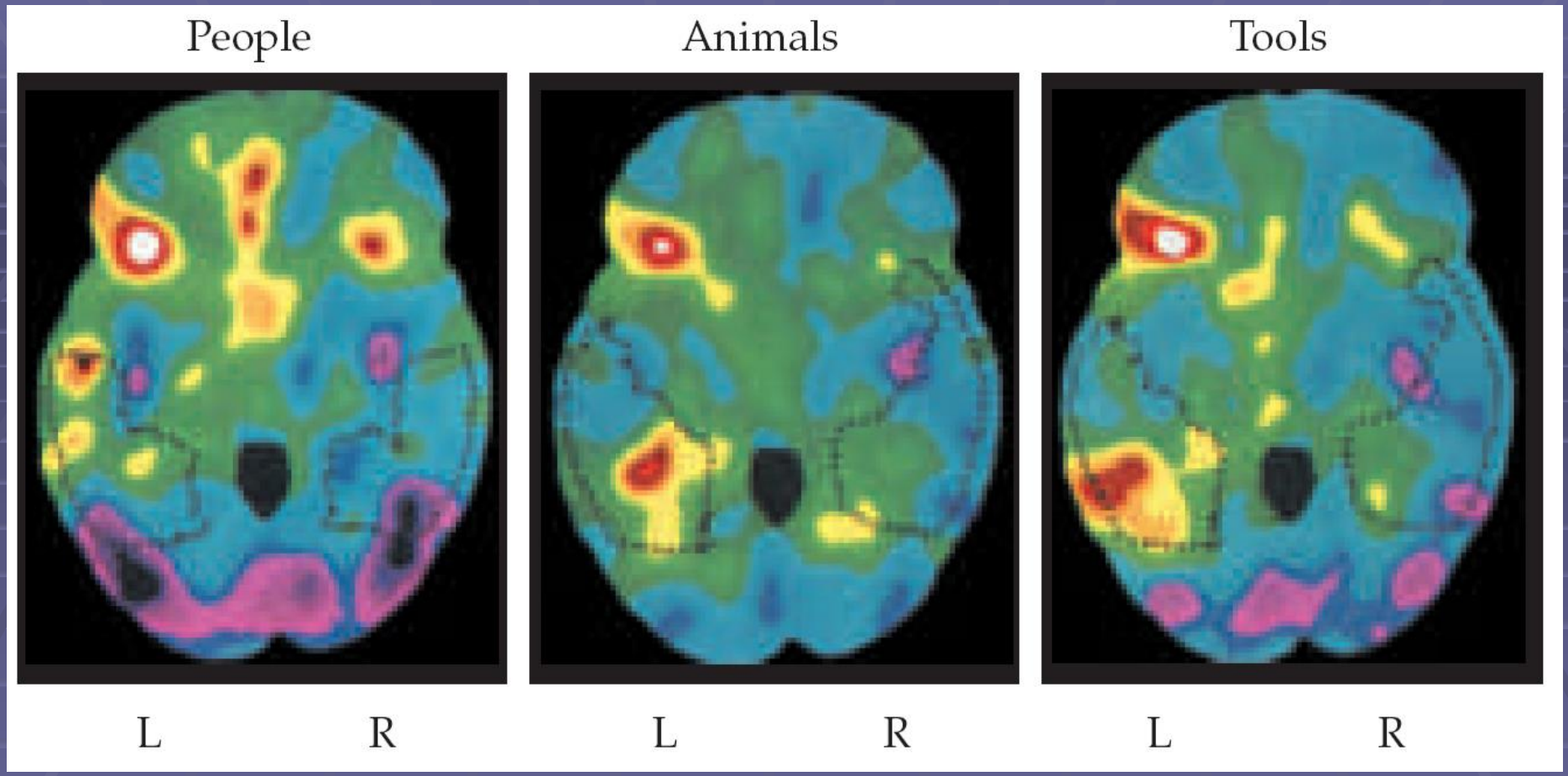




Generating word associations

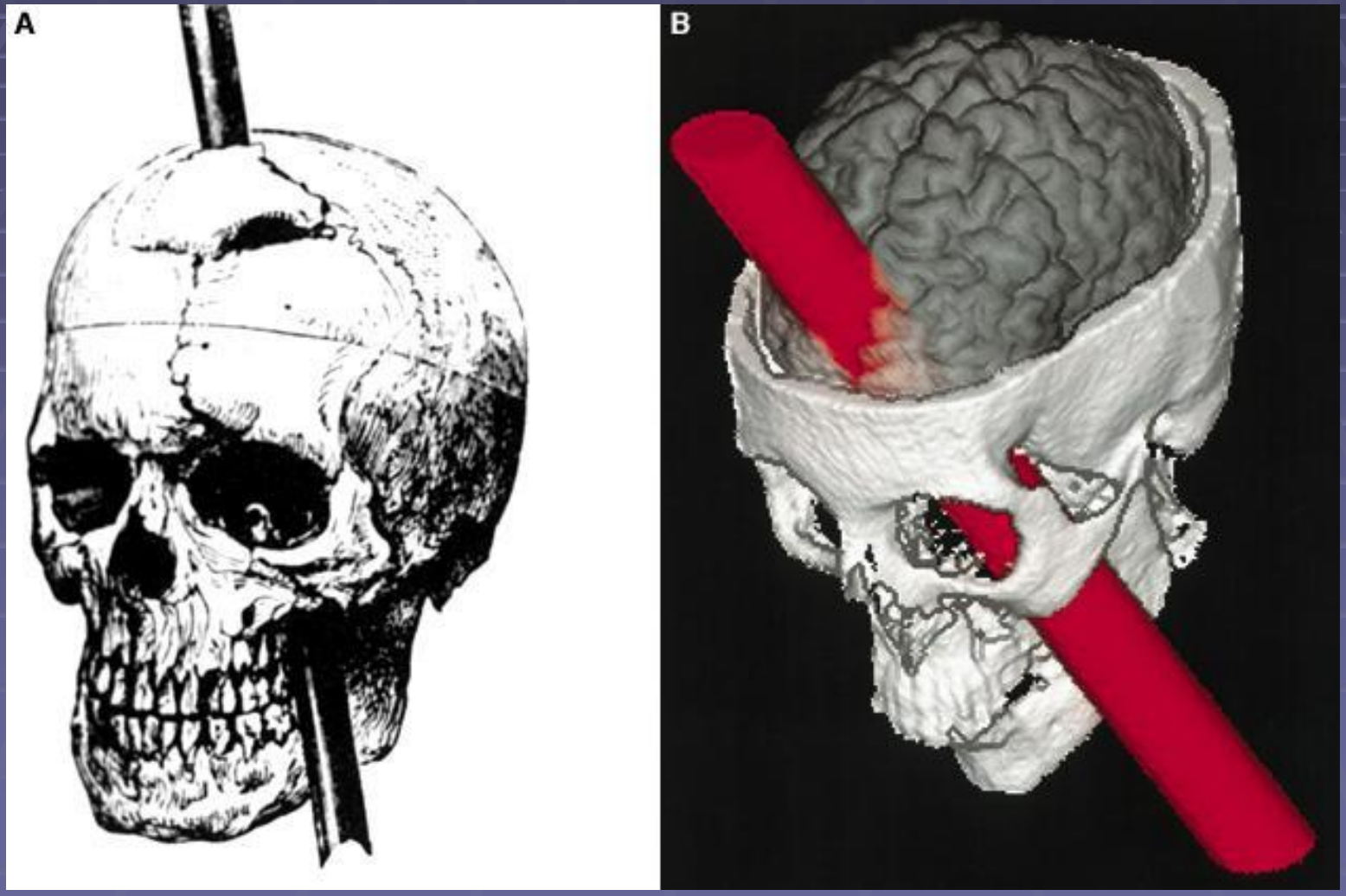





People
Animals
Tools
L
R
L
R
L
R
Low
Level of activity
High

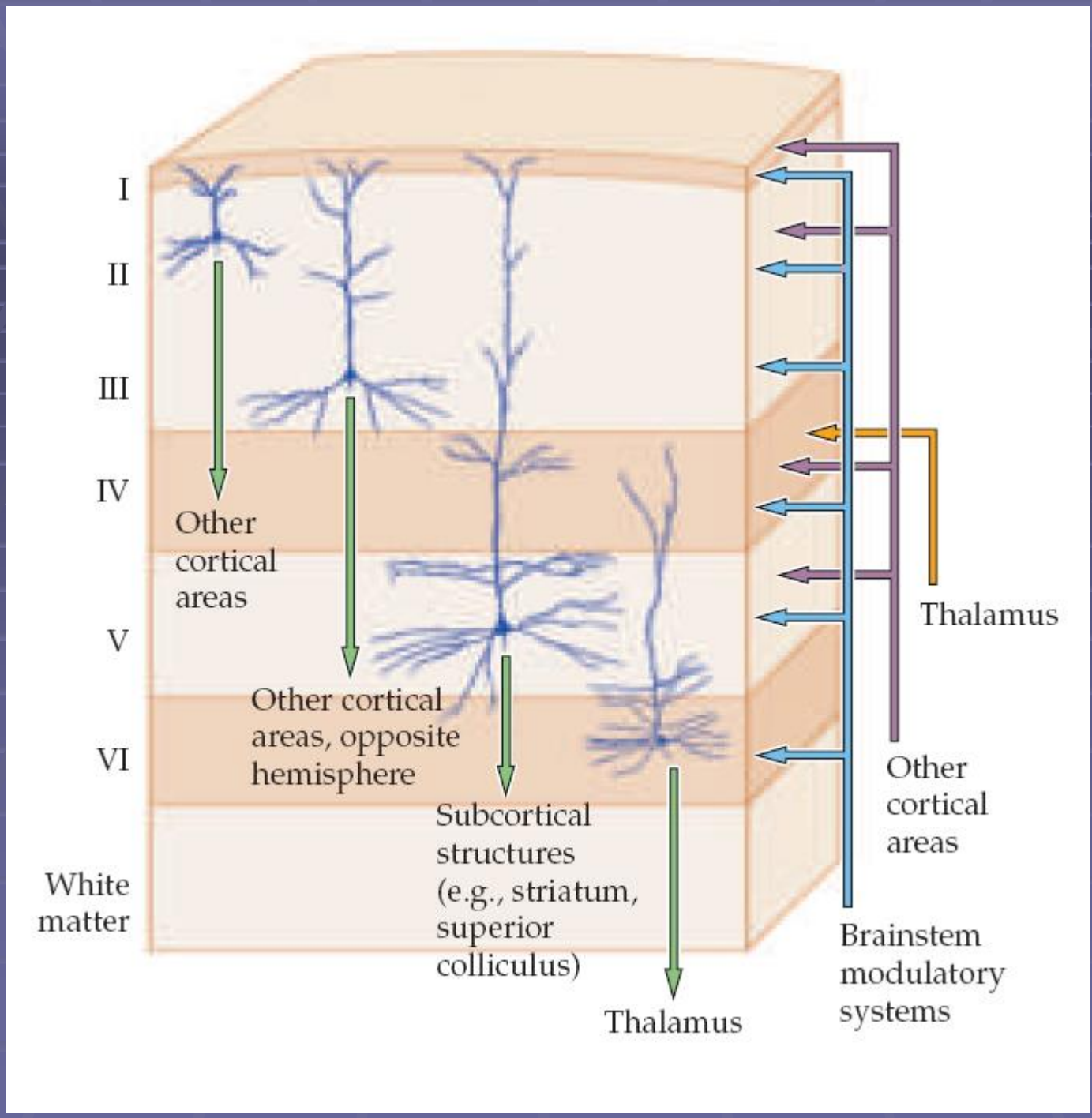
Plans for Action

(prefrontal cortex)


A
B

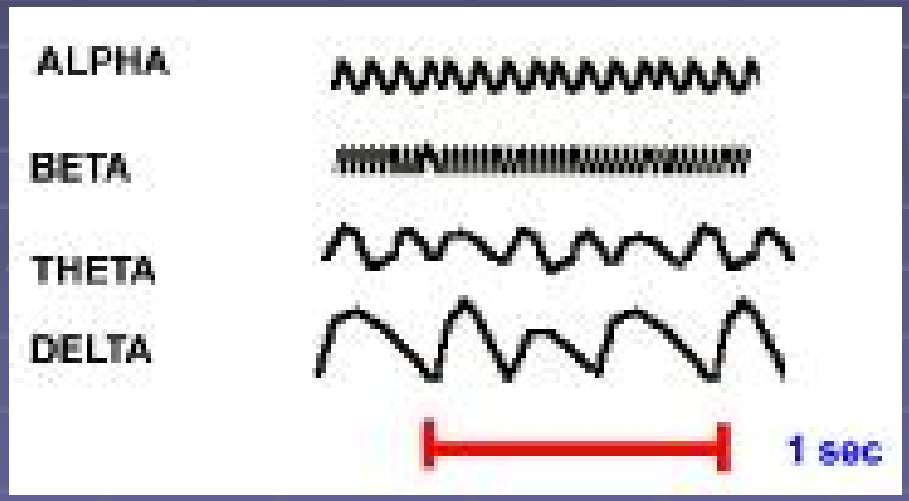
Prefrontal Cortex Damage:

- Lack of foresight
- Frequent stubbornness
- Inattentive and moody
- Lack of ambitions, sense of responsibility, sense of propriety (rude)
- Less creative and unable to plan forthe future


I
II
III
IV
V
VI
White matter
Other cortical areas
Other cortical areas, opposite hemisphere
Subcortical structures (e.g., striatum, superior colliculus)
Thalamus
Thalamus
Other cortical areas
Brainstem modulatory systems

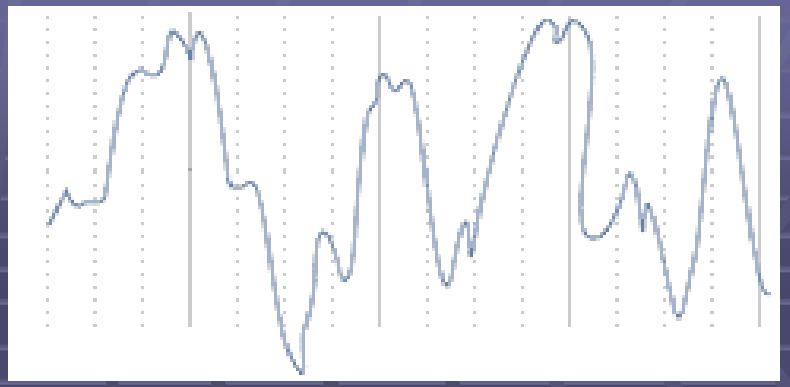
Classifying EEG brain waves

- Frequency: the number of oscillations/waves per second, measured in Hertz (Hz)
  - reflects the firing rate of neurons
  - alpha, beta, theta, delta



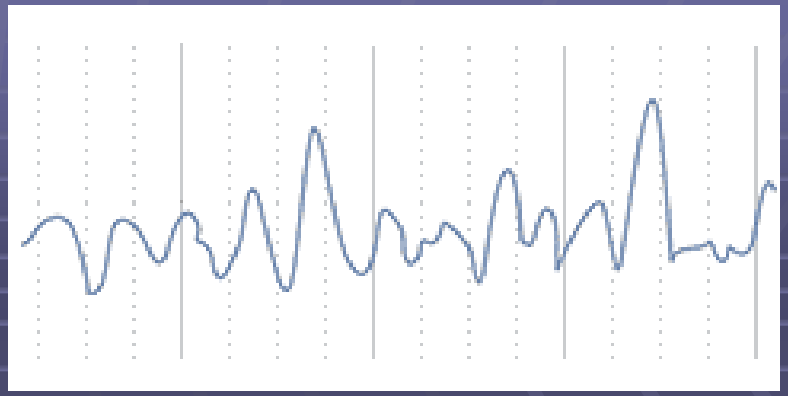
- Amplitude: the magnitude of brain waves, measured in millivolts (mV), gives an indication of the wave's "power".
  - The number of neurons firing in synchrony & the distance between the neurons and the recording electrode

Delta Waves



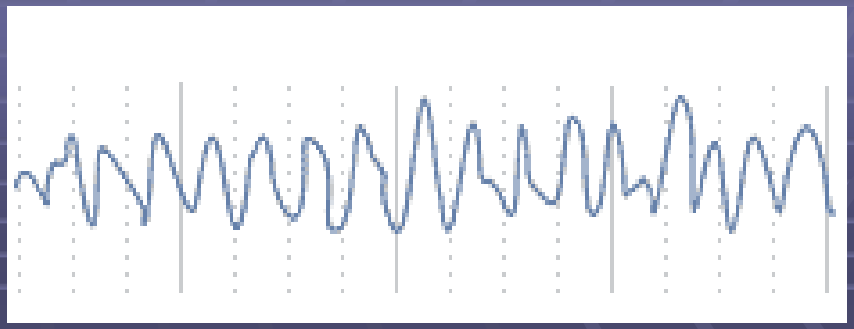
- **Slowest frequency waves: 1 – 3 Hz**
- **Associated tasks & behaviors:**
  - deep, dreamless sleep, not moving, not attentive, sleeping

Theta Waves

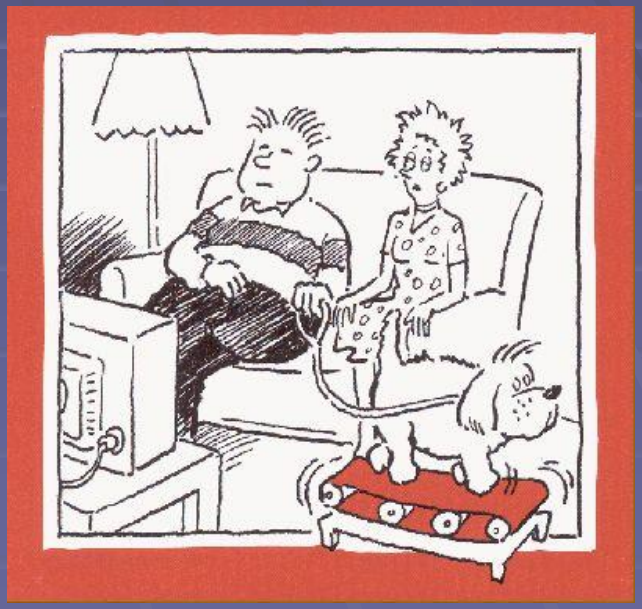


- **Slow wave frequency: 4 – 8 Hz**
- **Associated tasks & behaviors:**
  - State between wakefulness and sleep "Drowsy"
  - during sleep, meditation, internal focus, and prayer; subconsciousness.

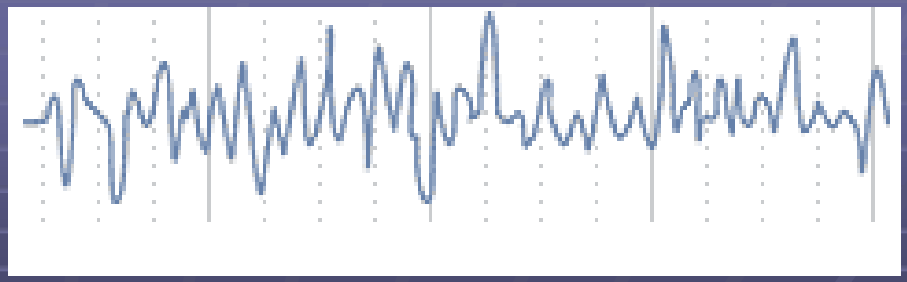
Alpha Waves



- Mid wave frequency: 8 - 13 Hz
- Parietal and occipital lobes
- Associated tasks & behaviors:
  - Relaxing, watching television, light reading (e.g., novel), eyes closed.



Beta Waves

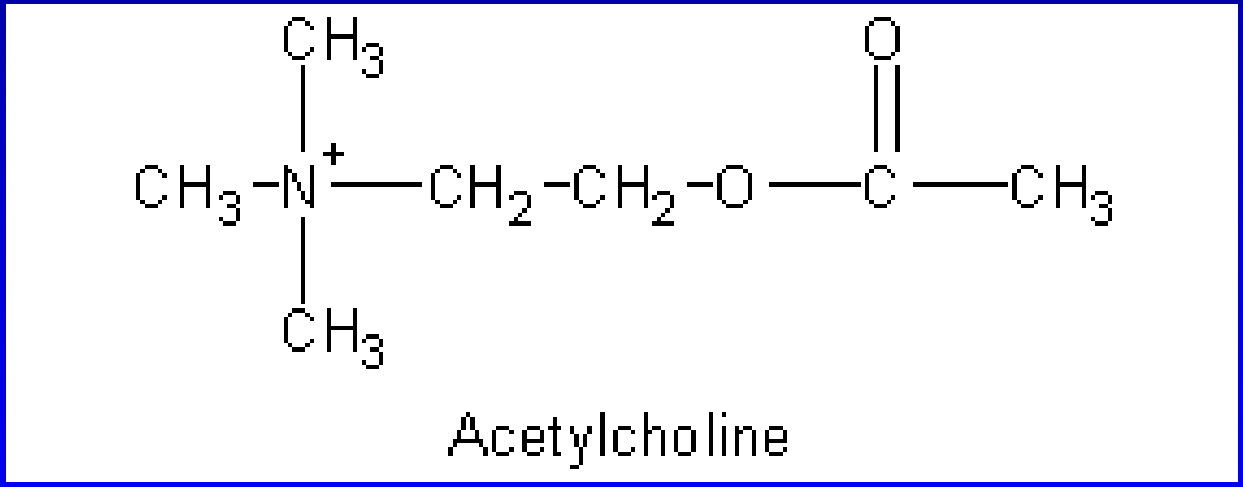


- **High wave frequency: 12 - 35 Hz**
  - The “normal” dominant rhythm \
  - mostly on temporal and frontal lobe
- **Associated tasks & behaviors:**
  - listening and thinking during analytical problem solving, judgment, decision making, processing information,

EEG Waveforms

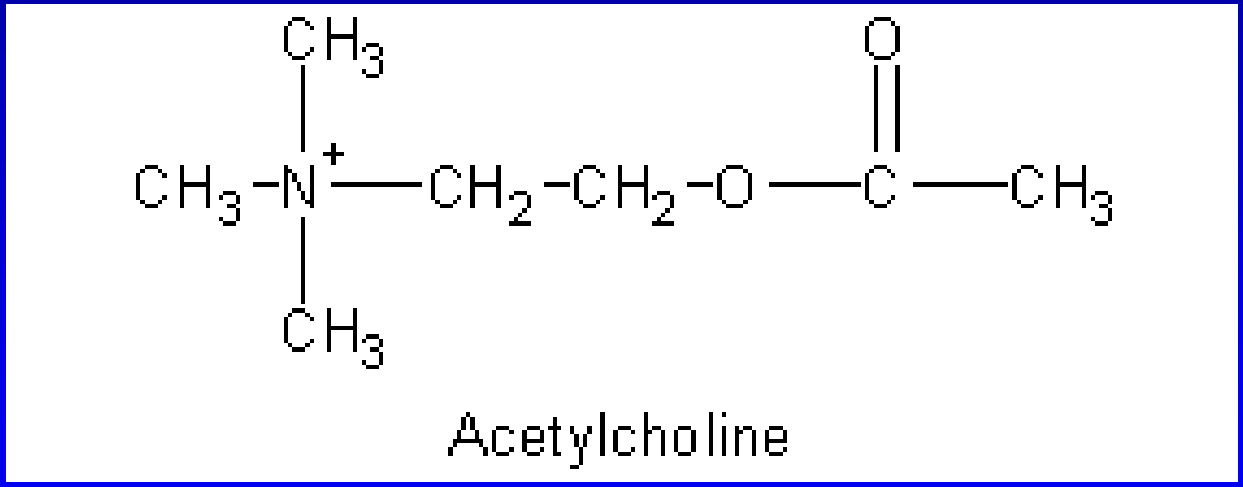
- Alpha
  - 8-13 Hz
  - Parietal and occipital prominent
  - Relaxed wakeful
- Beta
  - 13-30 Hz
  - Frontal prominent
  - Intense mental activity
- Delta
  - 0.5-4 Hz
  - Drowsiness/early SWS
- Theta
  - 4-7 Hz
  - Drowsiness/early SWS

Acetylcholine



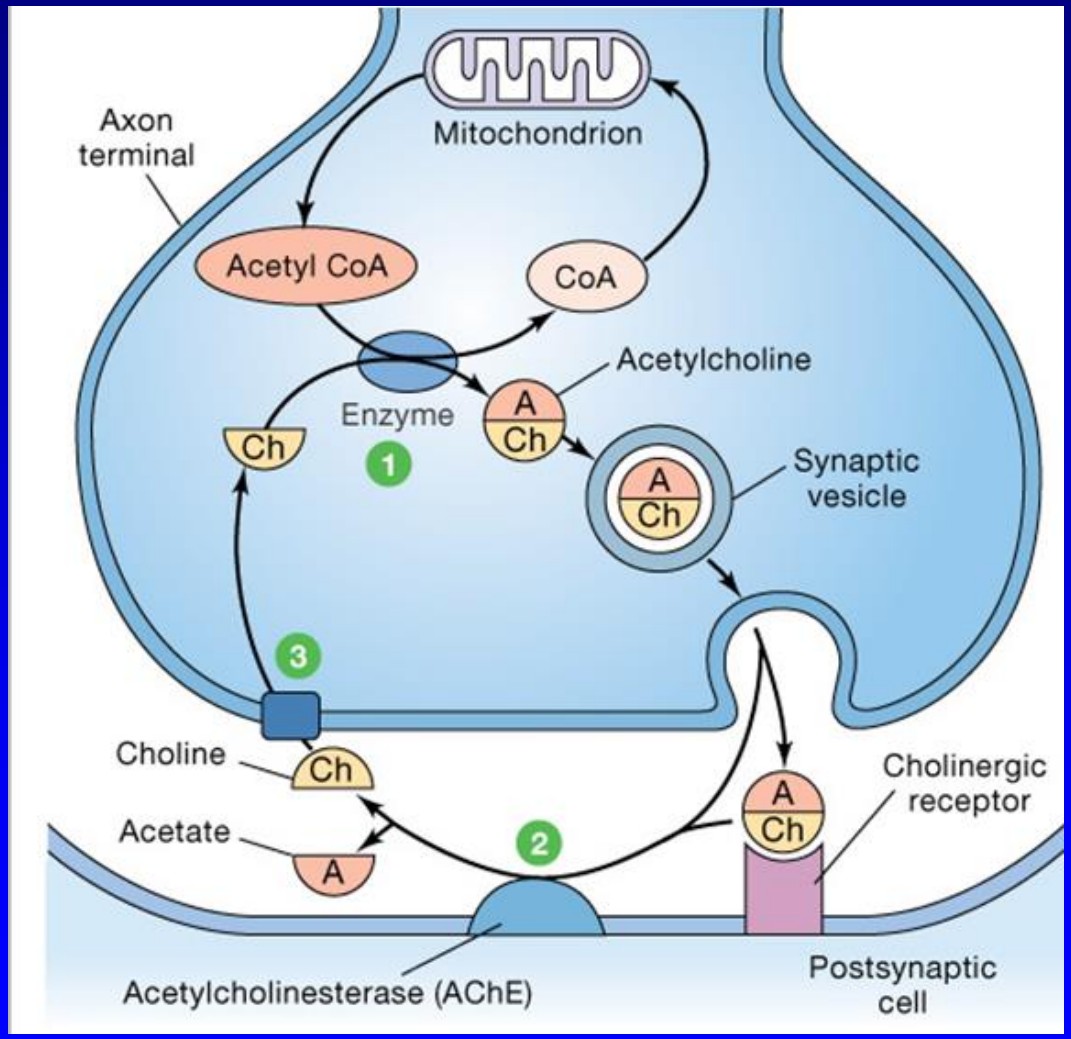
Acetylcholine

Acetylcholine

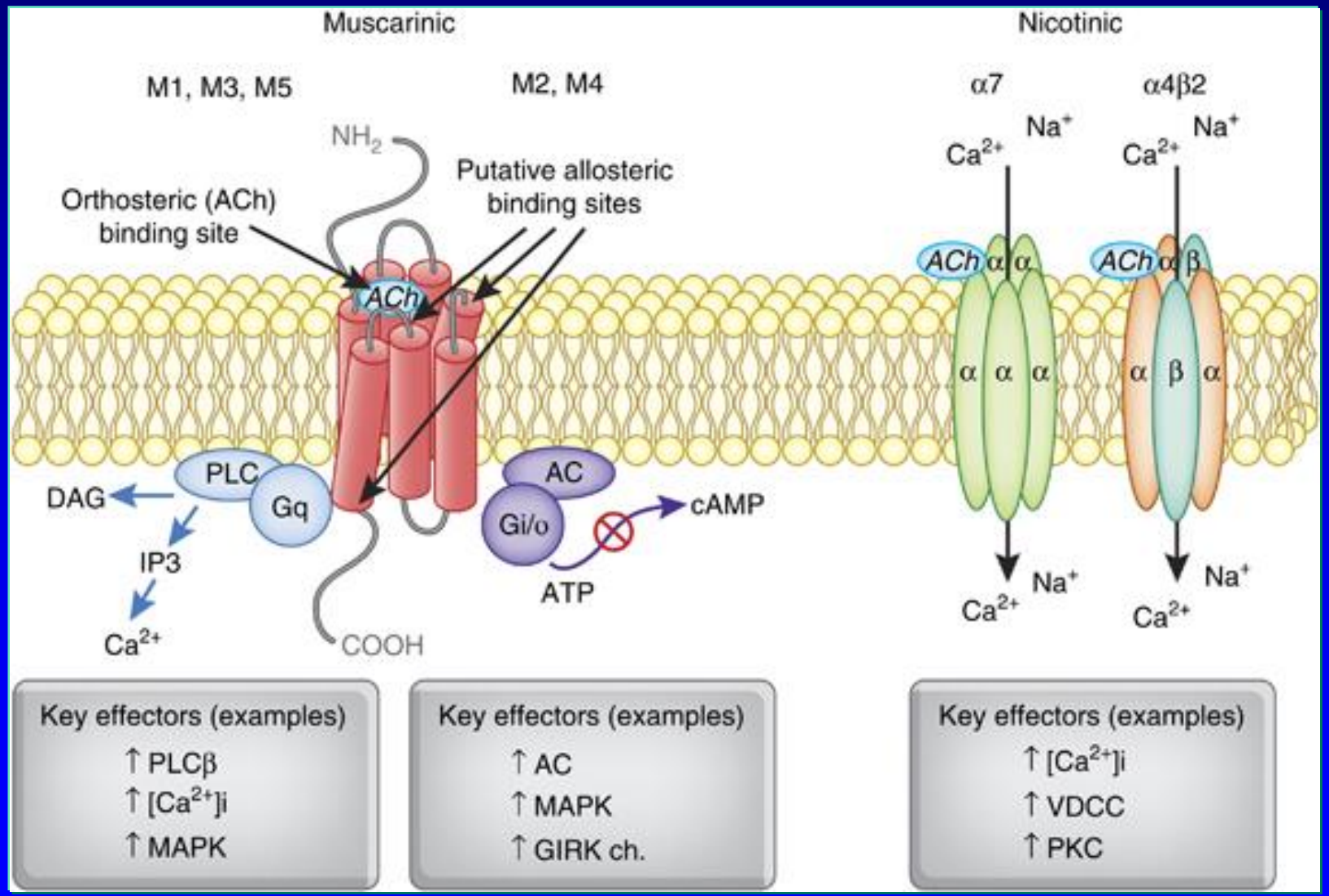


Choline + Acetyl CoA $\xrightarrow{\text{ChAT}}$ Acetyl choline + CoA

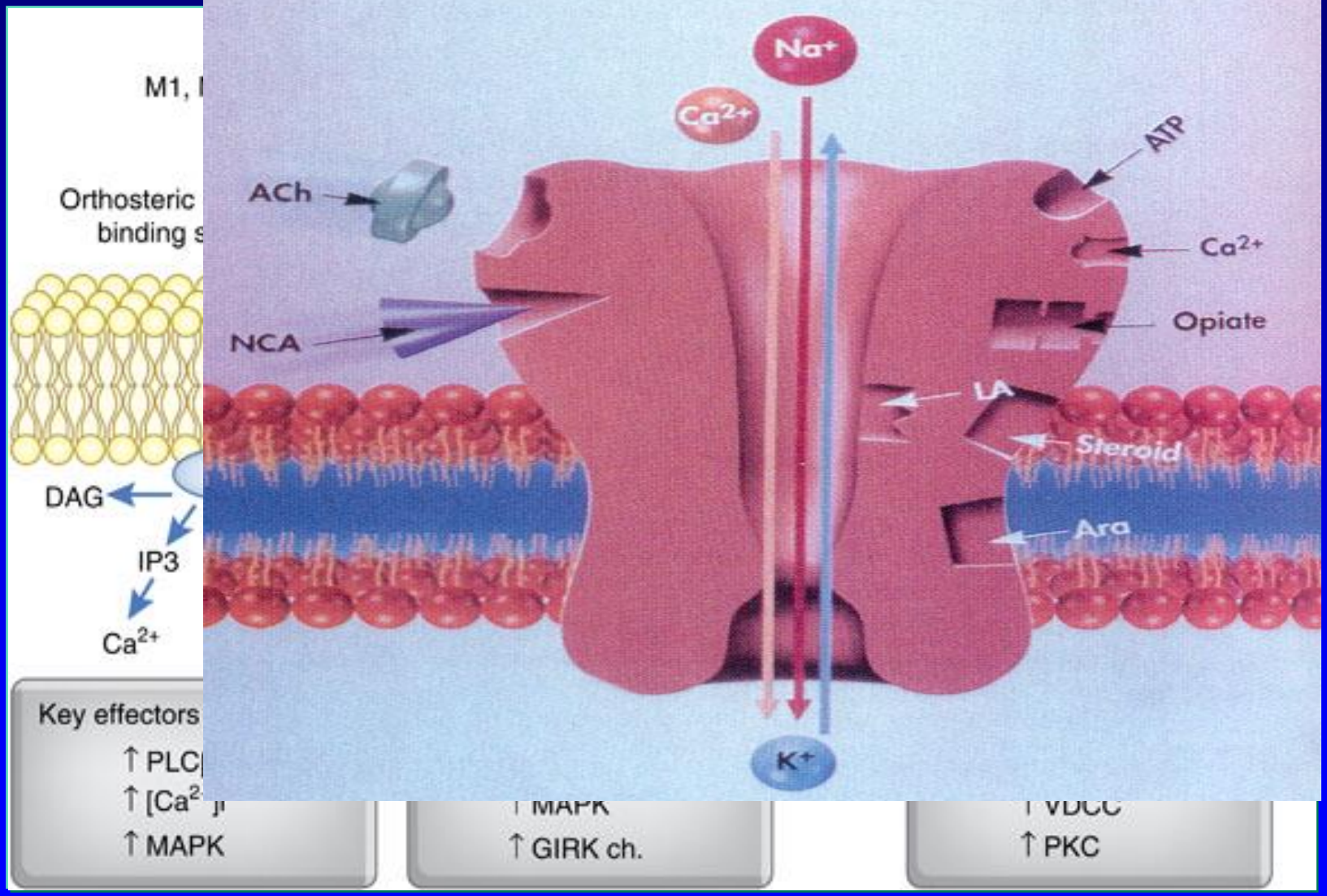
Acetylcholine synapse



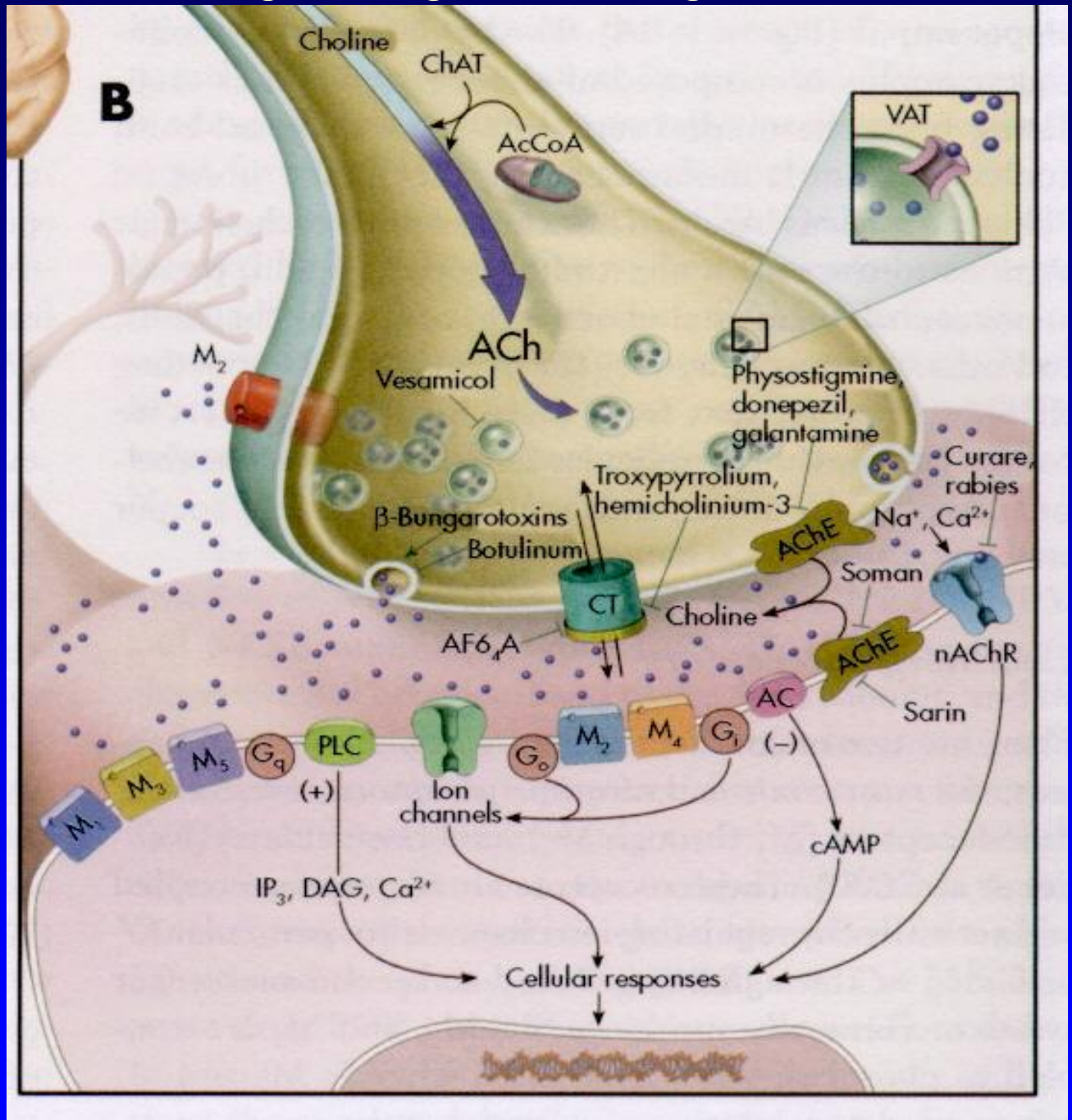
Acetylcholine receptors



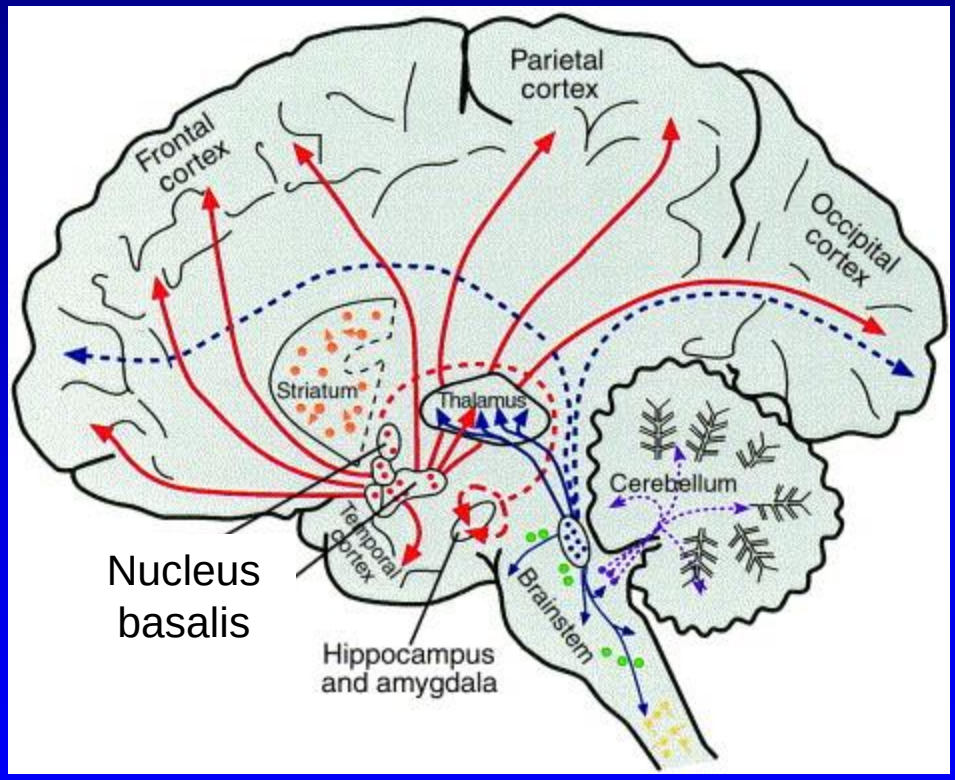
Acetylcholine receptors



Drugs acting at cholinergic terminal

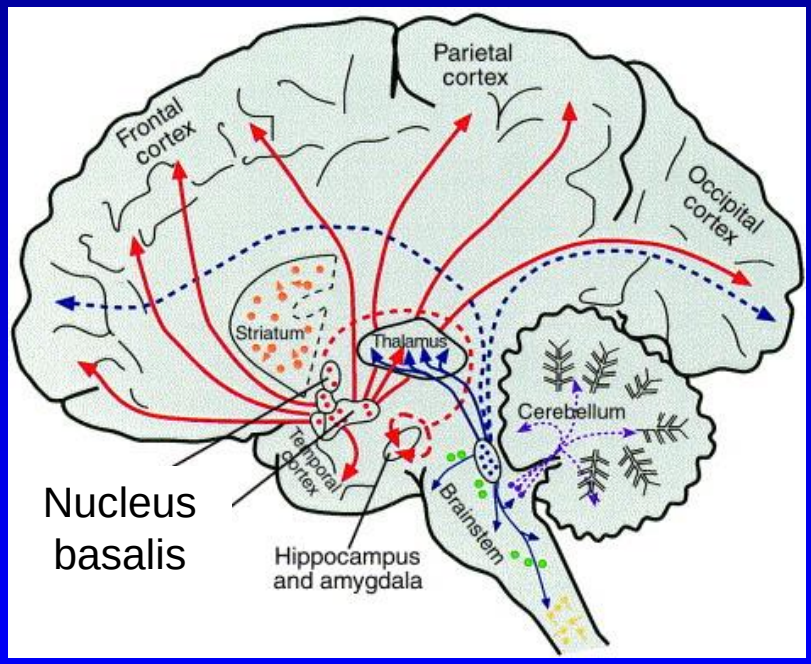


Acetylcholine Pathway



Acetylcholine Pathway

- arousal and reward
- enhancement of sensory perceptions
- sustaining attention



Acetylcholine Pathway

- arousal and reward
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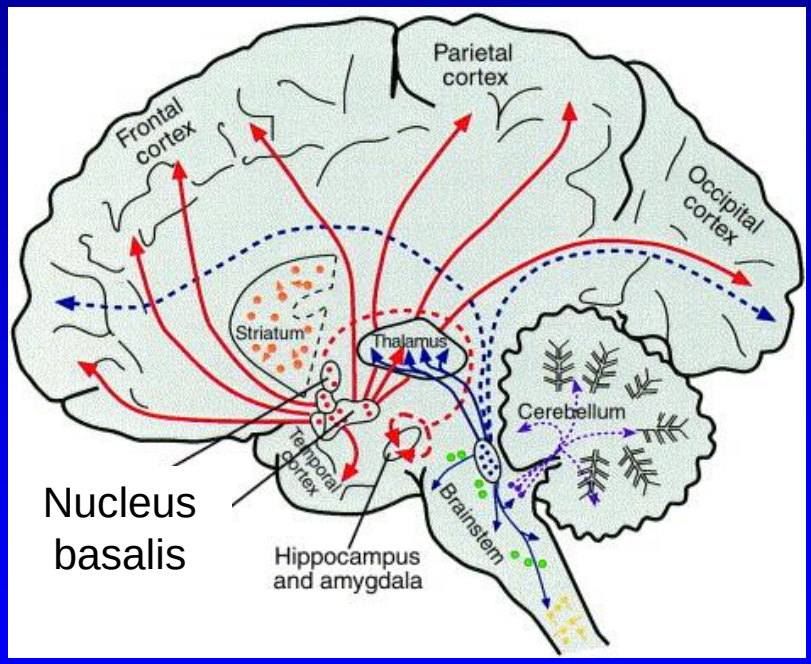
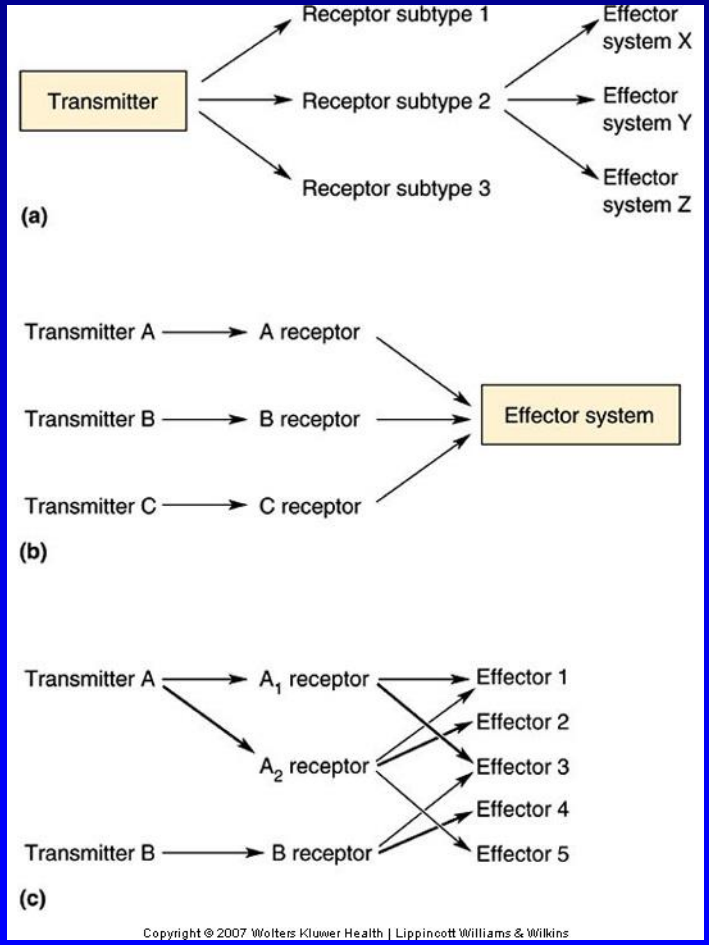


Alzheimer's disease – loss of cholinergic cells in nucleus basalis

Neuromodulators

Divergence and Convergence in Neurotransmitter Systems

- Divergence
  - One transmitter activates more than one receptor subtype→ greater postsynaptic response
- Convergence
  - Different transmitters converge to affect same effector system



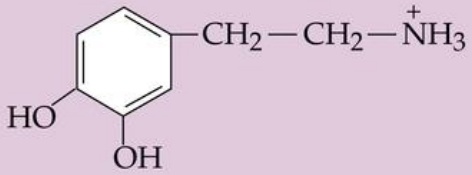
Biogenic Amines

SMALL-MOLECULE NEUROTRANSMITTERS

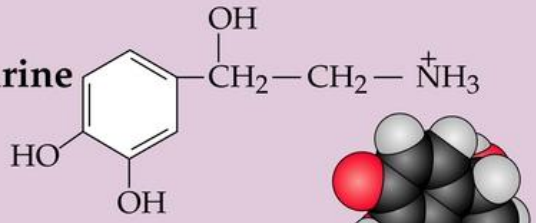
BIOGENIC AMINES

CATECHOLAMINES

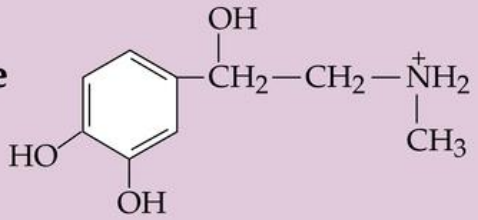
Dopamine



Norepinephrine

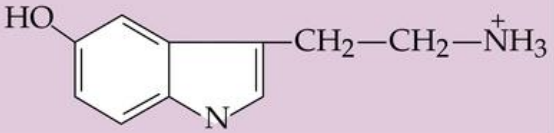


Epinephrine

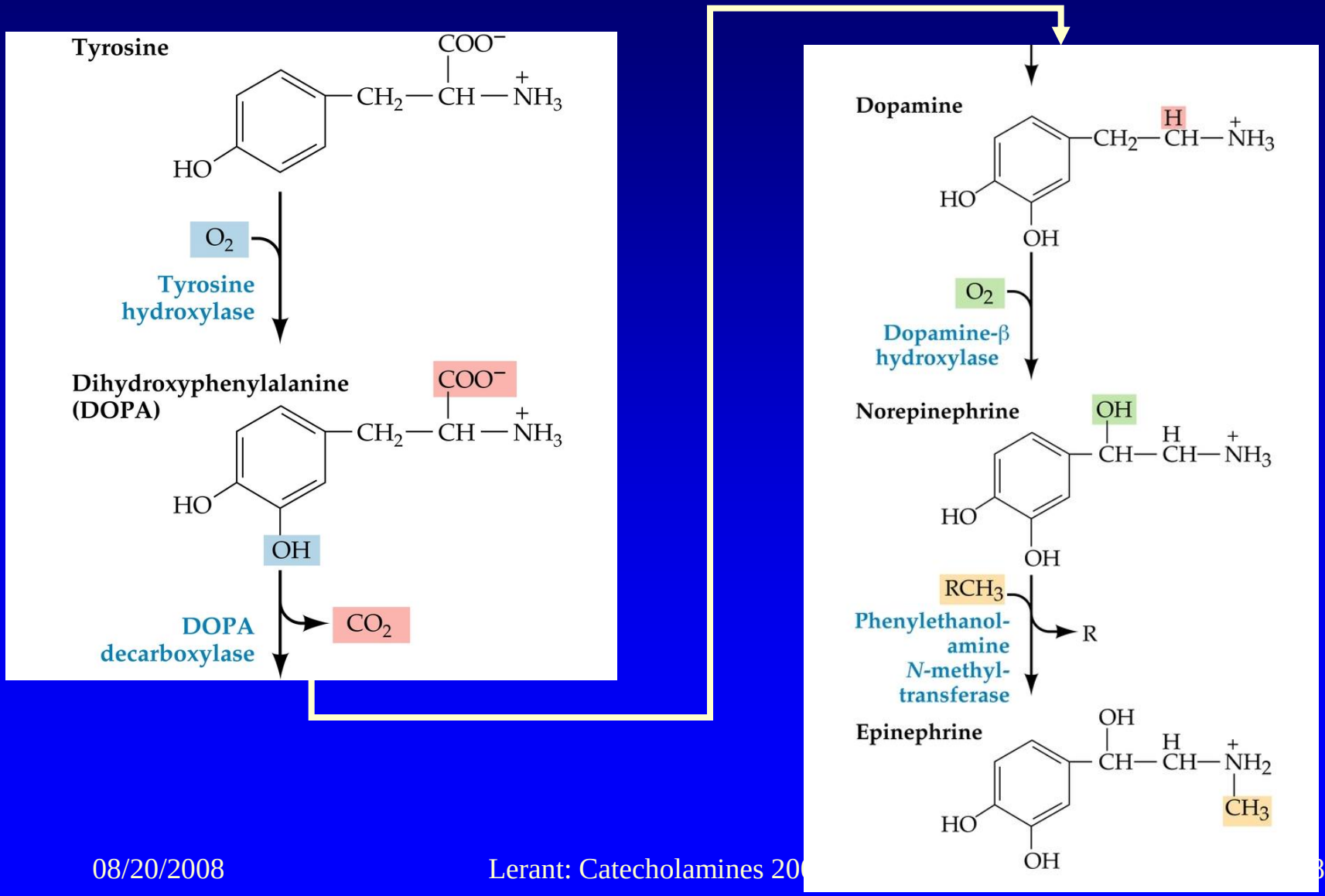


INDOLEAMINE

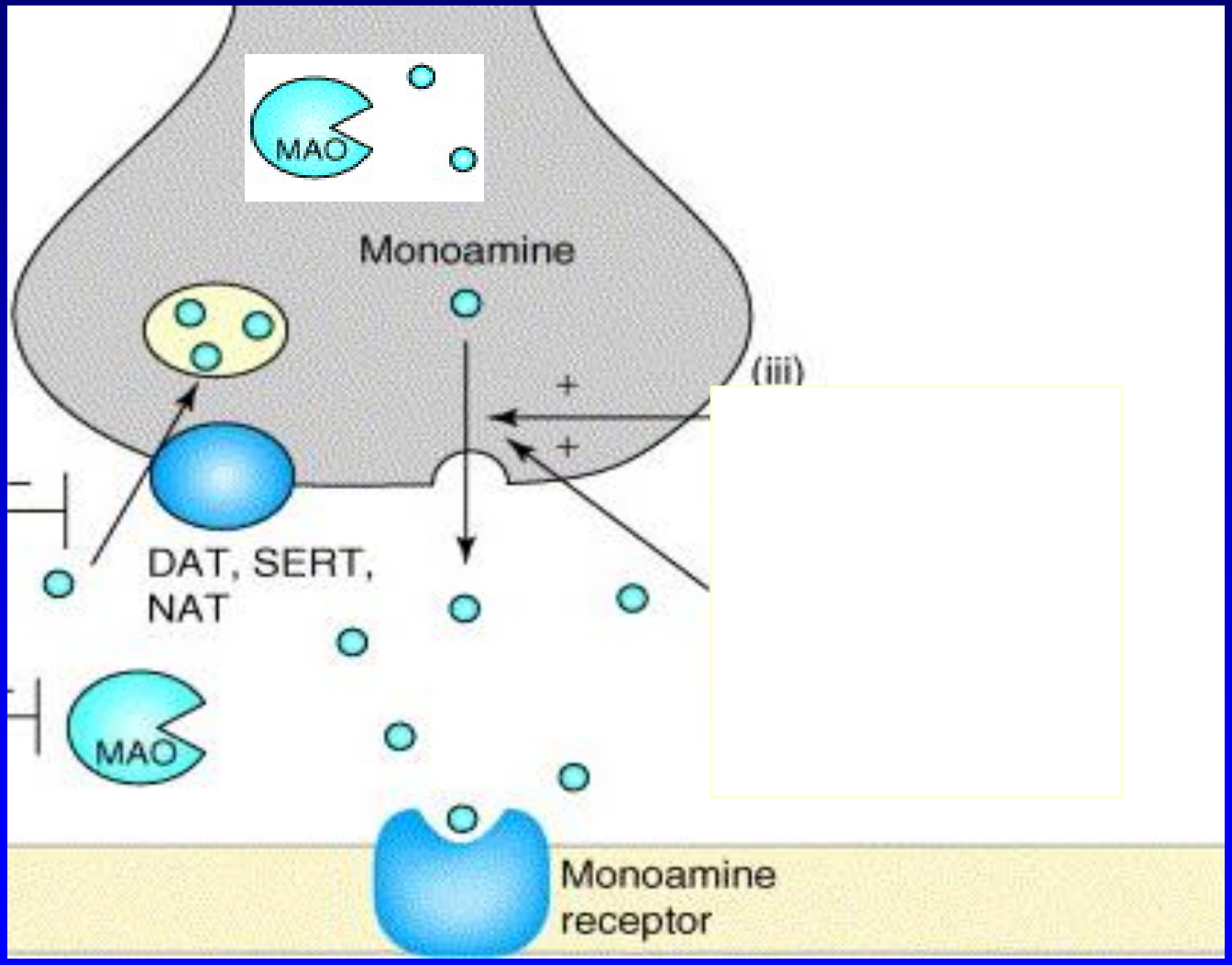
Serotonin



The biosynthetic pathway for the catecholamine neurotransmitters



Biogenic Amines Synapses



MAO : Monoamine Oxidase

Dopamine

Dopamine receptors

- G protein-coupled receptors

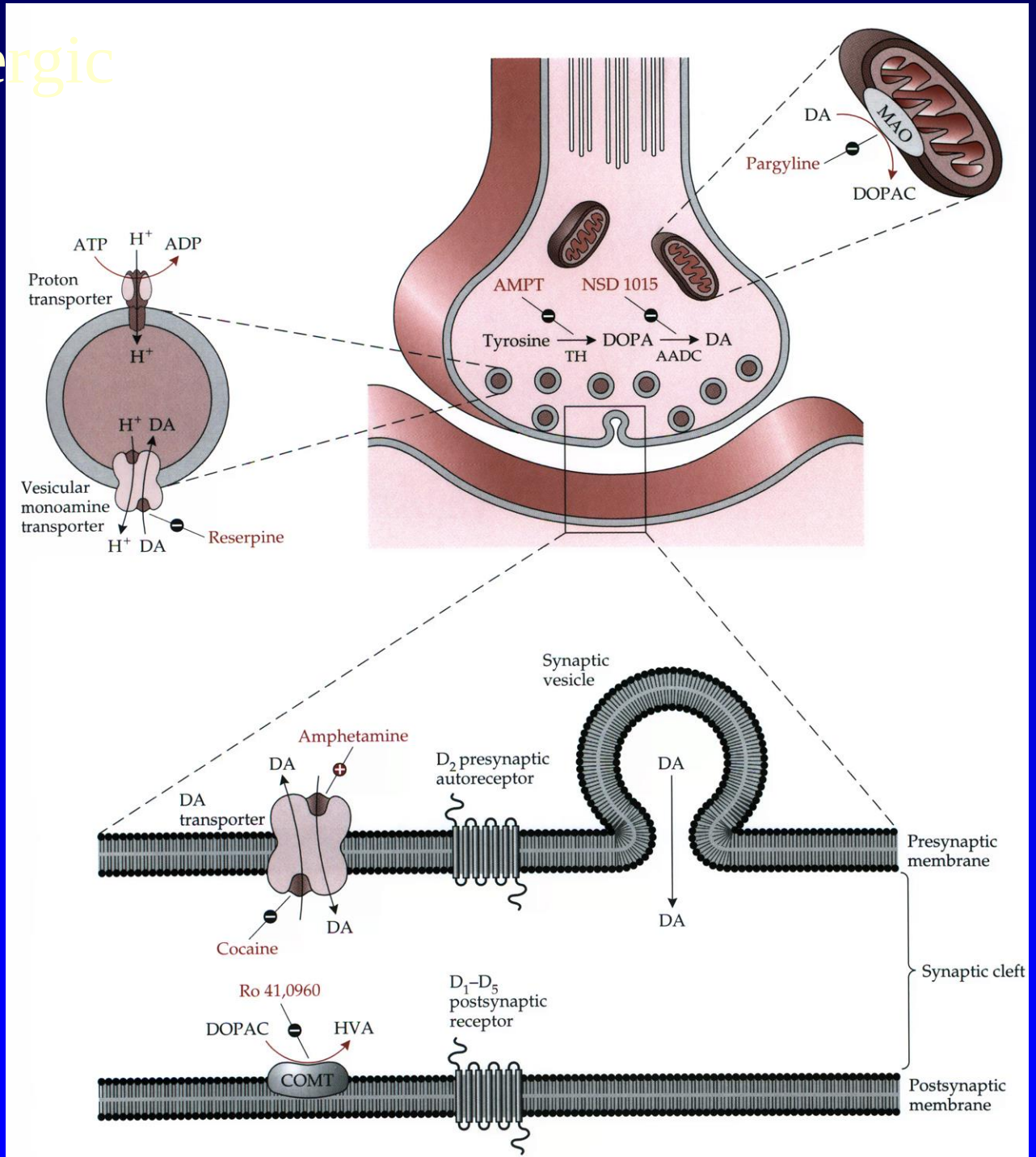
Dopamine receptors

- G protein-coupled receptors
- D1 → excite
- D2 → inhibit
- D3 → inhibit
- D4 → inhibit
- D5 → excite

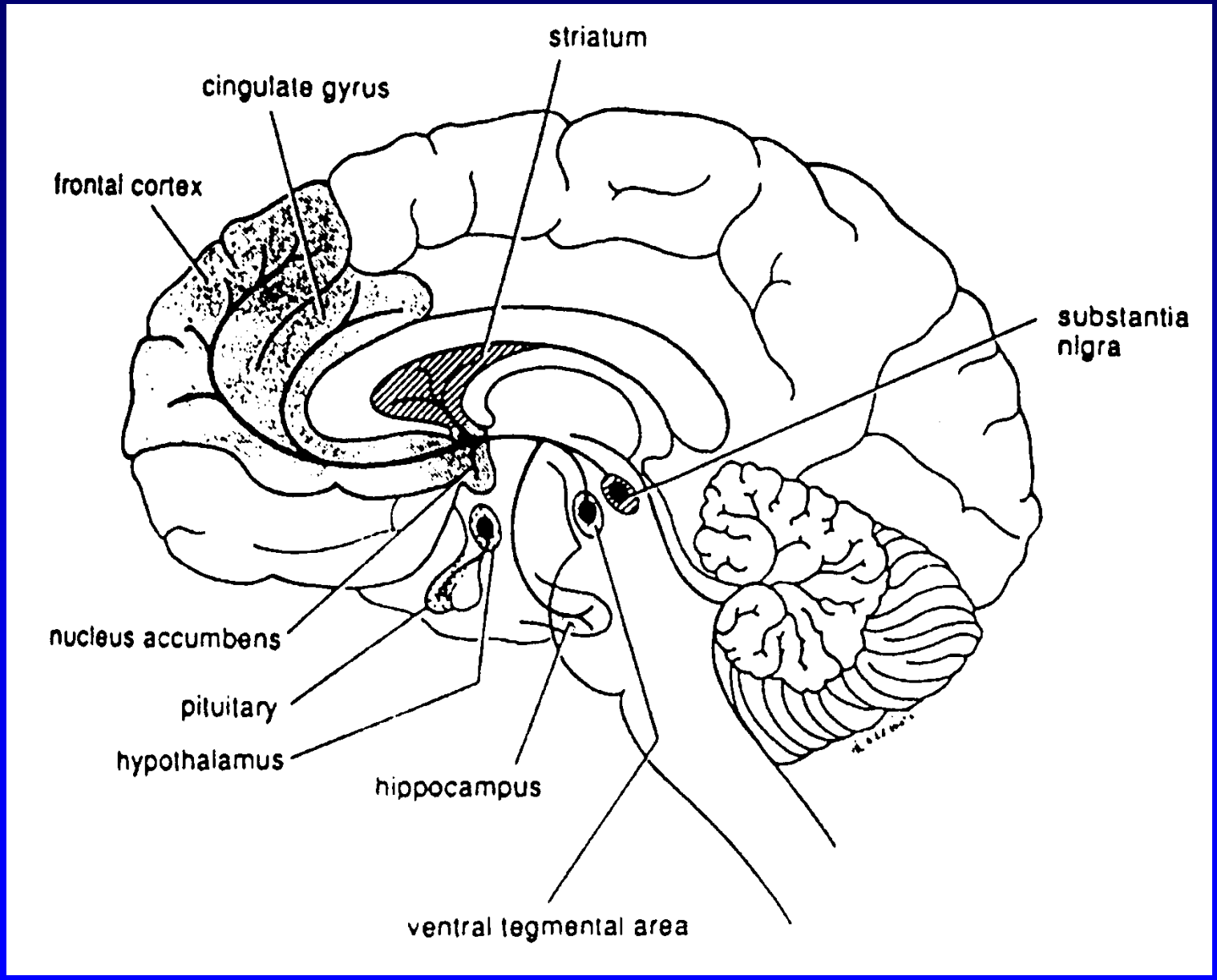
Dopamine receptors

- G protein-coupled receptors
- D1 → excite
- D2 → inhibit ★ Mainly presynabtic (Autoreceptor)
- D3 → inhibit
- D4 → inhibit
- D5 → excite

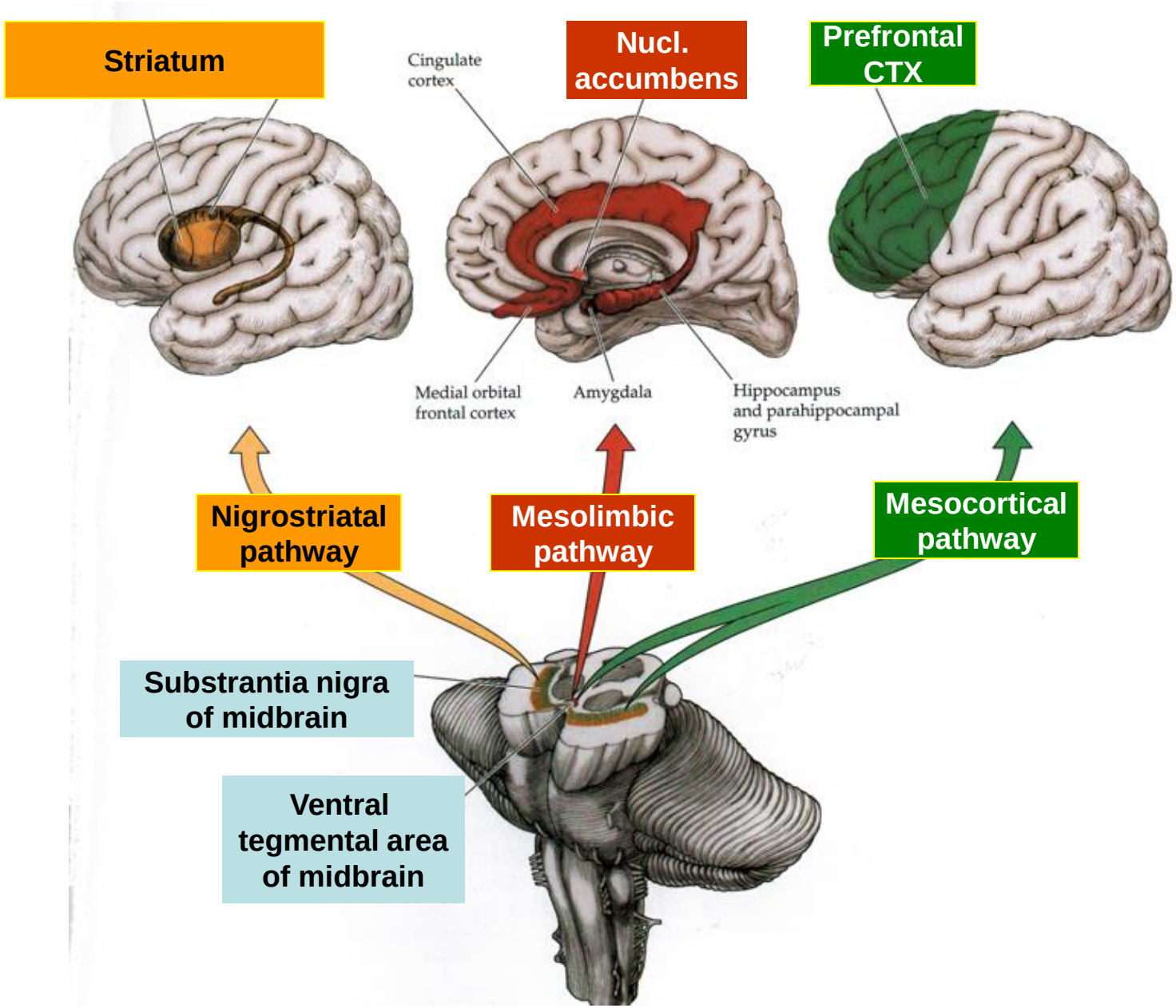
3. Dopaminergic (DA) synapse



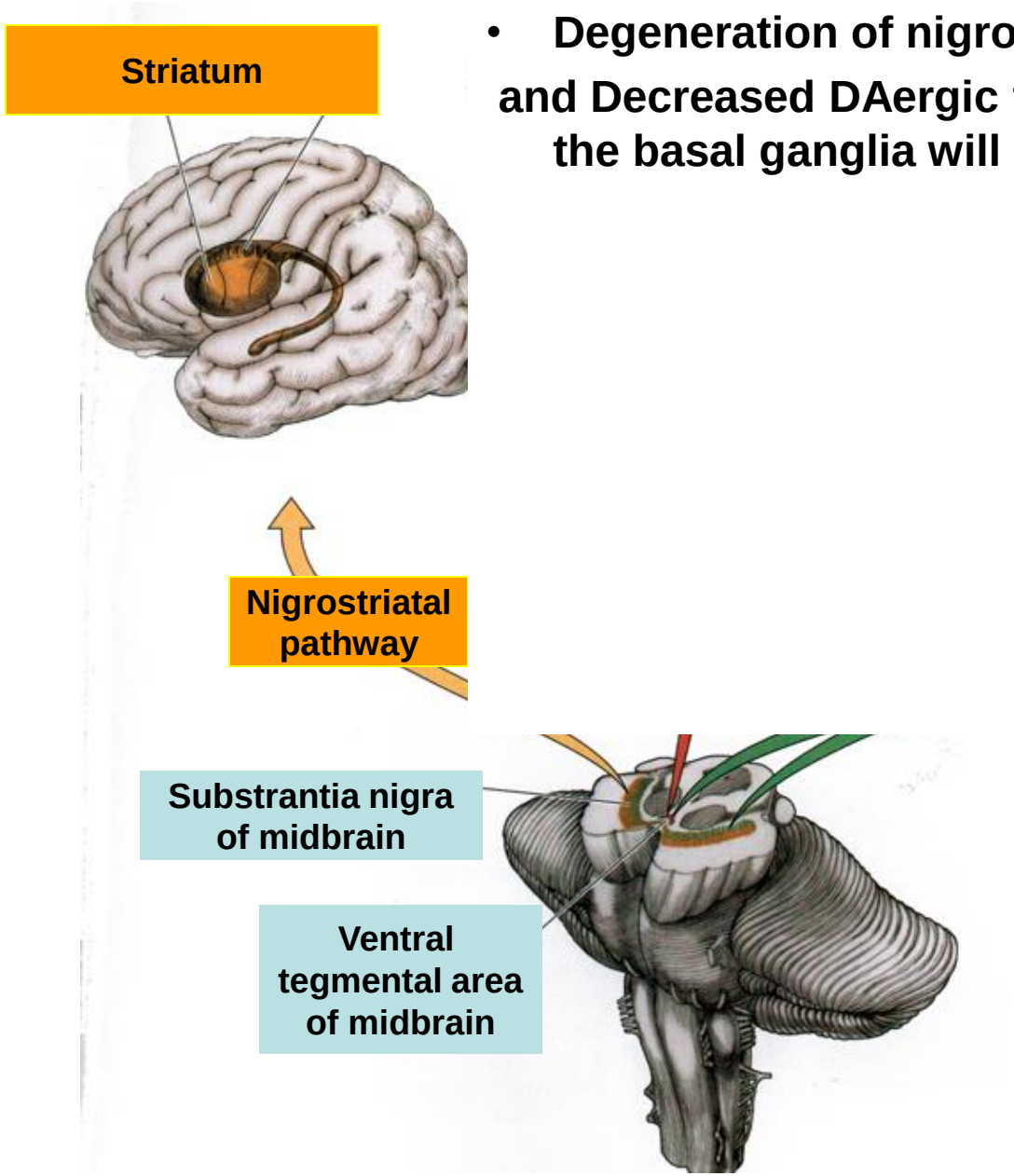
Dopamine Pathways



DOPAMINERGIC PATHWAYS

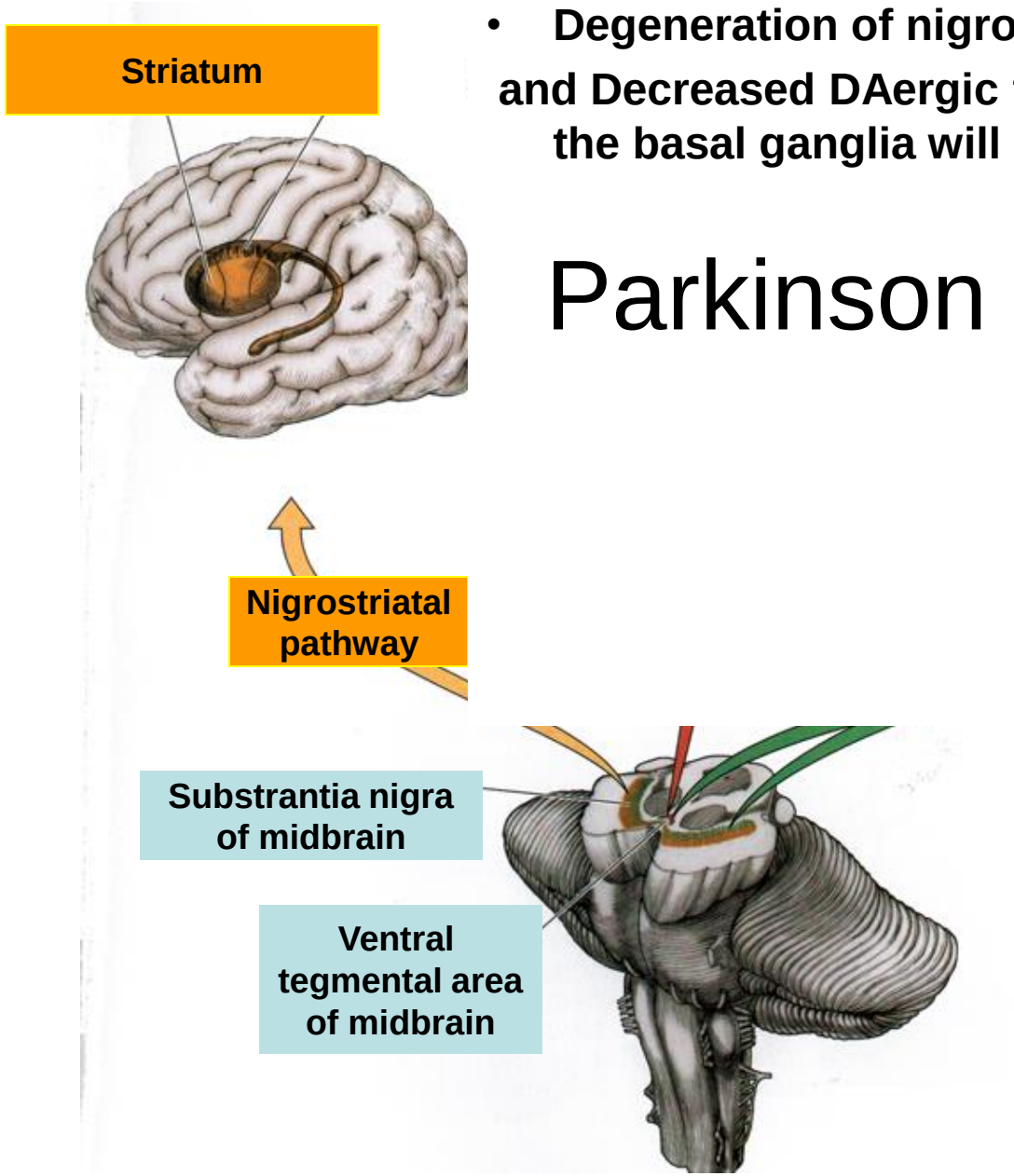


DOPAMINERGIC PATHWAYS



- **Degeneration of nigro-striatal DA system and Decreased DAergic trans-mission in the basal ganglia will lead to**

DOPAMINERGIC PATHWAYS



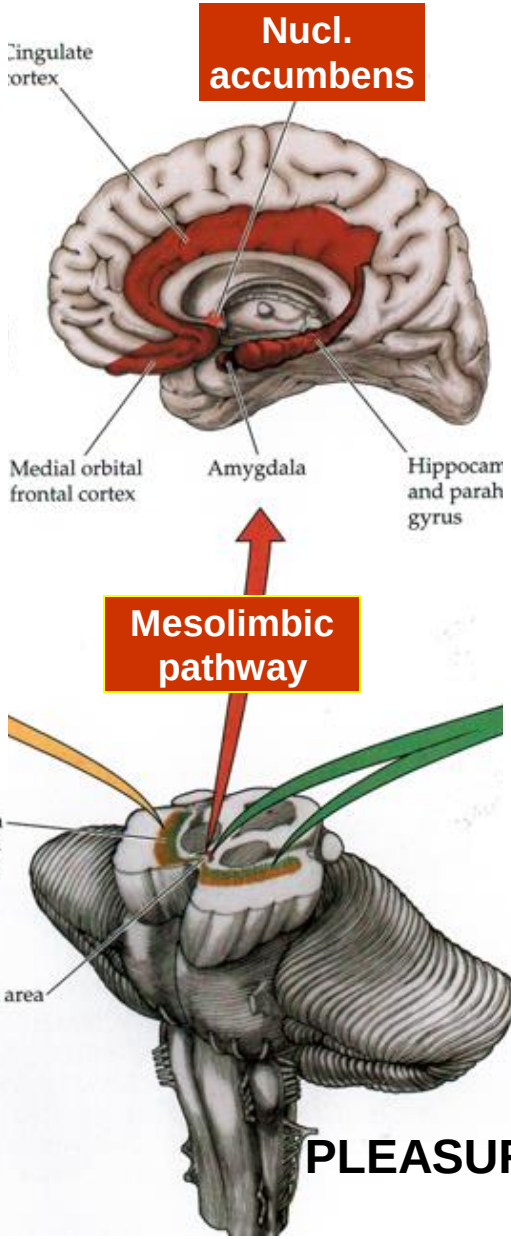
- **Degeneration of nigro-striatal DA system**

and Decreased DAergic trans-mission in the basal ganglia will lead to

Parkinson Disease

DOPAMINERGIC PATHWAYS

PLEASURE, REWARD AND BEHAVIOR REINFORCING PATHWAY



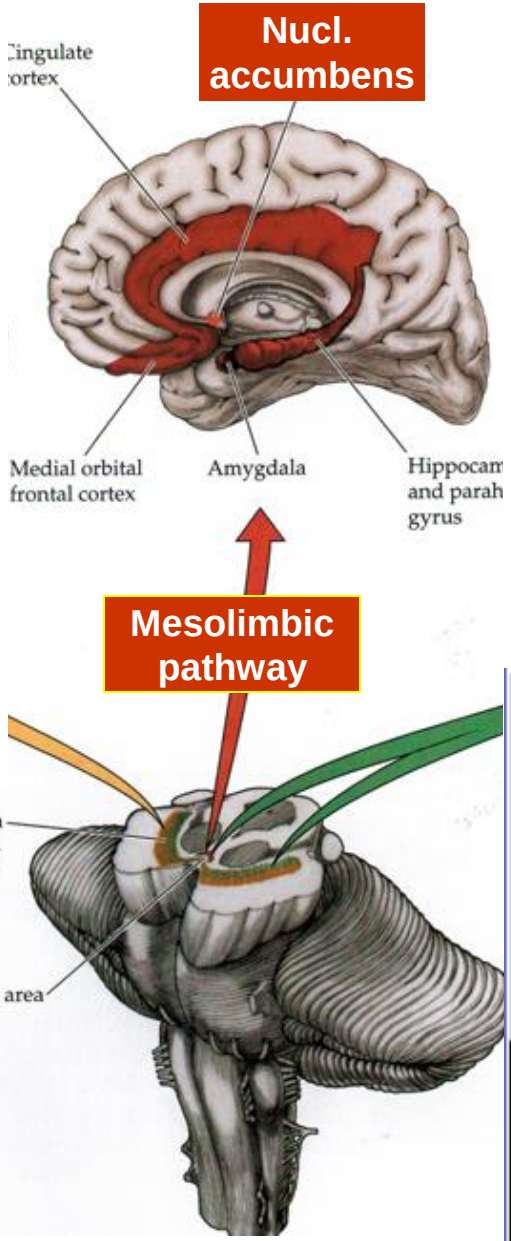
Substrantia nigra of midbrain

Ventral tegmental area of midbrain

PLEASURE, REWARD AND BEHAVIOR

DOPAMINERGIC PATHWAYS

PLEASURE, REWARD AND BEHAVIOR REINFORCING PATHWAY

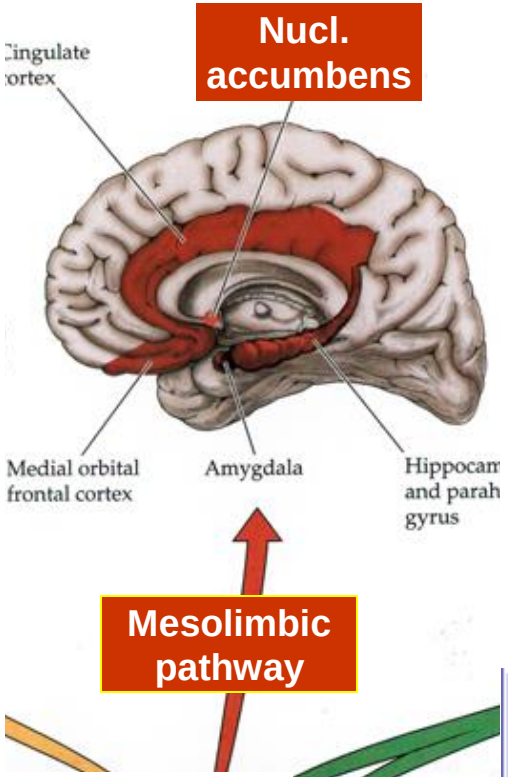


Substrantia nigra of midbrain

Ventral tegmental area of midbrain

DOPAMINERGIC PATHWAYS

PLEASURE, REWARD AND BEHAVIOR REINFORCING PATHWAY



Hyperactivity of mesolimbic pathway:
- positive symptoms of schizophrenia
(hallucinations, etc)

cocaine

DOPAMINERGIC PATHWAYS

PATHWAY INVOLVED IN MOTIVATION TO EXPLORE THE ENVIRONMENT: CURIOSITY, INTEREST, COGNITIVE FLEXIBILITY, DRIVE FOR SOCIAL ENGAGEMENT.

Relative hypofunction **in schizophrenia: Primary mesocortical dopamine deficiency will increase the NEGATIVE SYMPTOMS like Cognitive blunting, social isolation, apathy, anhedonia**