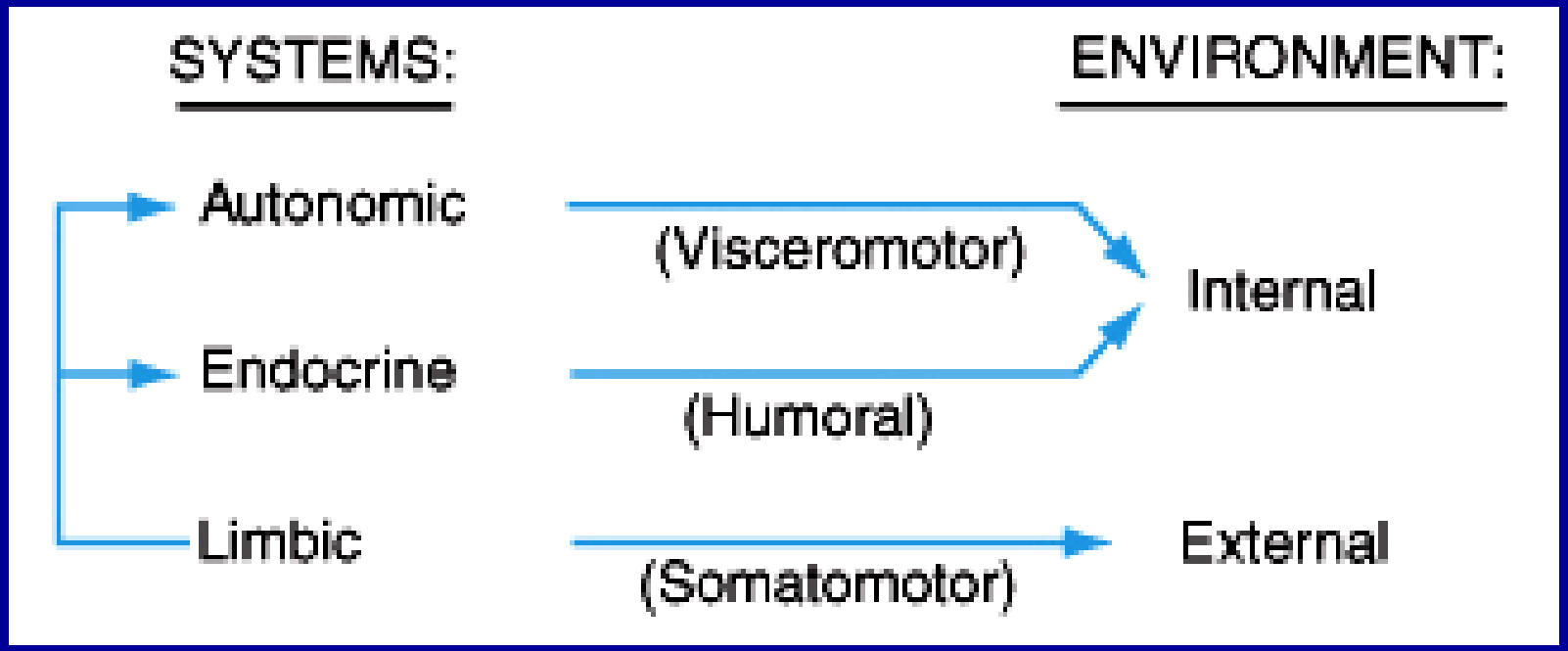
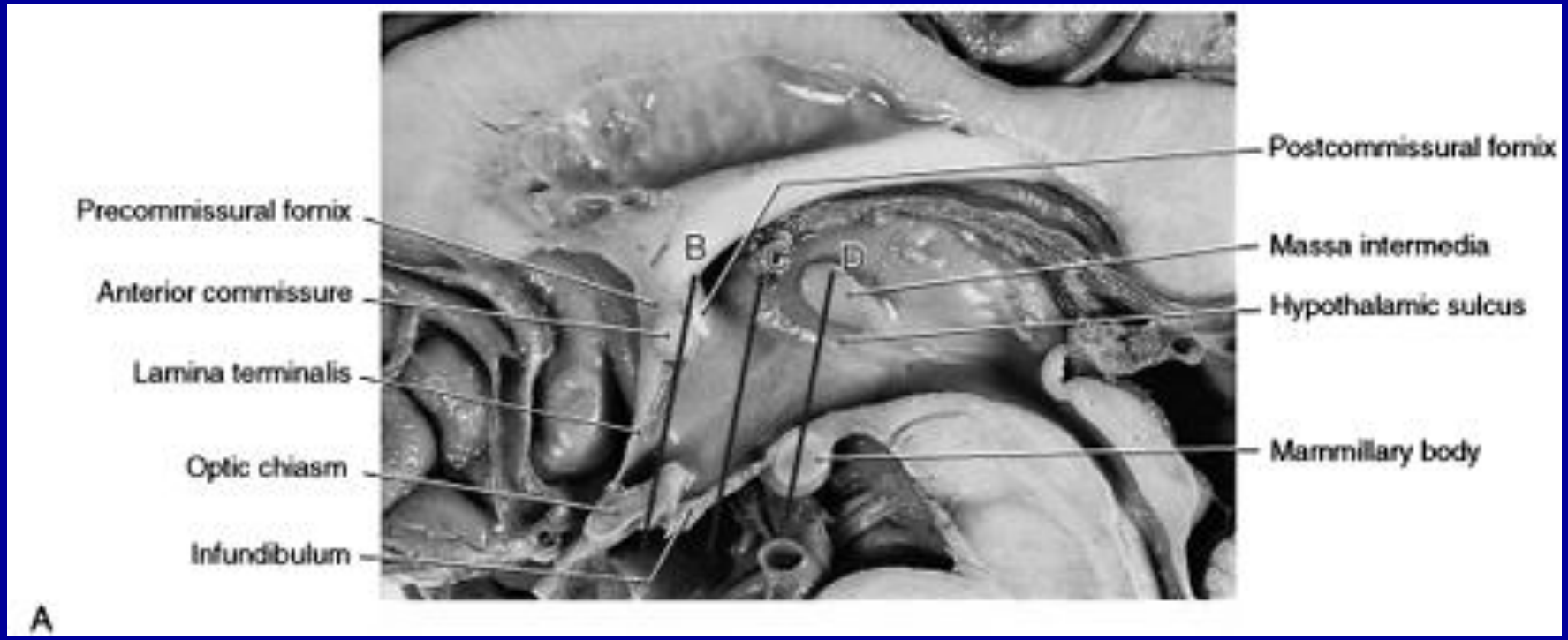
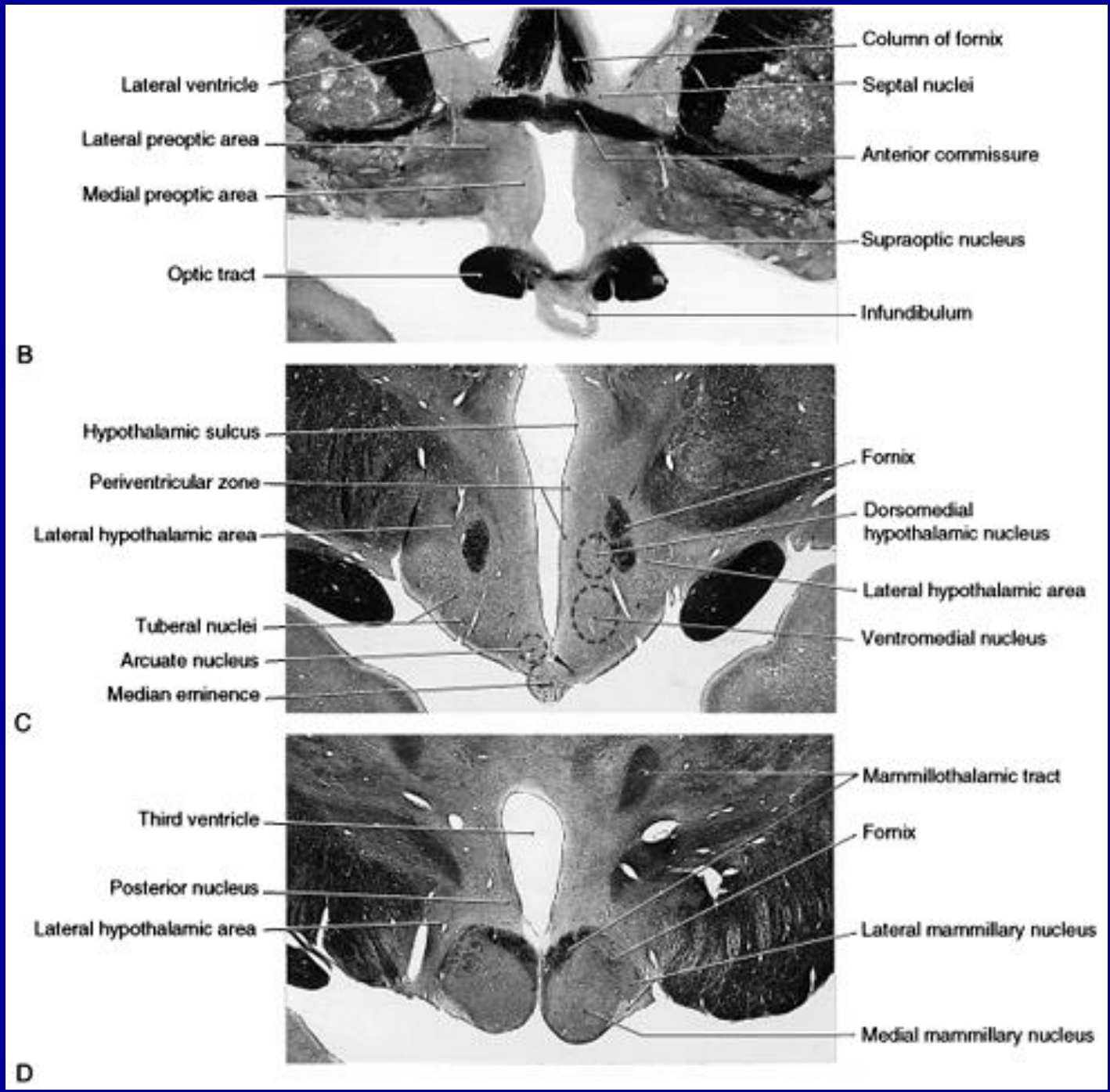
The Hypothalamus

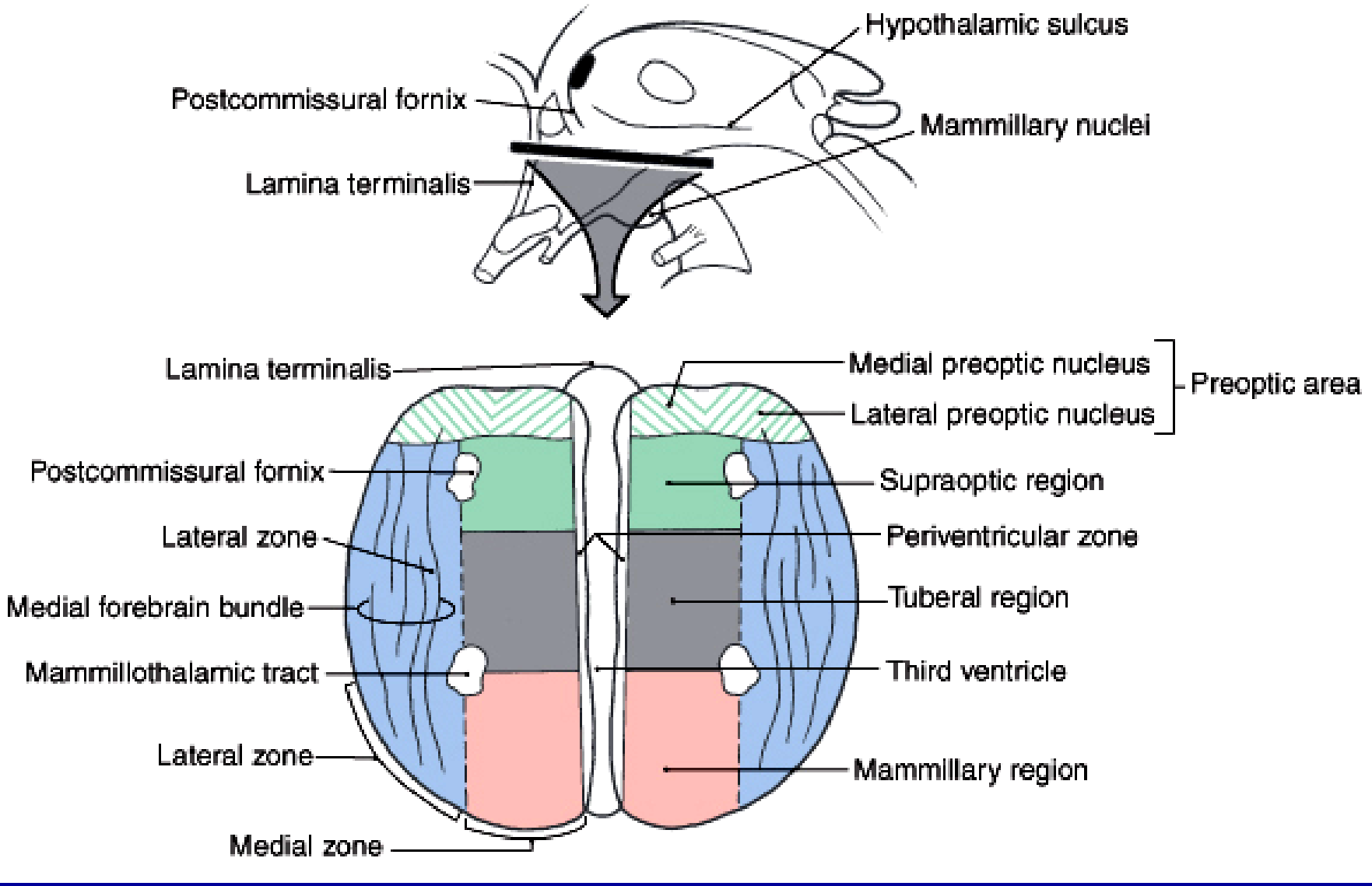

SYSTEMS:
ENVIRONMENT:
Autonomic
(Visceromotor)
Internal
Endocrine
(Humoral)
Limbic
External
(Somatomotor)

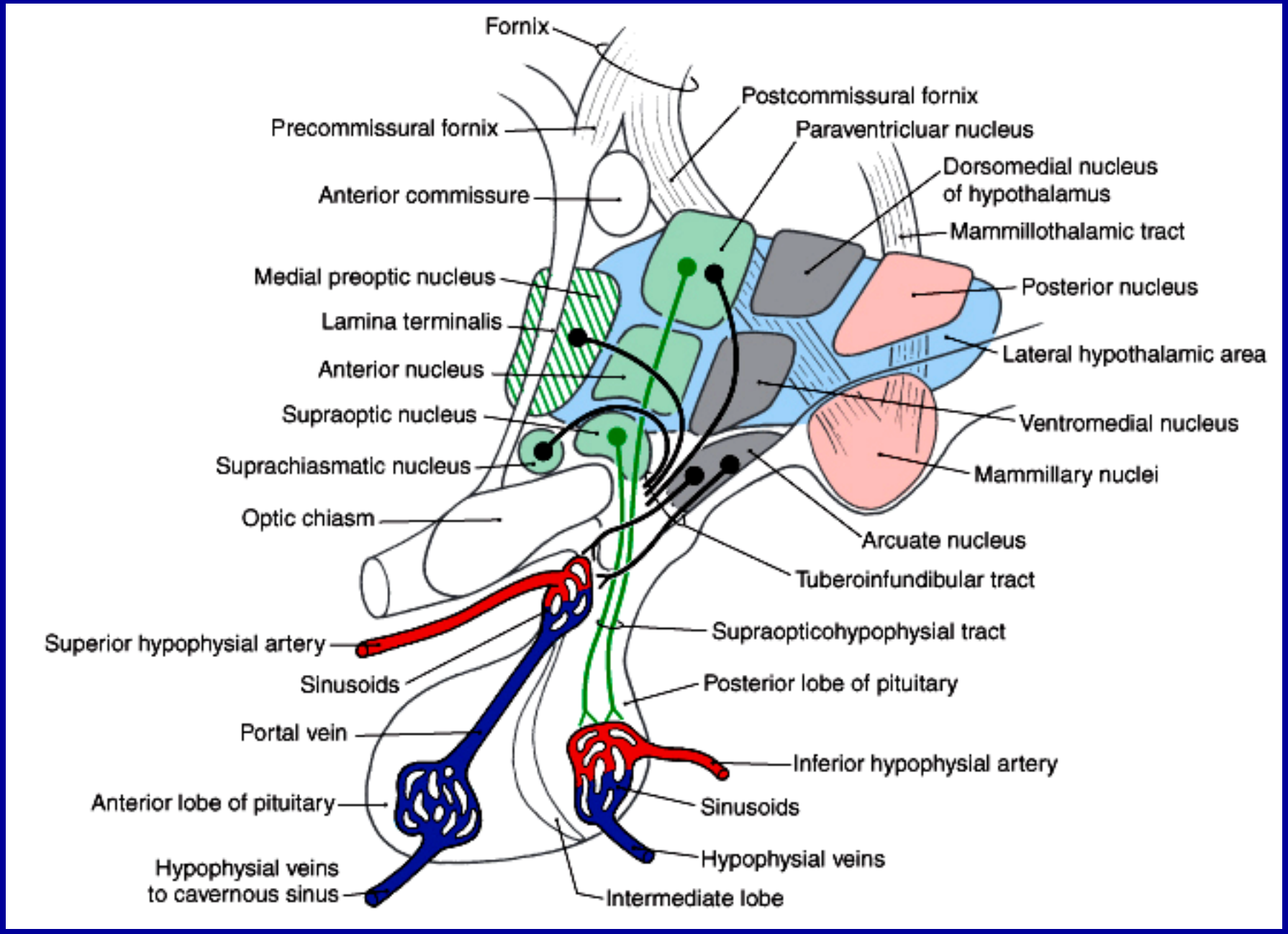
Functions of hypothalamus

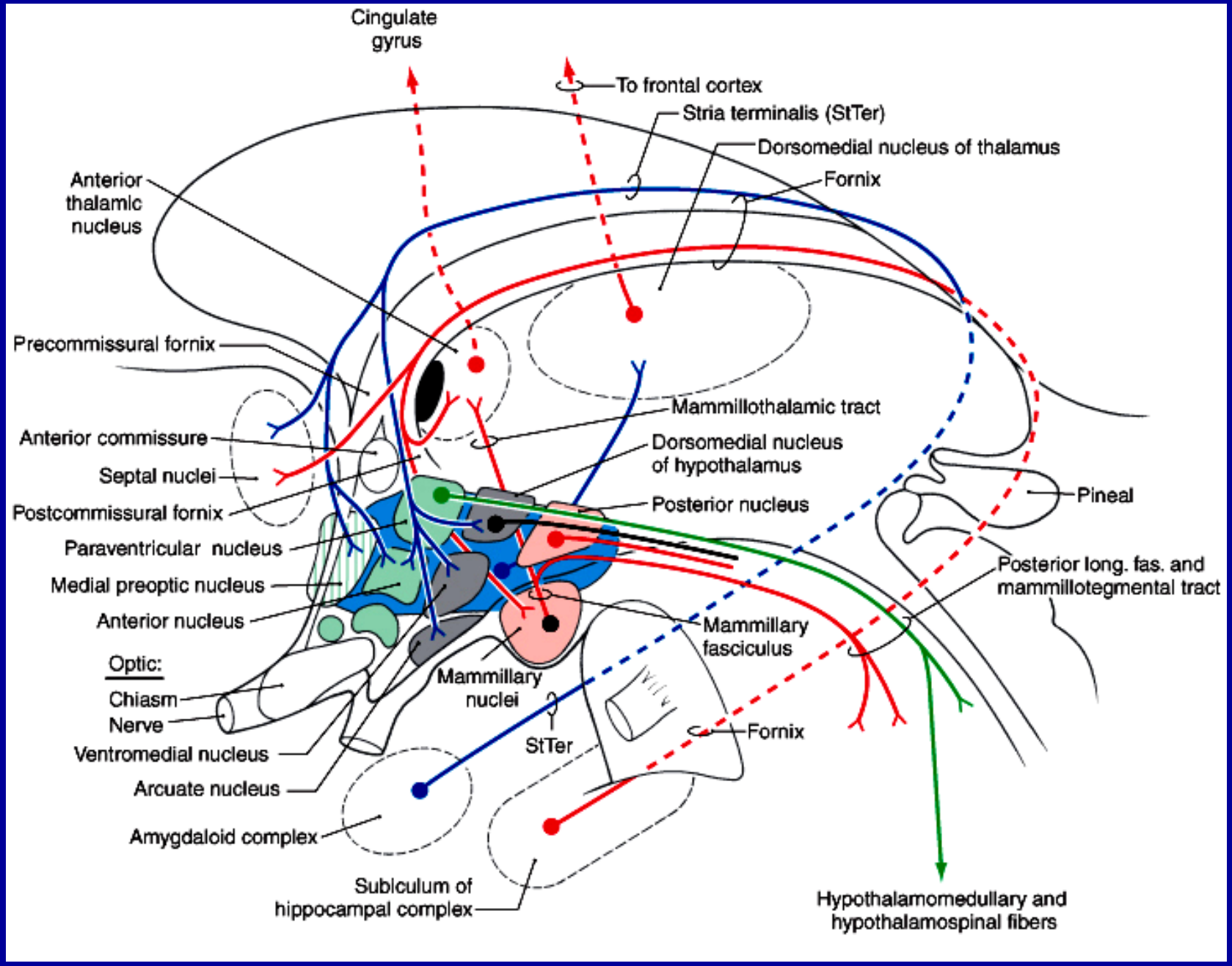
- Endocrine function
- Caloric balance
- Osmolarity balance
- Thermal regulation
- Autonomic balance
- Sleep
- Affective behavior
- Memory
- Somatic movements

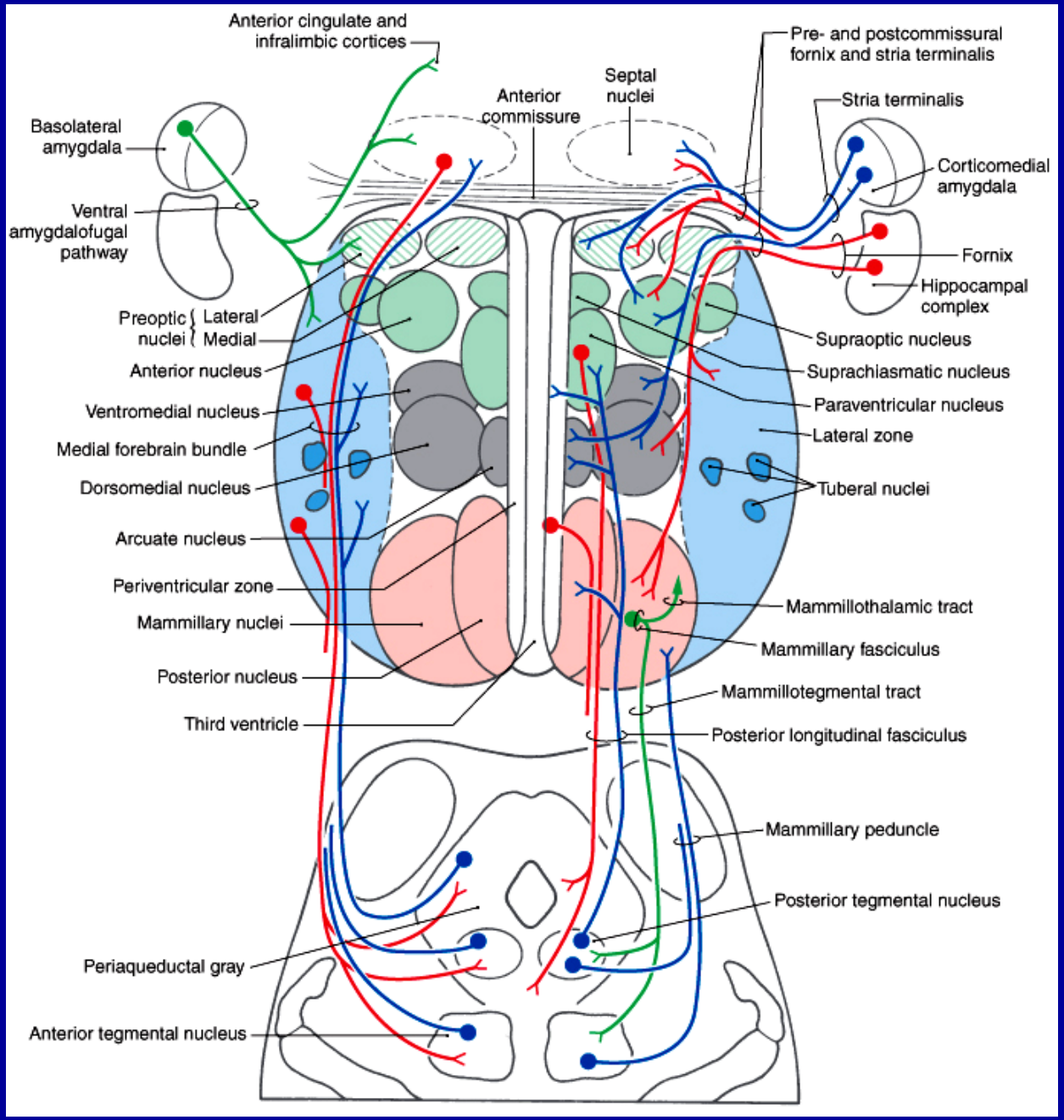

Precommissural fornix
Anterior commissure
Lamina terminalis
Optic chiasm
Infundibulum
B
C
D
Postcommissural fornix
Massa intermedia
Hypothalamic sulcus
Mammillary body
A

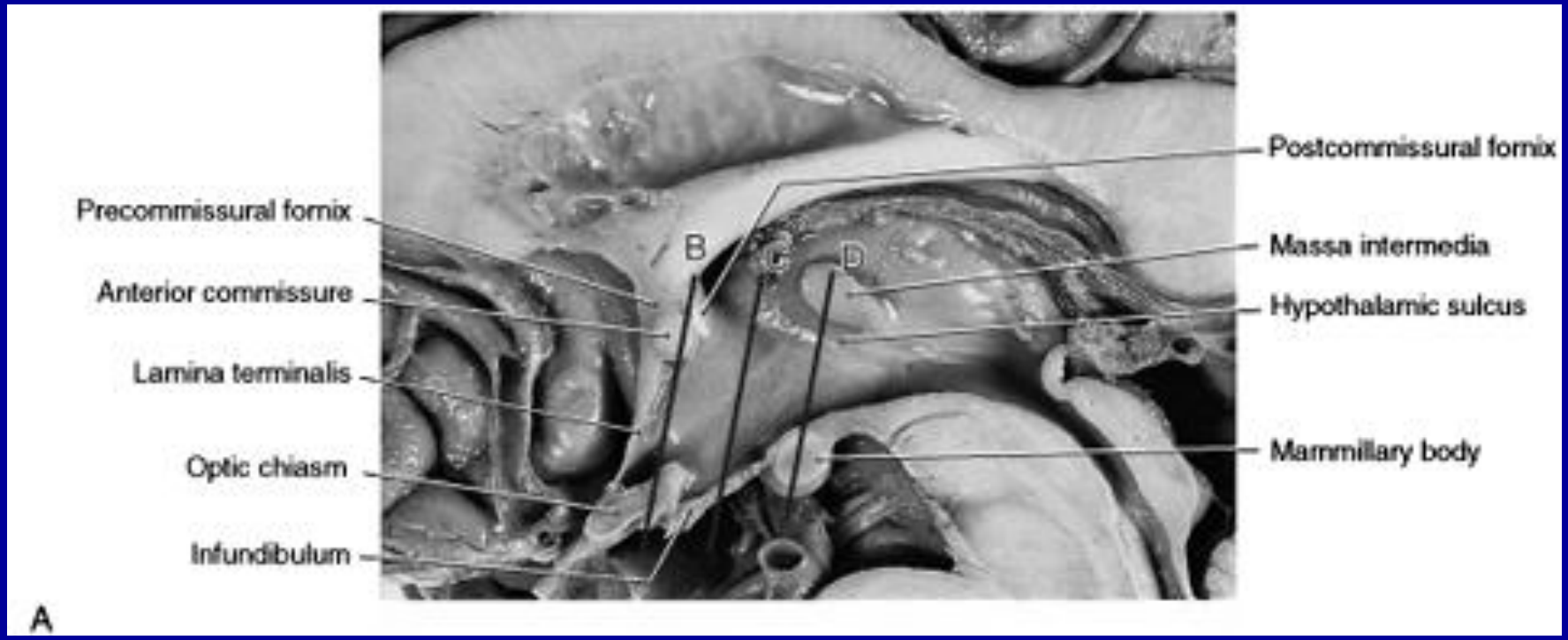

Lateral ventricle
Lateral preoptic area
Medial preoptic area
Optic tract
Column of fornix
Septal nuclei
Anterior commissure
Supraoptic nucleus
Infundibulum
B
Hypothalamic sulcus
Periventricular zone
Lateral hypothalamic area
Tuberal nuclei
Arcuate nucleus
Median eminence
Fornix
Dorsomedial hypothalamic nucleus
Lateral hypothalamic area
Ventromedial nucleus
C
Third ventricle
Posterior nucleus
Lateral hypothalamic area
Mammillothalamic tract
Fornix
Lateral mammillary nucleus
Medial mammillary nucleus
D


Hypothalamic sulcus
Postcommissural fornix
Mammillary nuclei
Lamina terminalis
Lamina terminalis
Medial preoptic nucleus
Preoptic area
Lateral preoptic nucleus
Postcommissural fornix
Supraoptic region
Lateral zone
Periventricular zone
Medial forebrain bundle
Tuberal region
Mammillothalamic tract
Third ventricle
Lateral zone
Mammillary region
Medial zone

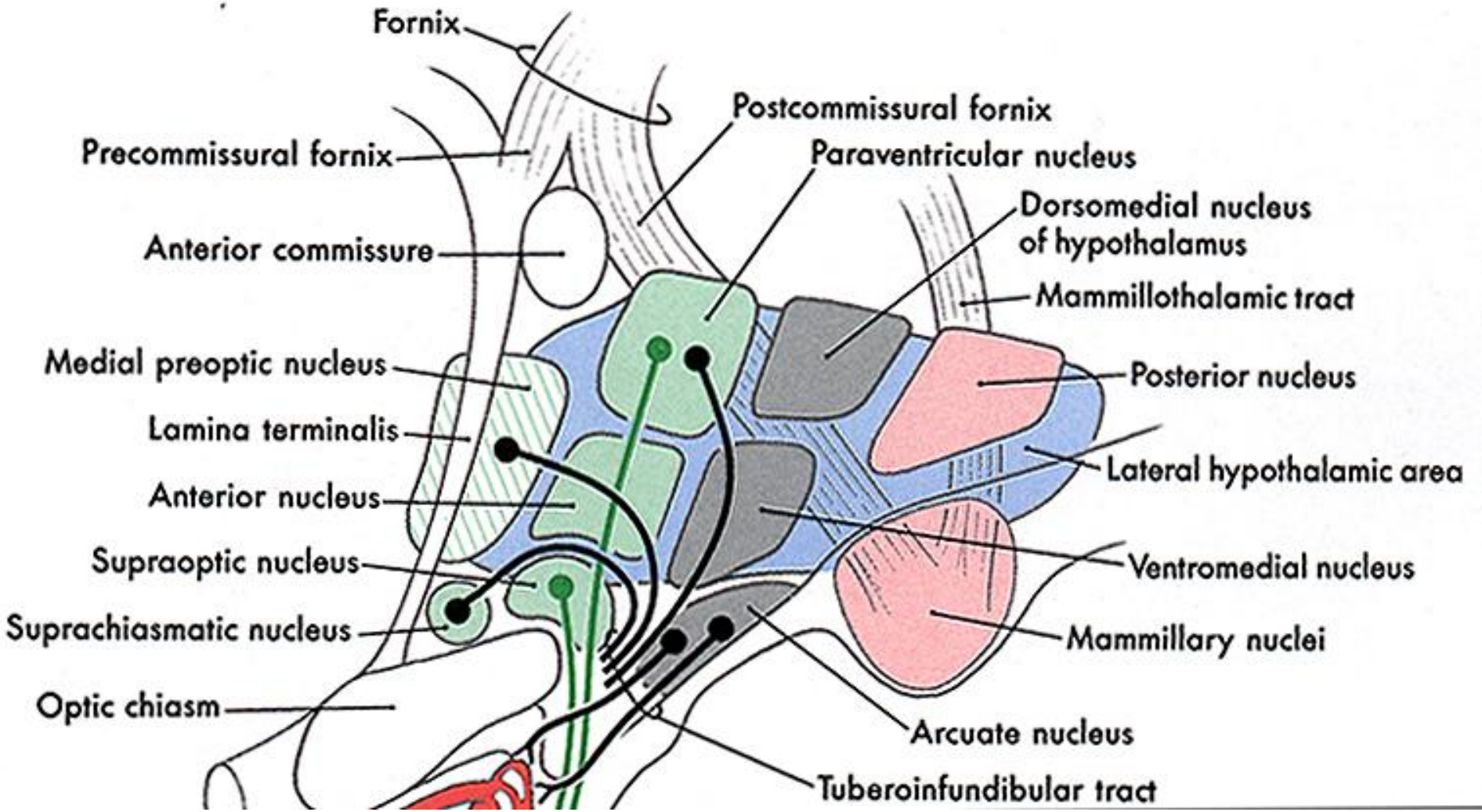

Fornix
Postcommissural fornix
Precommissural fornix
Paraventricluar nucleus
Dorsomedial nucleus of hypothalamus
Anterior commissure
Mammillothalamic tract
Medial preoptic nucleus
Posterior nucleus
Lamina terminalis
Lateral hypothalamic area
Anterior nucleus
Supraoptic nucleus
Ventromedial nucleus
Suprachiasmatic nucleus
Mammillary nuclei
Optic chiasm
Arcuate nucleus
Tuberoinfundibular tract
Supraopticohypophysial tract
Superior hypophysial artery
Sinusoids
Posterior lobe of pituitary
Portal vein
Inferior hypophysial artery
Anterior lobe of pituitary
Sinusoids
Hypophysial veins
Hypophysial veins to cavernous sinus
Intermediate lobe


Cingulate gyrus
To frontal cortex
Stria terminalis (StTer)
Dorsomedial nucleus of thalamus
Fornix
Anterior thalamic nucleus
Precommissural fornix
Mammillothalamic tract
Anterior commissure
Dorsomedial nucleus of hypothalamus
Septal nuclei
Pineal
Postcommissural fornix
Posterior nucleus
Paraventricular nucleus
Posterior long. fas. and mammillotegmental tract
Medial preoptic nucleus
Anterior nucleus
Mammillary fasciculus
Optic:
Chiasm
Nerve
Mammillary nuclei
StTer
Fornix
Ventromedial nucleus
Arcuate nucleus
Amygdaloid complex
Subiculum of hippocampal complex
Hypothalamomedullary and hypothalamospinal fibers


Anterior cingulate and infralimbic cortices
Pre- and postcommissural fornix and stria terminalis
Septal nuclei
Anterior commissure
Stria terminalis
Basolateral amygdala
Corticomedial amygdala
Ventral amygdalofugal pathway
Fornix
Hippocampal complex
Preoptic nuclei
Lateral
Medial
Supraoptic nucleus
Anterior nucleus
Suprachiasmatic nucleus
Ventromedial nucleus
Paraventricular nucleus
Medial forebrain bundle
Lateral zone
Dorsomedial nucleus
Tuberal nuclei
Arcuate nucleus
Periventricular zone
Mammillothalamic tract
Mammillary nuclei
Mammillary fasciculus
Posterior nucleus
Mammillotegmental tract
Third ventricle
Posterior longitudinal fasciculus
Mammillary peduncle
Posterior tegmental nucleus
Periaqueductal gray
Anterior tegmental nucleus

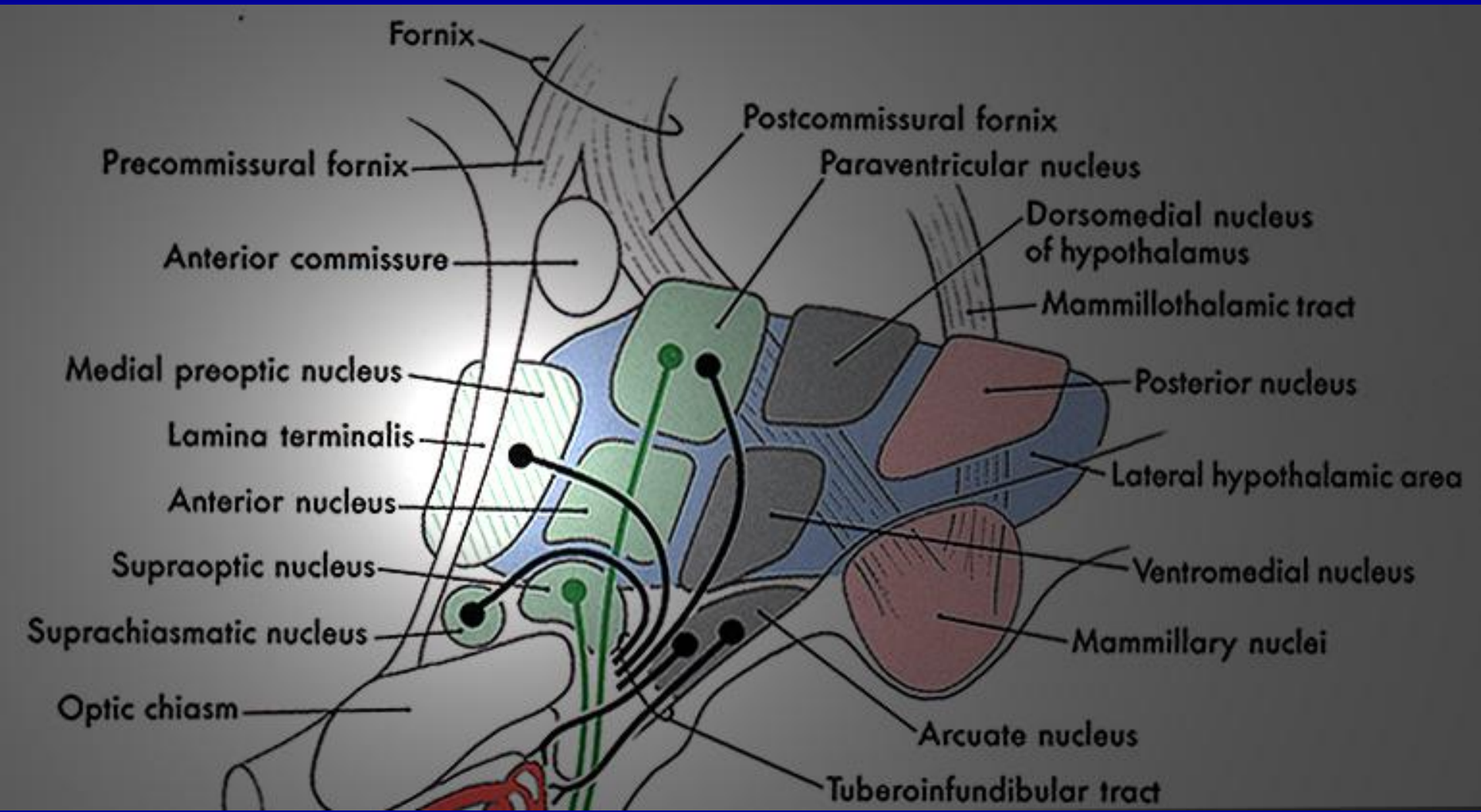

Precommissural fornix
Anterior commissure
Lamina terminalis
Optic chiasm
Infundibulum
B
D
Postcommissural fornix
Massa intermedia
Hypothalamic sulcus
Mammillary body
A

Anatomy of Hypothalamus

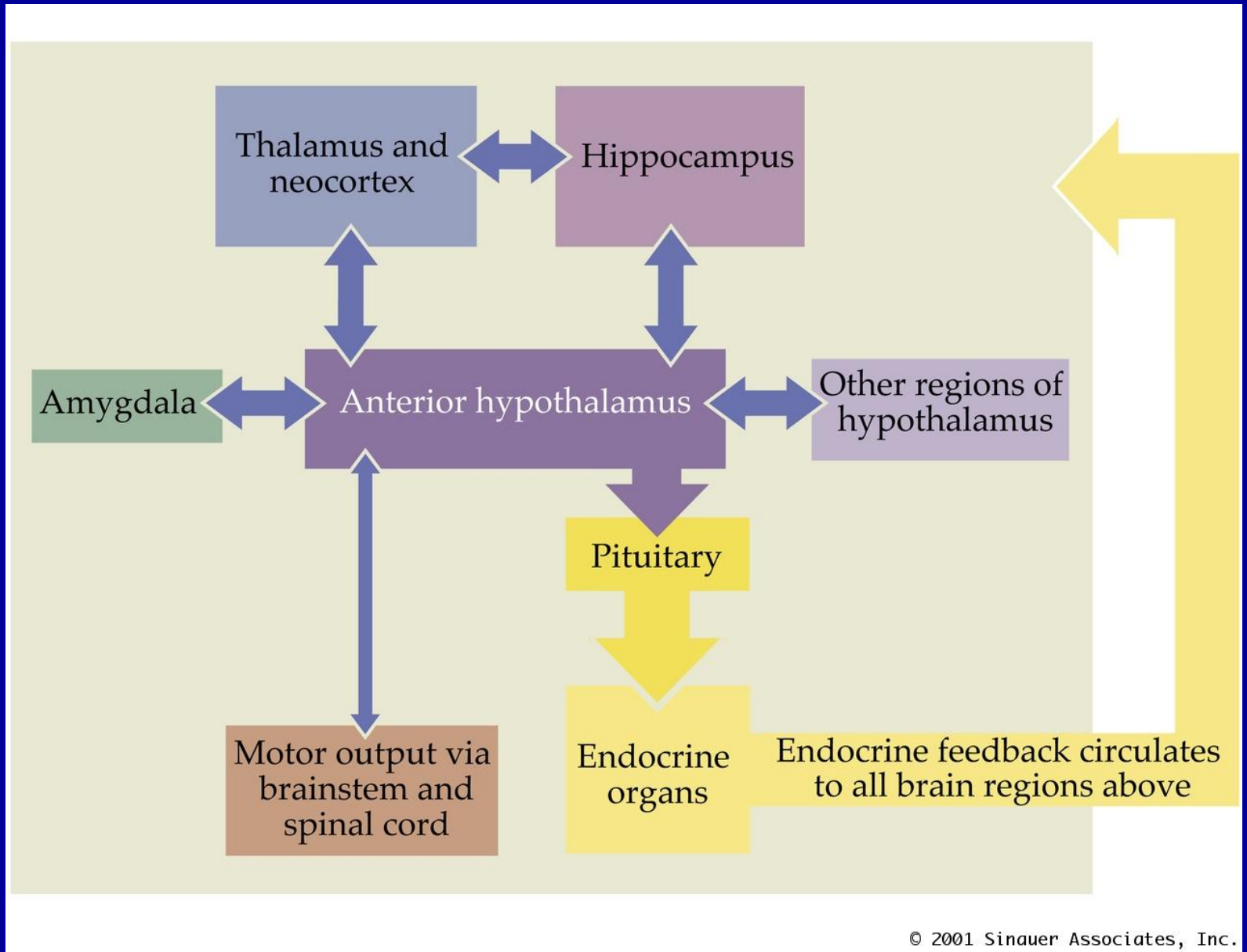


Preoptic area

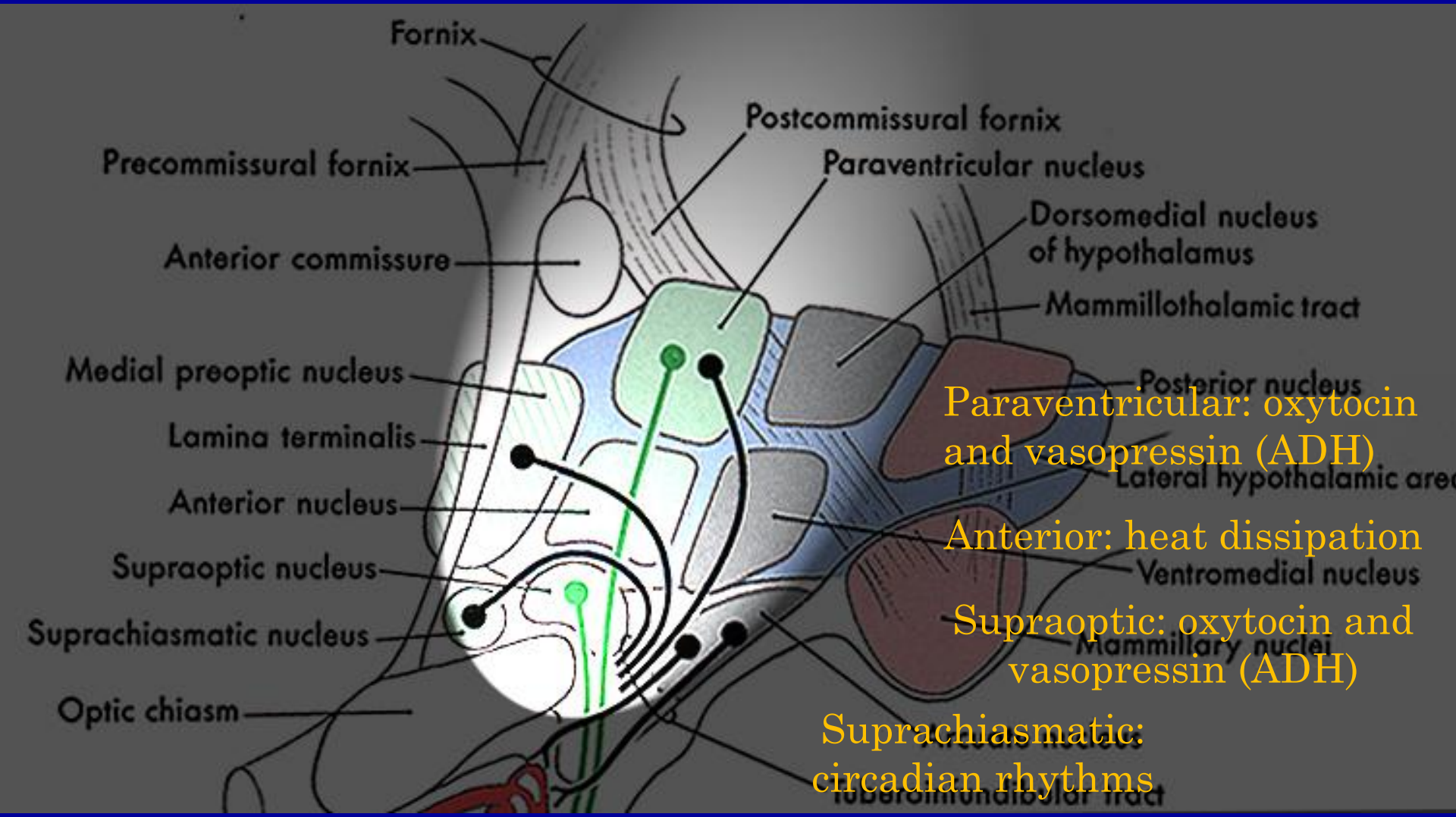
- Medial preoptic: LHRH
- Lateral preoptic: motor control



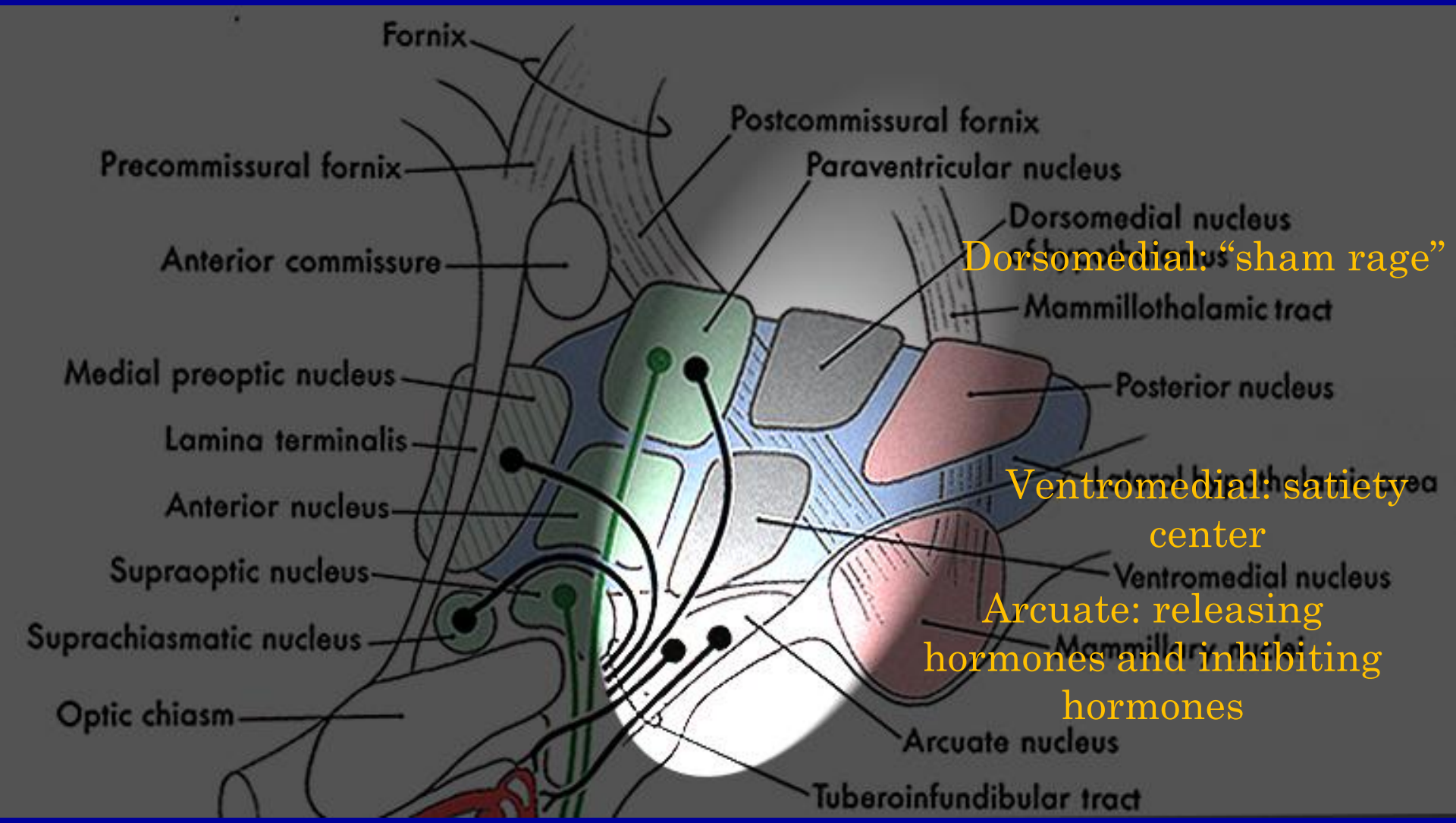
Motor connections of hypothalamus



Supraoptic region



Tuberal region



Dorsomedial: "sham rage"

Ventromedial: satiety center

Arcuate: releasing hormones and inhibiting hormones

Mammillary region

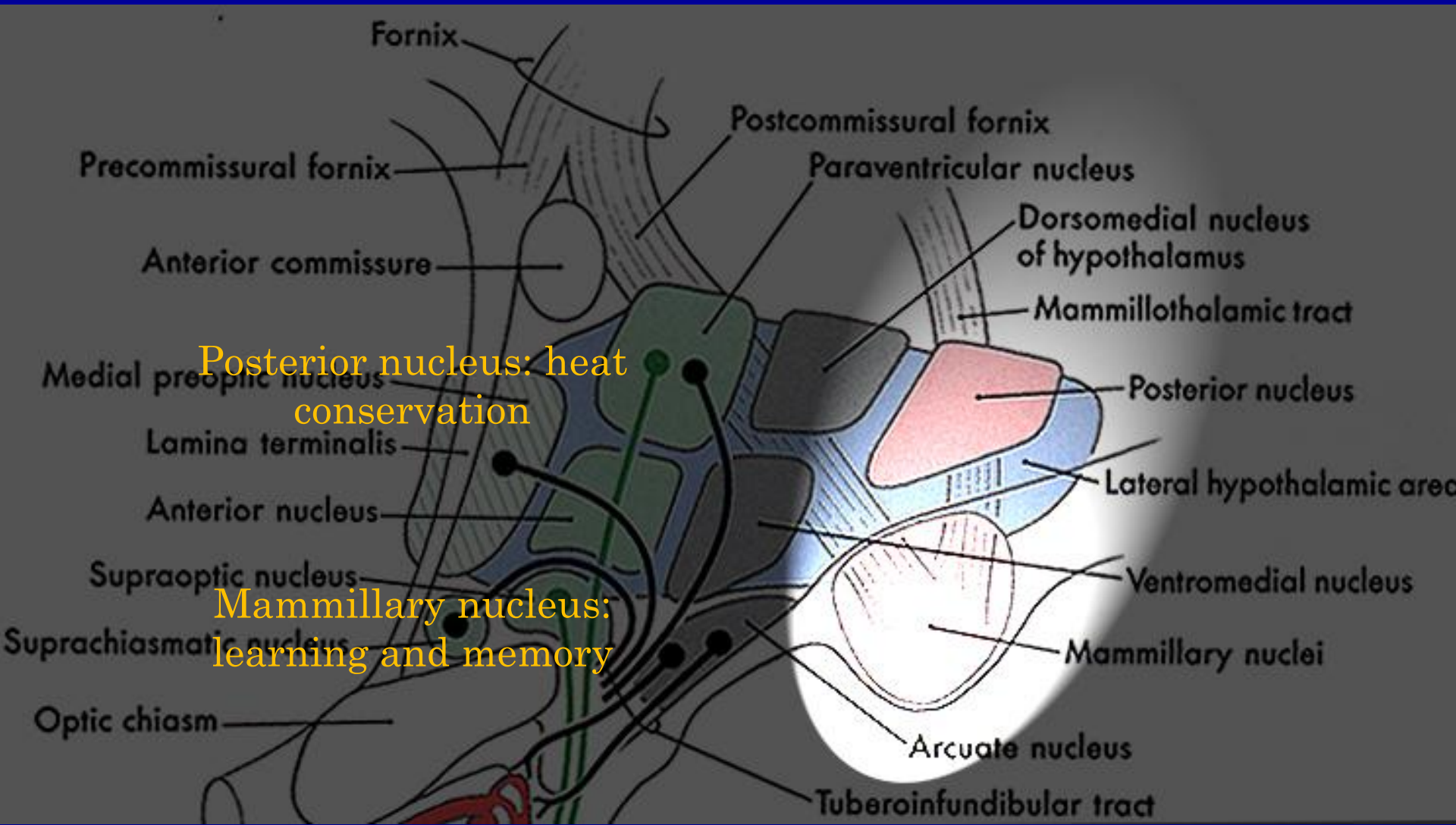


Table 30-1 The Effect of Stimulation or Lesion of the Principal Hypothalamic Nuclei		
Nucleus	**Stimulation of**	**Lesion of**
Suprachia. n.	Adjusts circadian rhythms	Abolishes circadian rhythms
Supraoptic n. Paraventri. n.	Increased blood pressure	Diabetes insipidus
Lat. Hypotha. n.	Increased feeding	Decreased feeding
Ventromedial n.	Decreased feeding	Increased feeding
Dorsomedial n.	Sham rage	Decreased aggression & feeding
Mammillary body	?	Short-term memory is not processed into long-term memory

Plans for Action

(prefrontal cortex)

Functions of the prefrontal cortex:

1) Planning

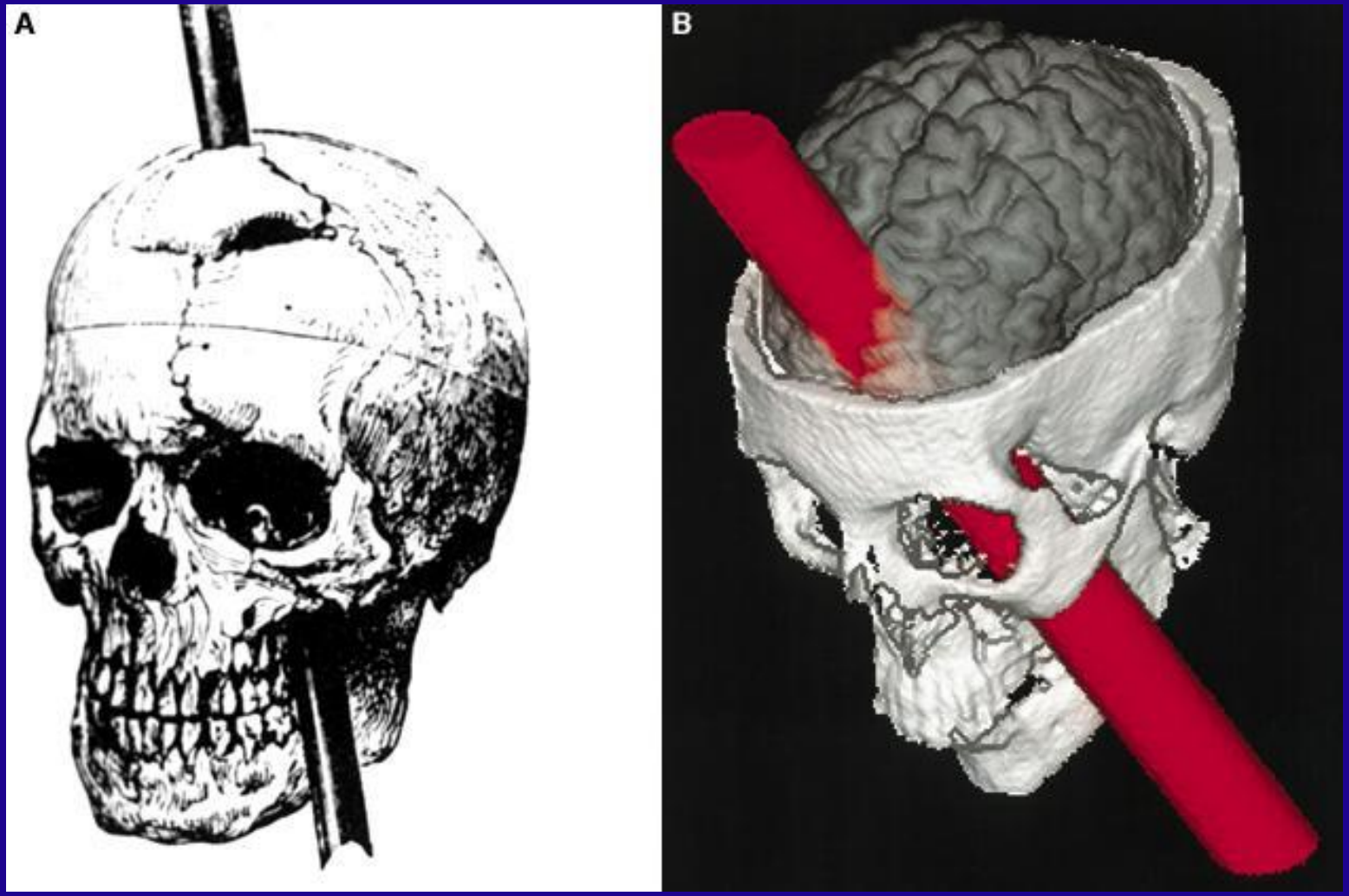
This is the area where volition, thinking ahead, problem solving are located. Before you can have these, and do them flexibly, fluently, adaptively, have to inhibit more primitive, automatic, instinctive behavior patterns; hence

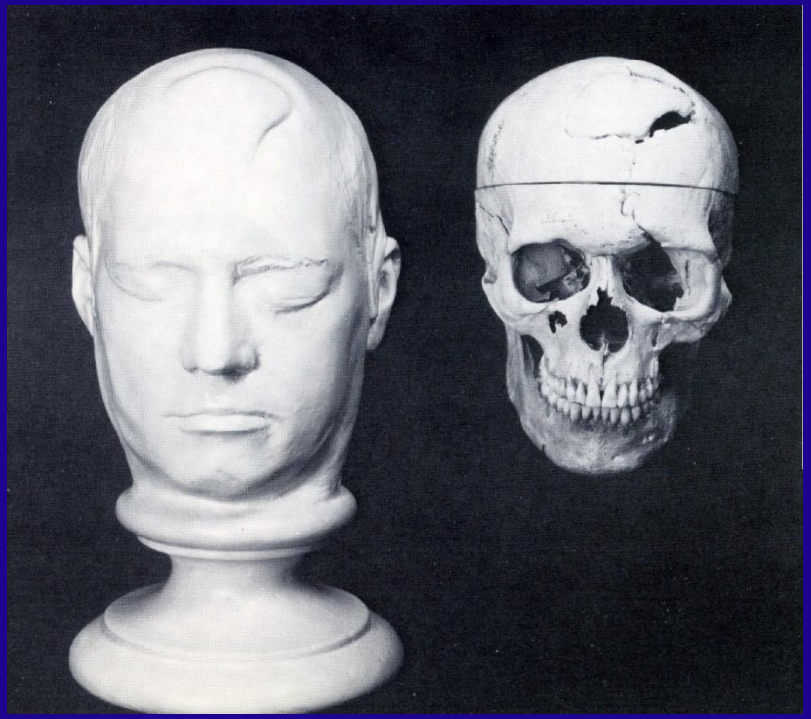
↓

2) Inhibition

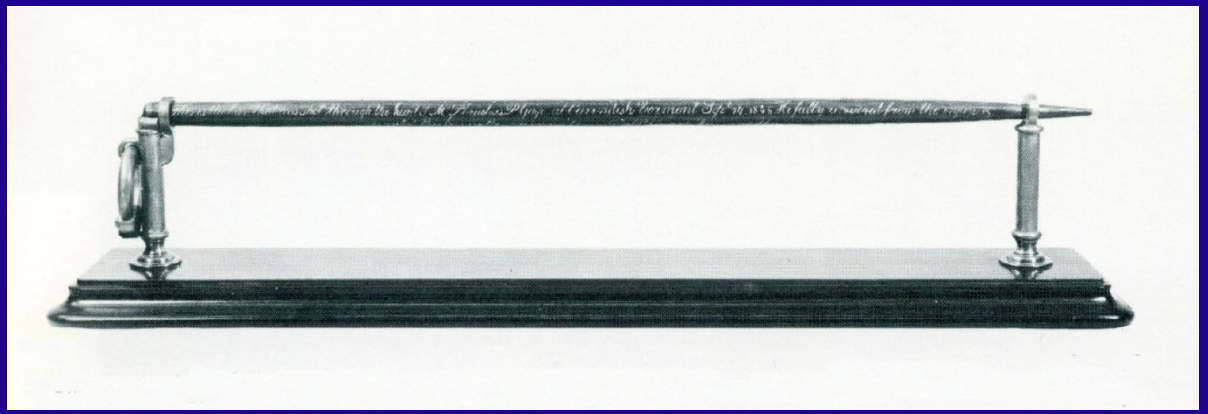
3) Selectivity

'I will do this, I will not do that'


A
B



Phineas Gage




Article from Scien
Clues About the Br
Hanna Damasio, T
Galaburda, and An
Skull of Phineas Gage

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

Sleep

Why Do We Need Sleep?

Adaptive Evolutionary Function

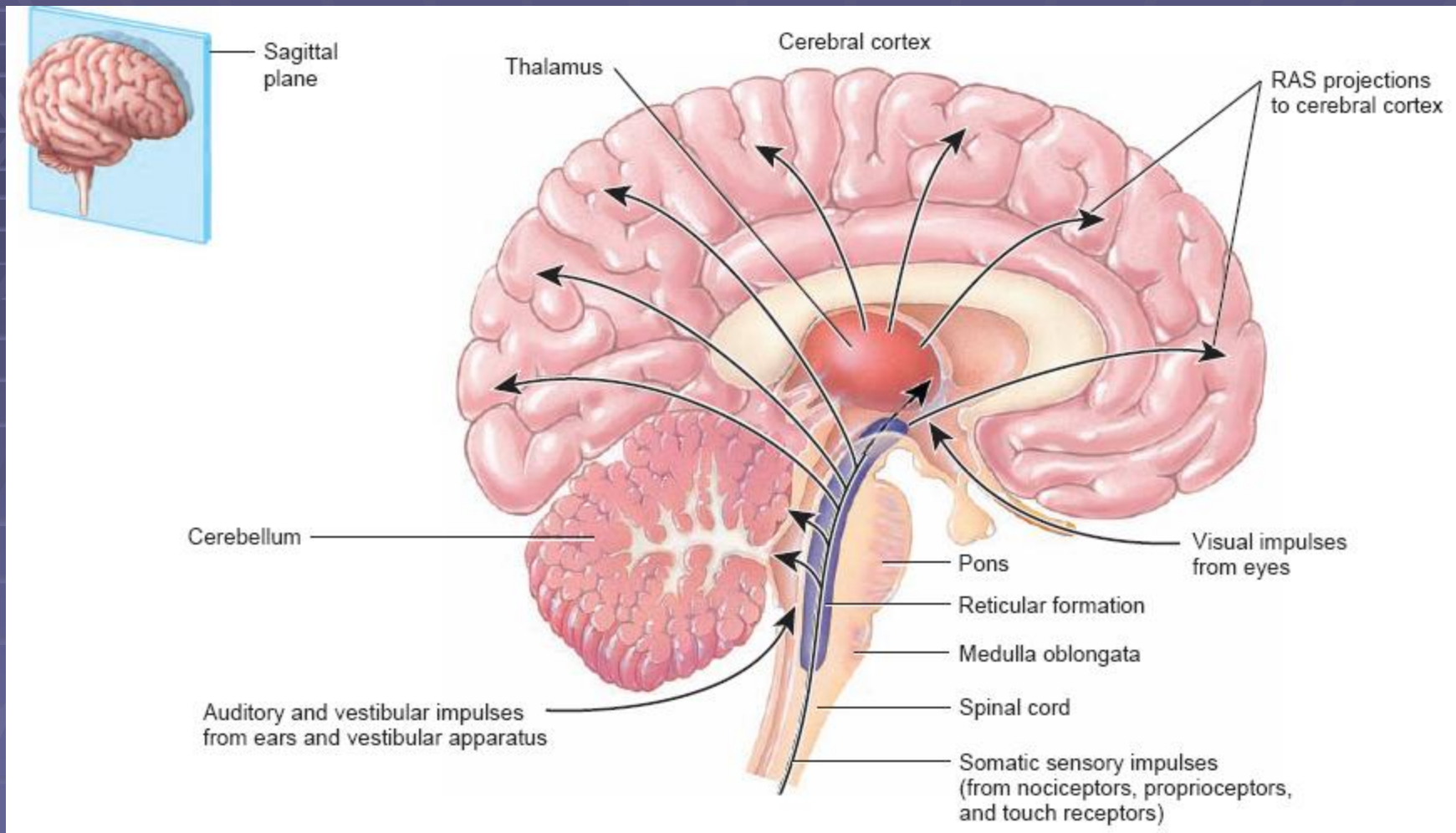
- safety
- energy conservation/ efficiency

Restorative Function

- body rejuvenation & growth

Brain Plasticity

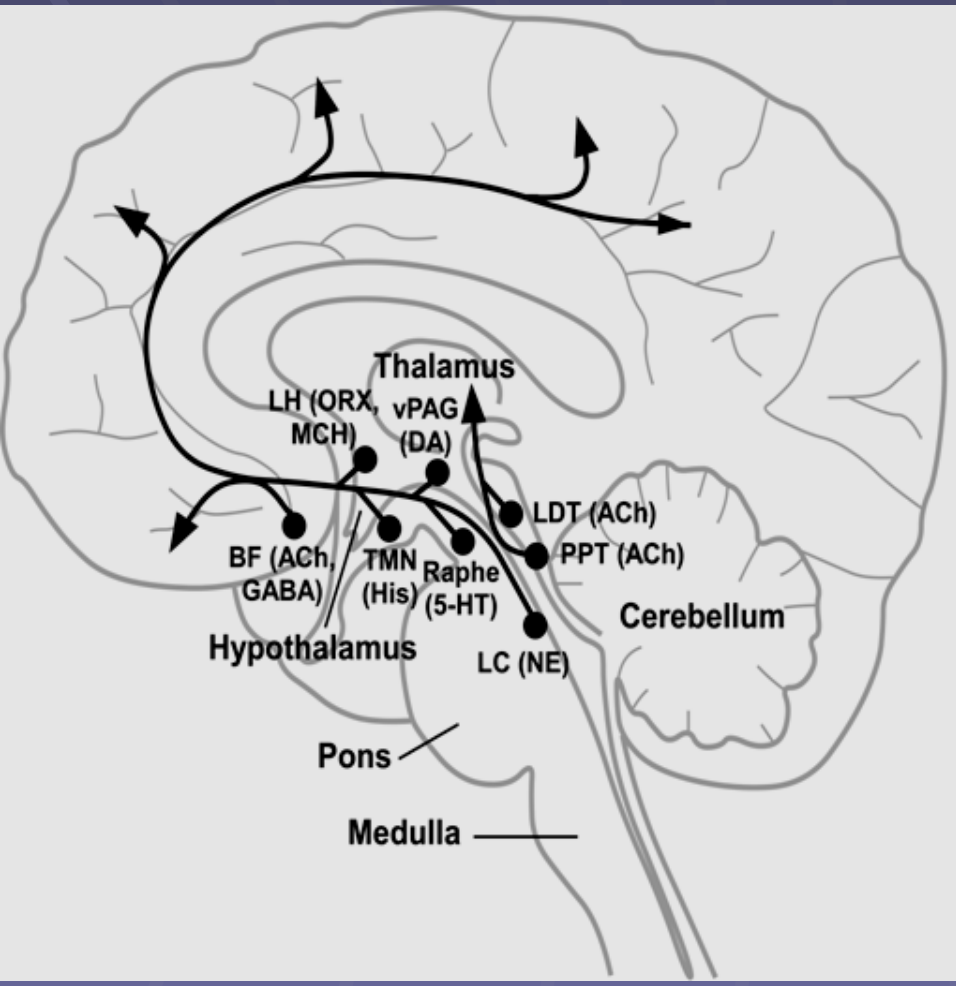
- enhances synaptic connections
- memory consolidation



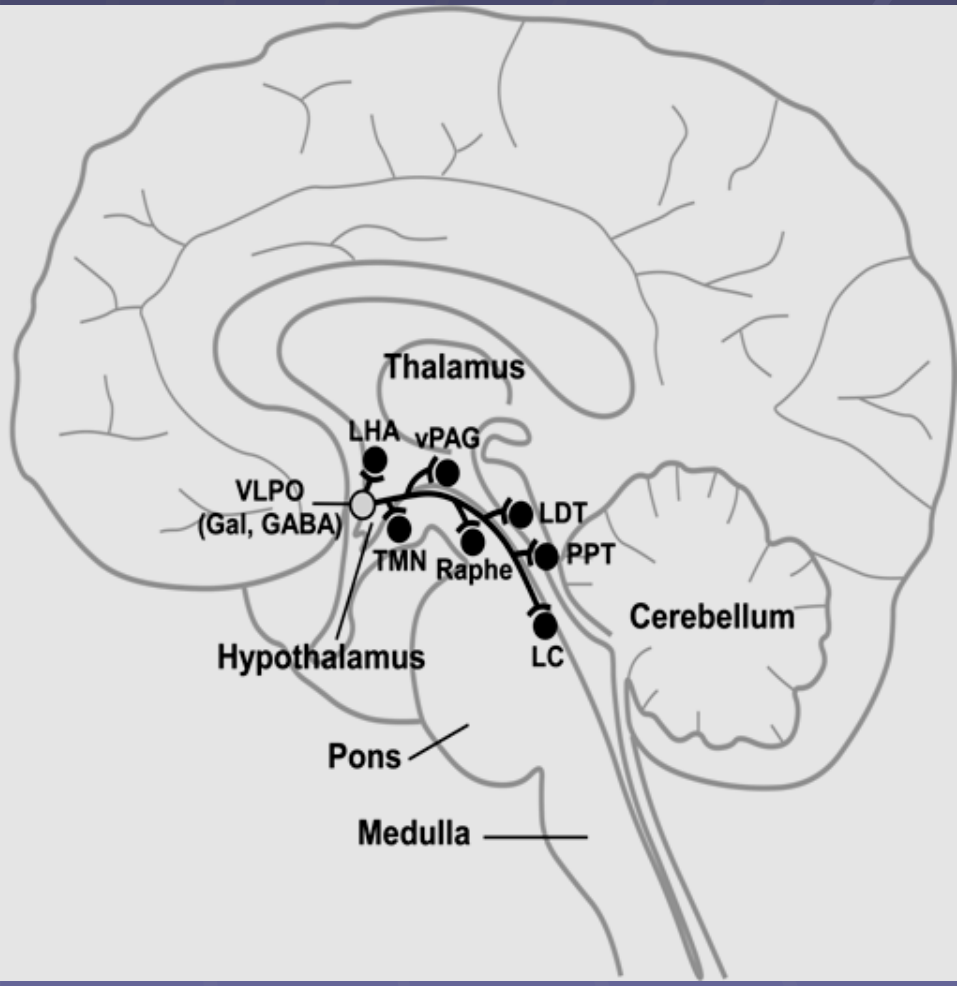
Sagittal section through brain and spinal cord

The ascending arousal system promotes wake

A.

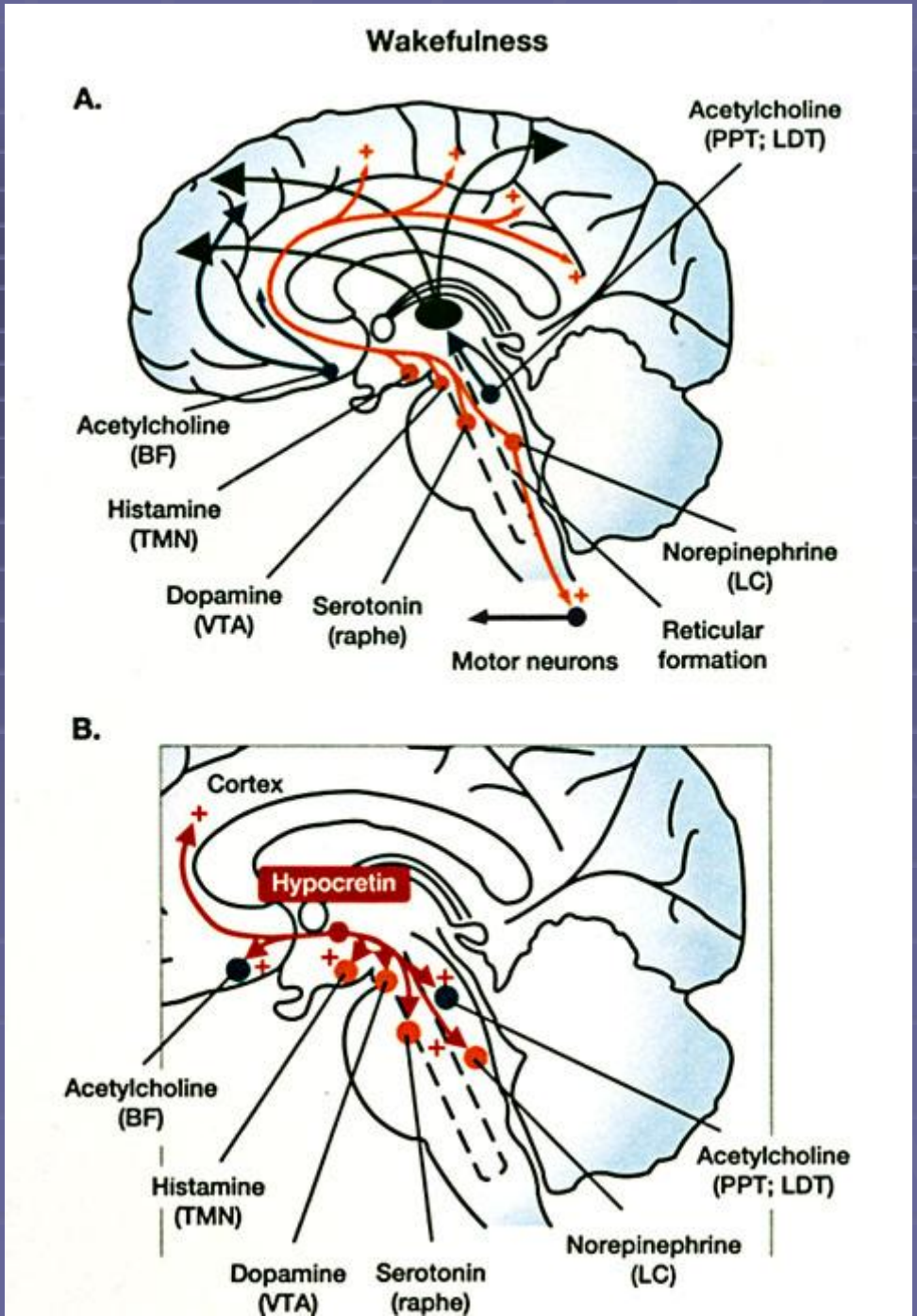


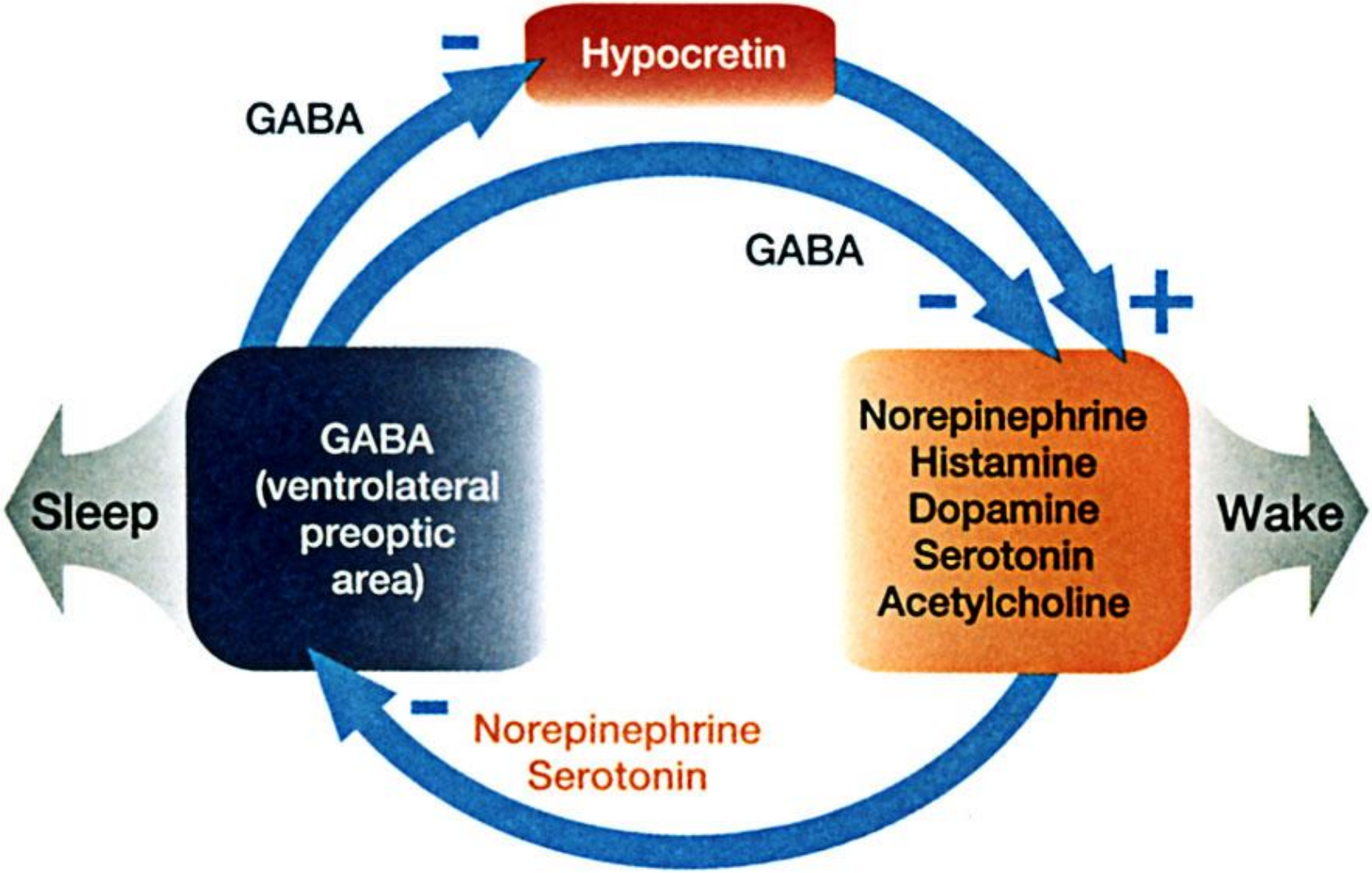
B.



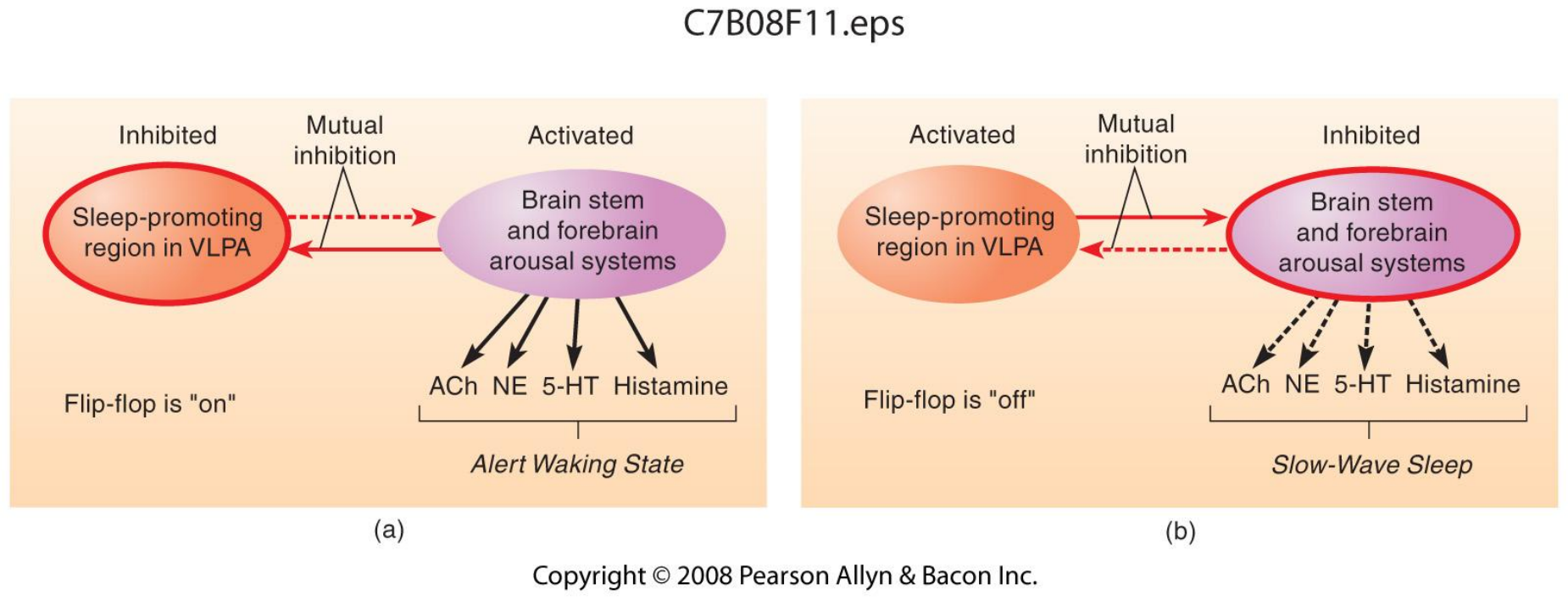
Modified from Fuller et al., J Biol Rhythms, 2006

Hypocreatin (orexin)

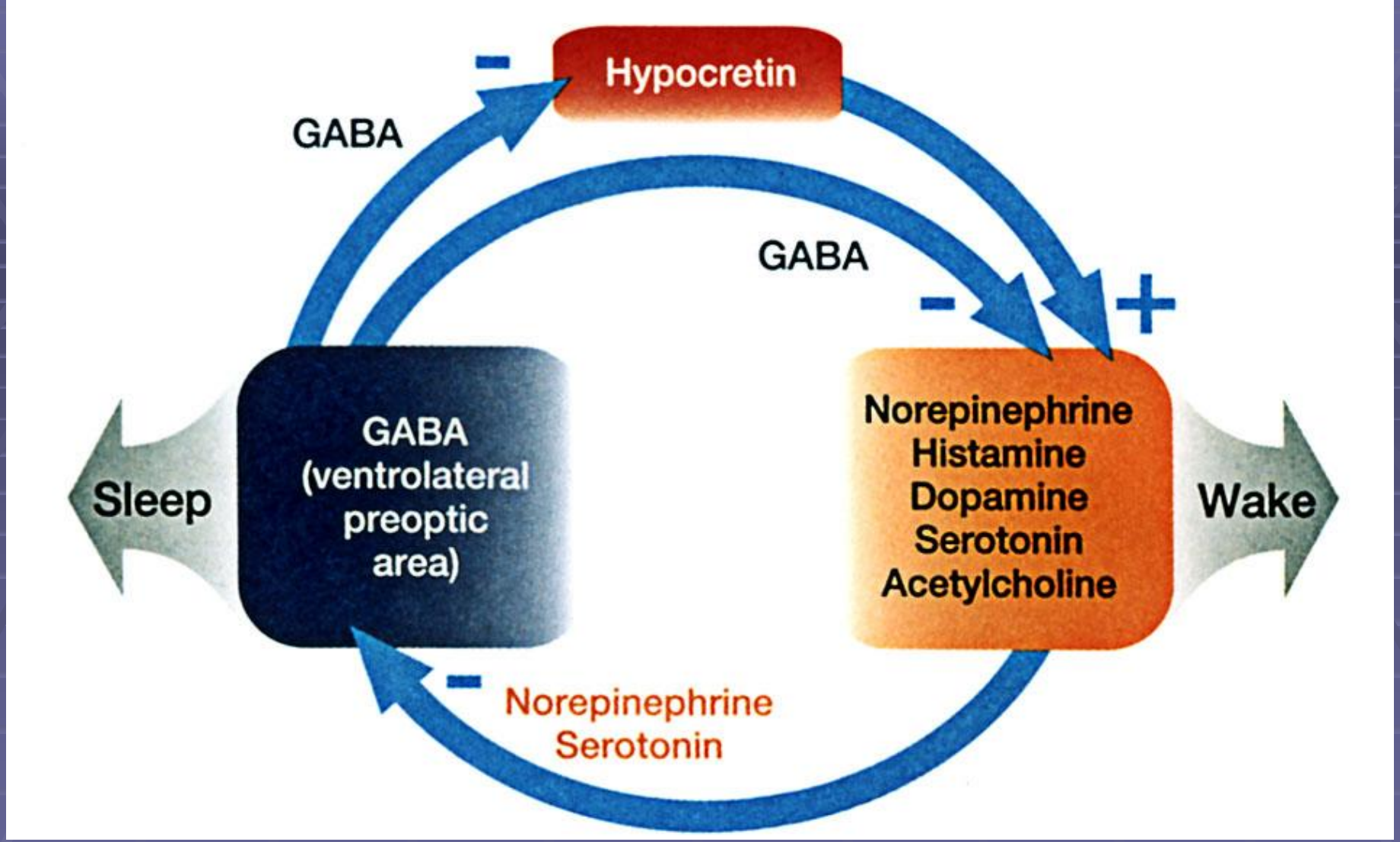



Hypocretin
GABA
GABA
Sleep
GABA
(ventrolateral
preoptic
area)
Norepinephrine
Histamine
Dopamine
Serotonin
Acetylcholine
Wake
Norepinephrine
Serotonin

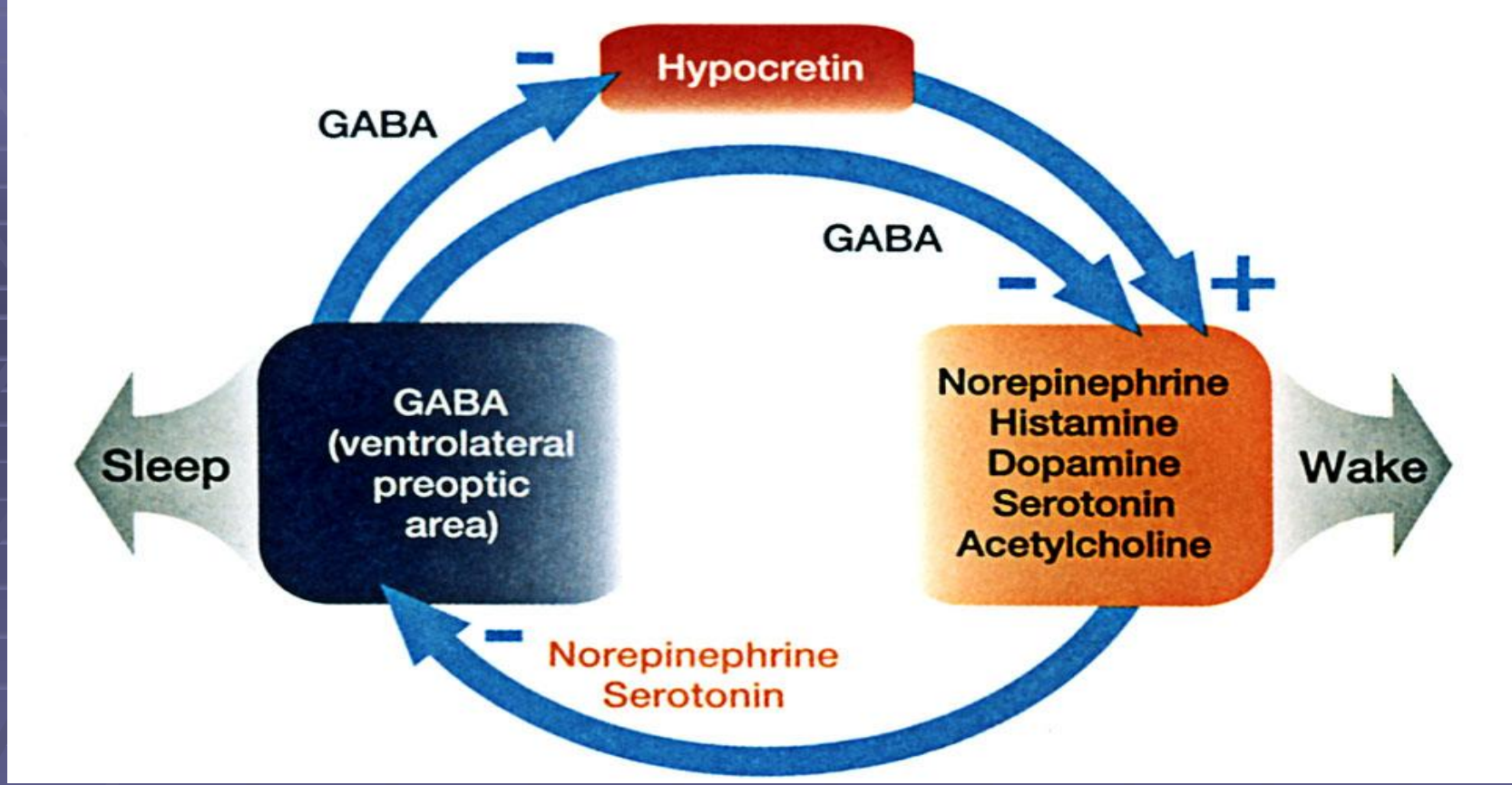
Sleep/Waking "Flip-Flop"



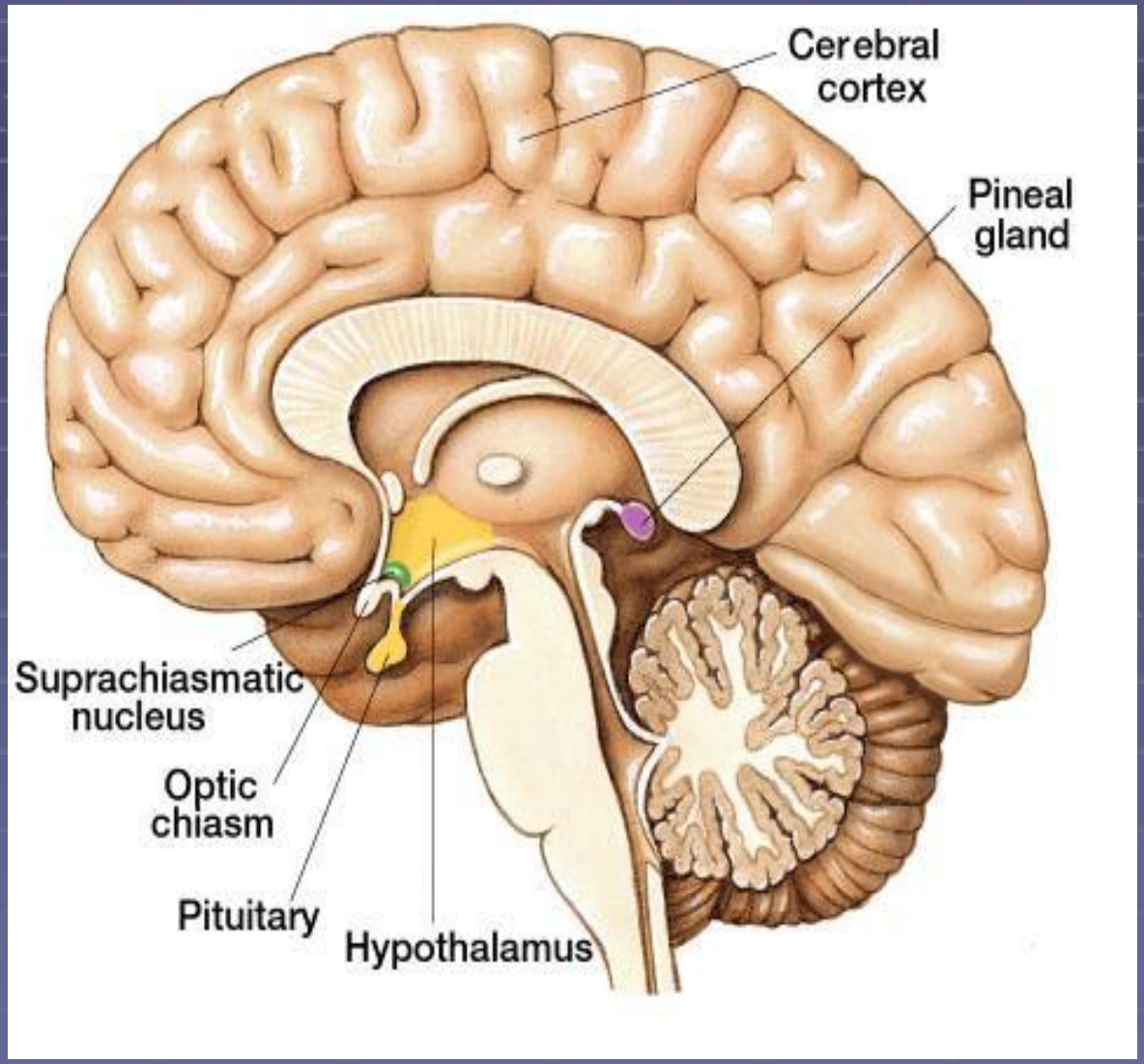
vlPOA= ventrolateral preoptic area
ACh = acetylcholine
NE = norepinephrine
5-HT = serotonin



Narcolepsy VS Insomnia

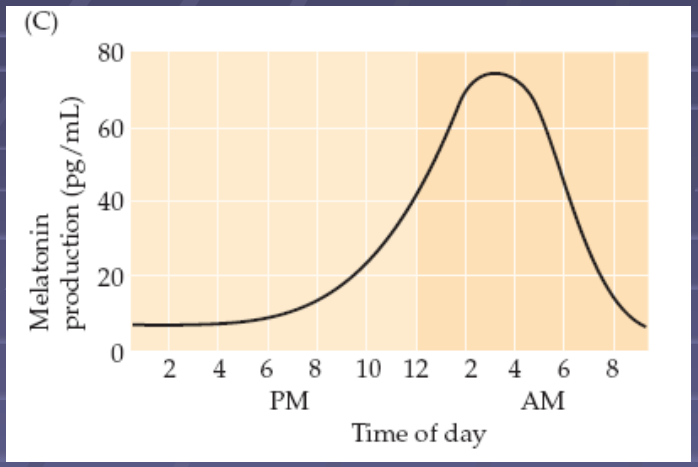


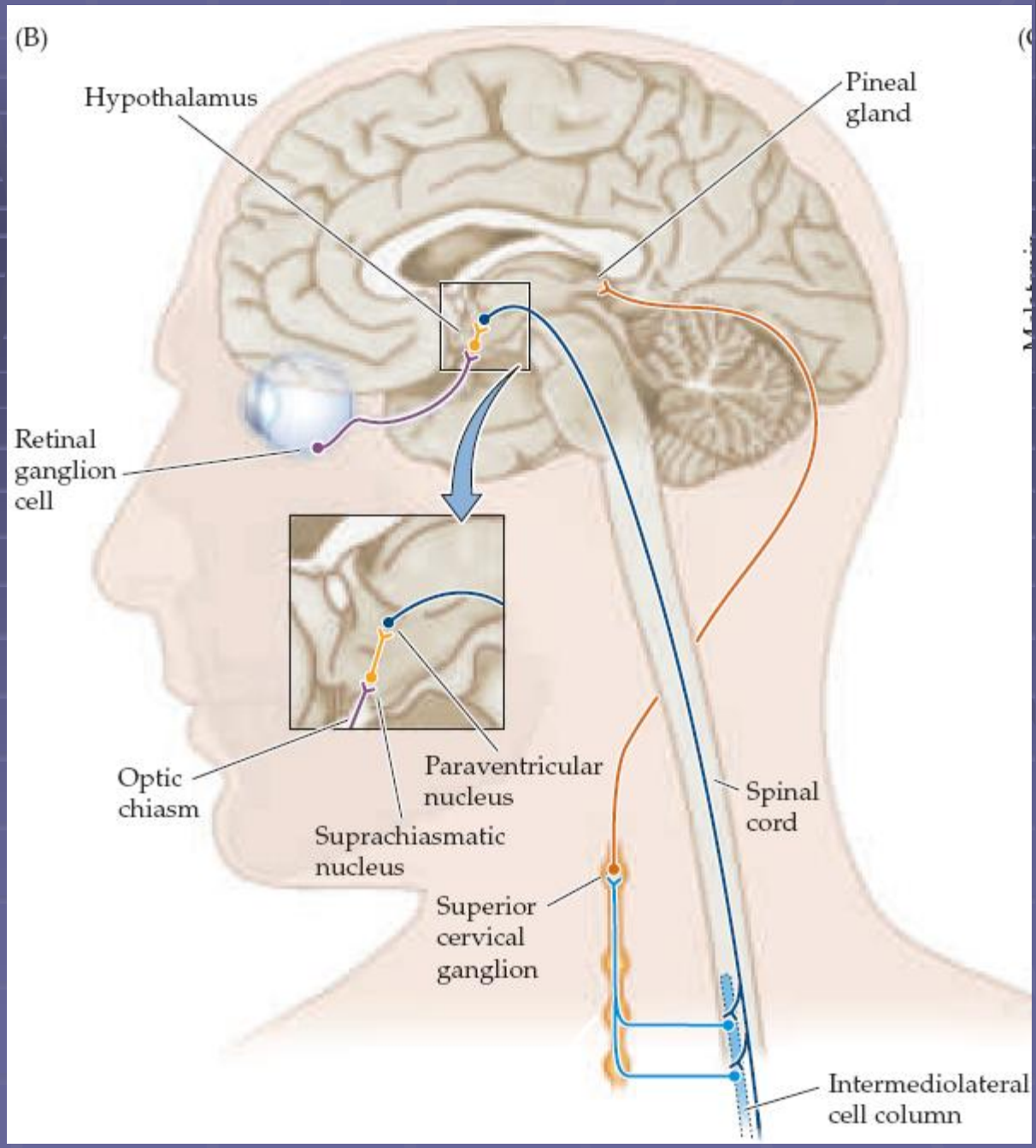
Melatonin: Produced by pineal gland, released at night-inhibited during the day (circadian regulation); initiates and maintain sleep; treat symptoms of jet lag and insomnia


Cerebral cortex
Pineal gland
Suprachiasmatic nucleus
Optic chiasm
Pituitary
Hypothalamus

Biological Clocks

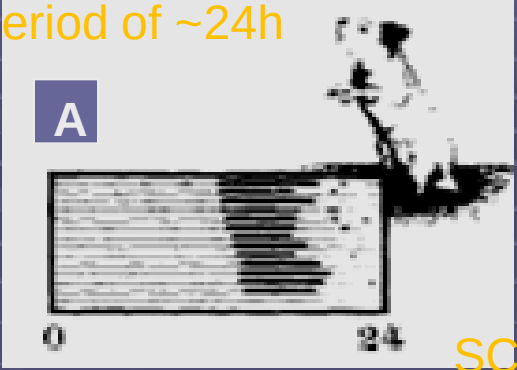
- Suprachiasmatic nucleus
  - A nucleus situated atop the optic chiasm responsible for organizing circadian rhythms.
- Pineal gland
  - A gland attached to the dorsal tectum; produces melatonin and plays a role in circadian and seasonal rhythms.


(C)
Melatonin production (pg/mL)
80
60
40
20
0
2 4 6 8 10 12 2 4 6 8
PM
AM
Time of day

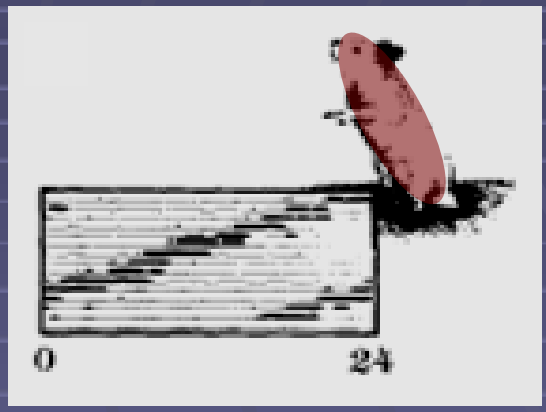

(B)
Hypothalamus
Pineal gland
Retinal ganglion cell
Optic chiasm
Paraventricular nucleus
Suprachiasmatic nucleus
Spinal cord
Superior cervical ganglion
Intermediolateral cell column

SCN and sleep

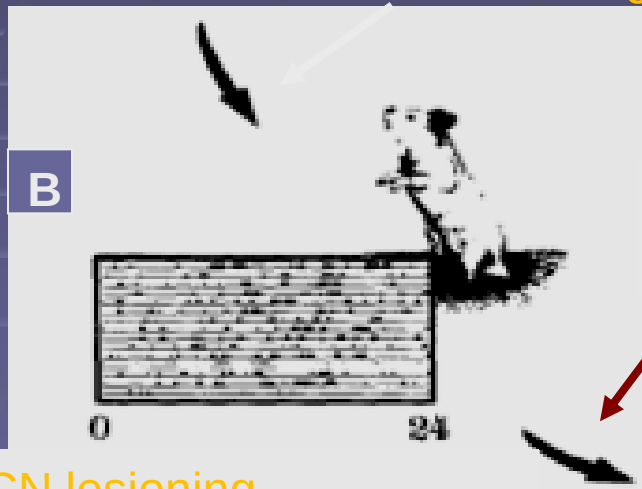
Wild type animal
with period of ~24h



Tau mutant
with period of ~20h



SCN lesioning



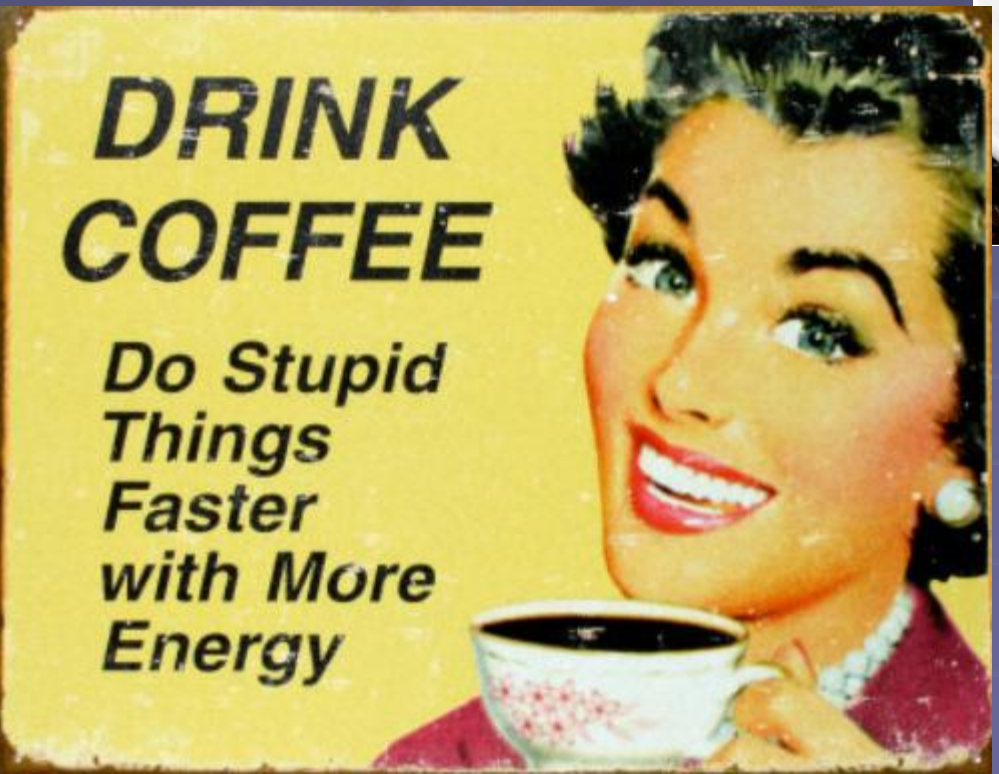
SCN lesioning
abolishes circadian rhythm

Transplanting SCN
of donor with ~20-h period

Wild type animal acquires
period of donor (~20h)

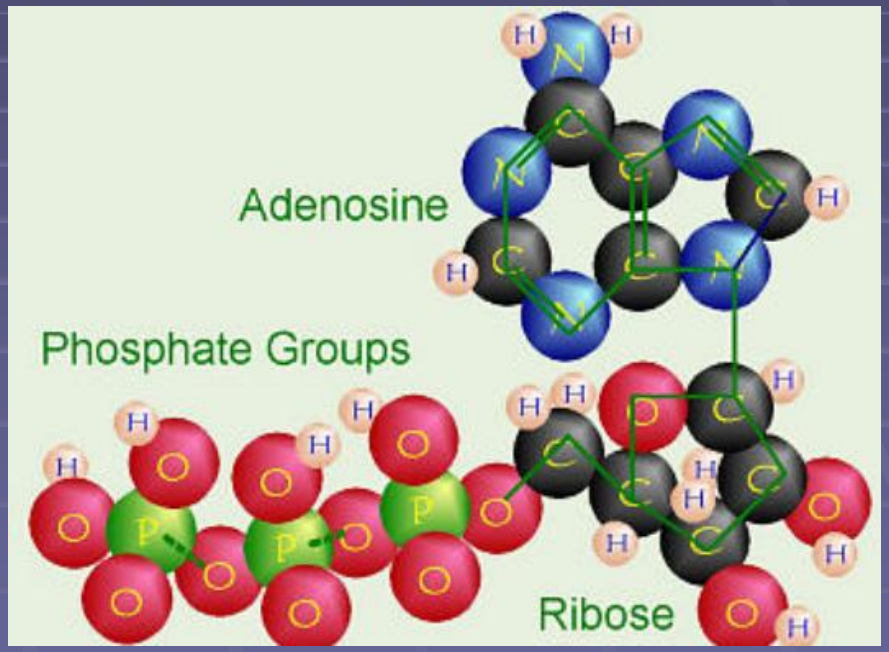
Modified from Ralph and Lehman, Trends Neuro 1991

Coffee



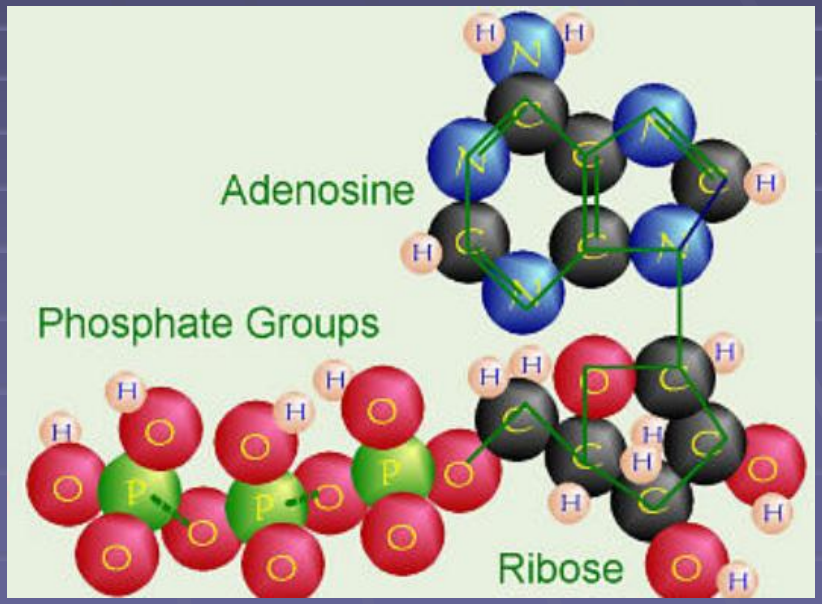
Coffee

- During waking, brain consume ATP



Coffee

- During waking, brain consume ATP
- ↑ adenosine



Coffee

- During waking, brain consume ATP
- ↑ adenosine
- Adenosine bind to A1 receptor
- Inhibit acetylcholine neurons

Coffee

- During waking, brain consume ATP
- ↑ adenosine
- Adenosine bind to A1 receptor
- Inhibit acetylcholine neurons
- Caffeine and Theophylline are A1 antagonist