the hypothalamus

Image https://www.ted.com/topics/motivation

Types of behavior

- Unconscious reflexes and voluntary movements

Voluntary movement—motivation

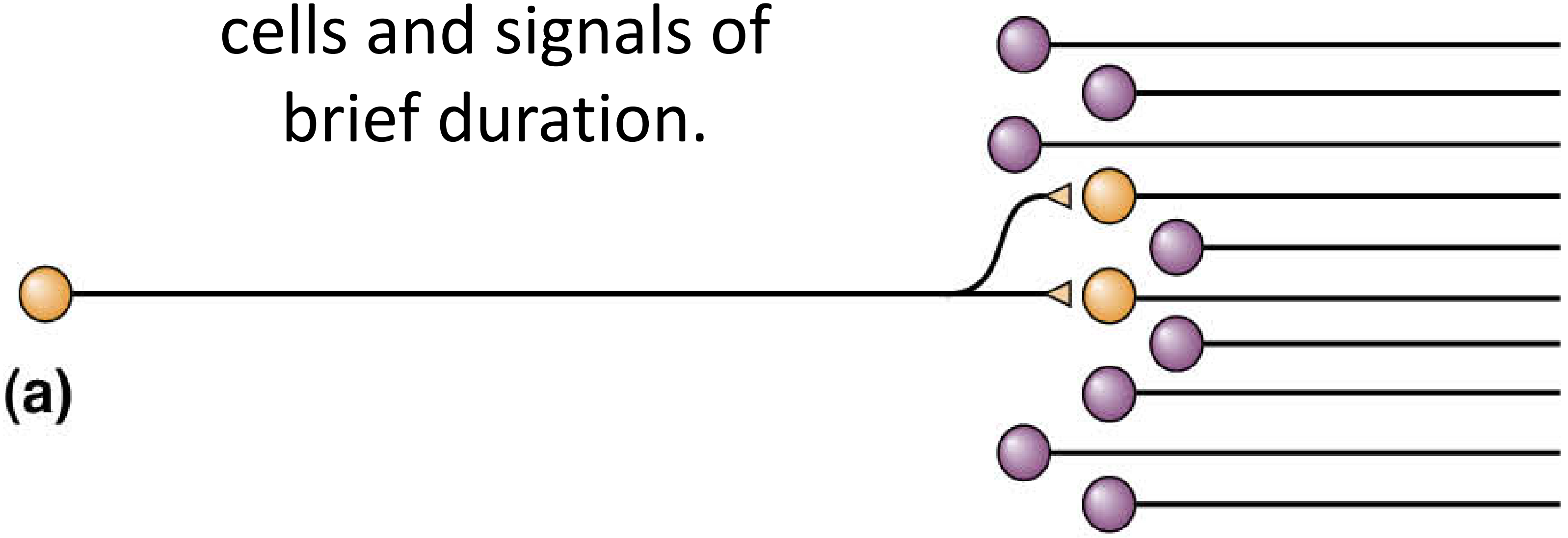
- Driving force on behavior
  - Analogy: like ionic driving force, motivation depends on many factors
- Probability and direction of behavior
  - Vary with the driving force needed to perform the behavior

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

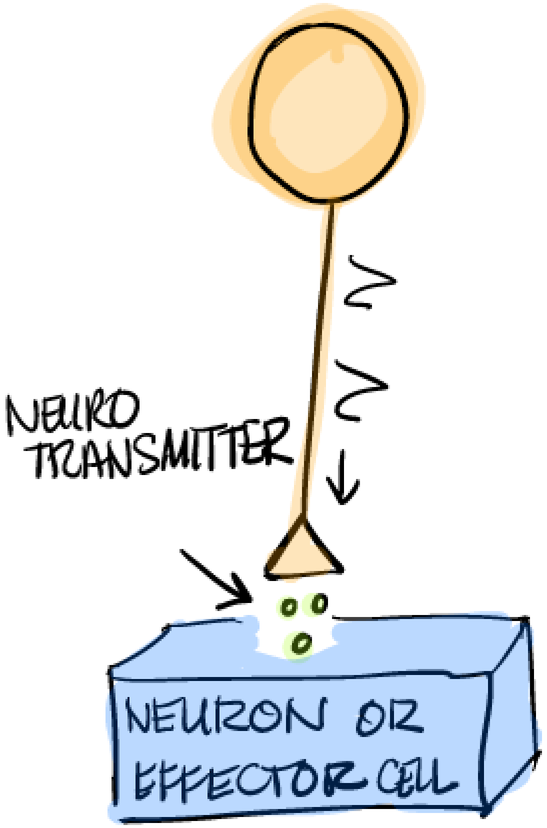
Image: https://lancastersafety.com/behavior-based-safety-human-organizational-performance/

Patterns of communication in the nervous system:

Point to point: restricted synaptic activation of target cells and signals of brief duration.



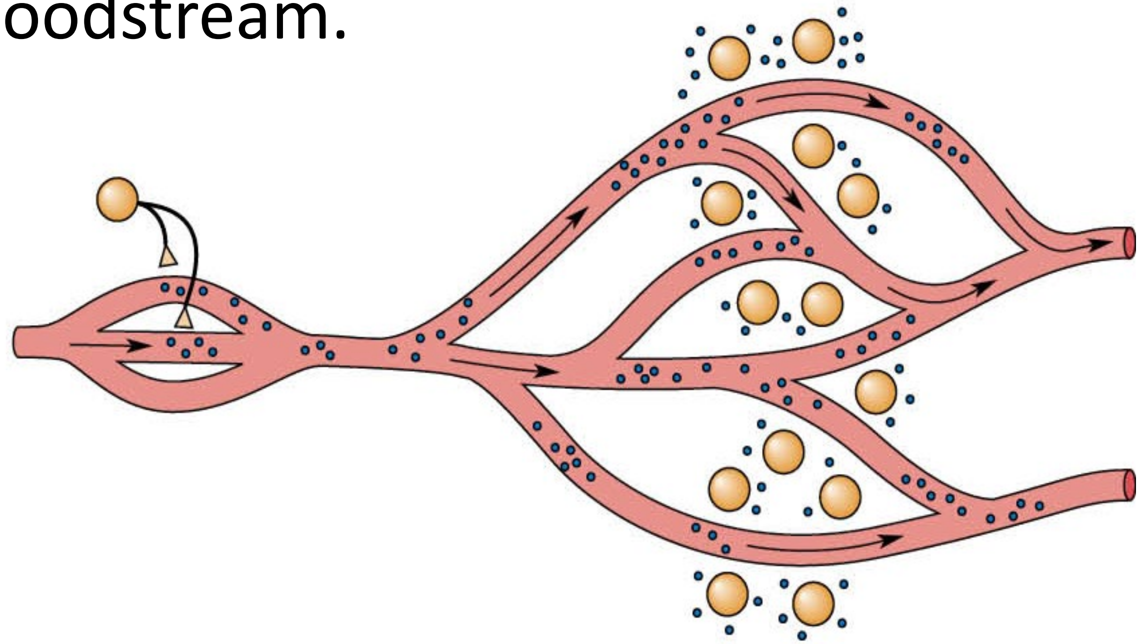
(a)



Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Patterns of communication in the nervous system:

Neurons of the secretory hypothalamus release hormones directly into the bloodstream.

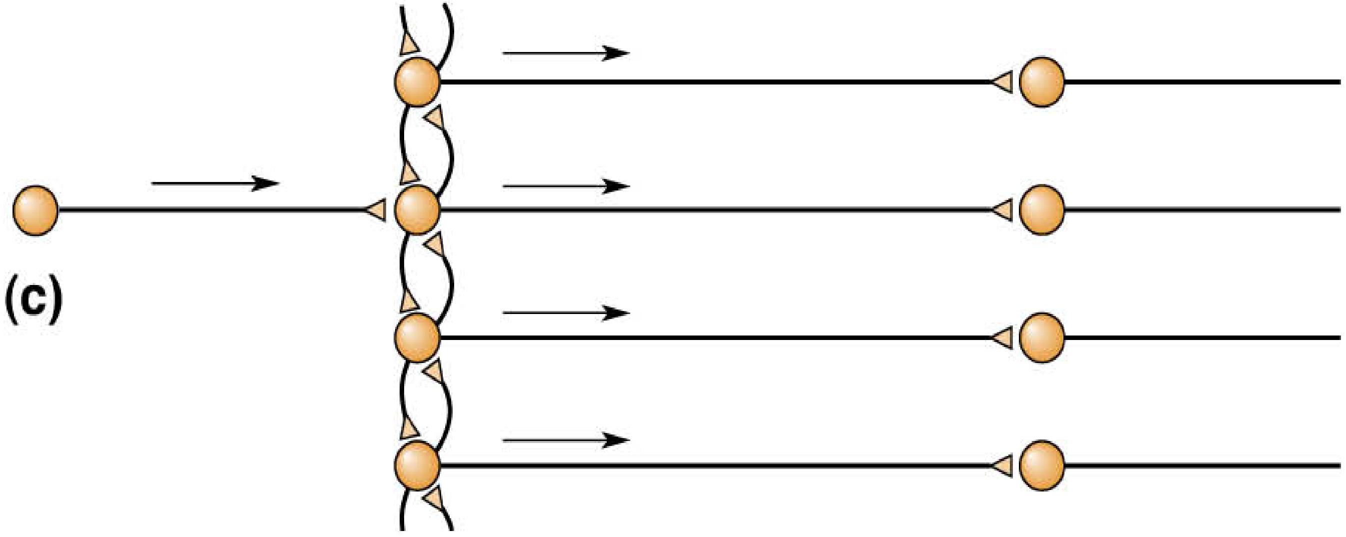


(b)

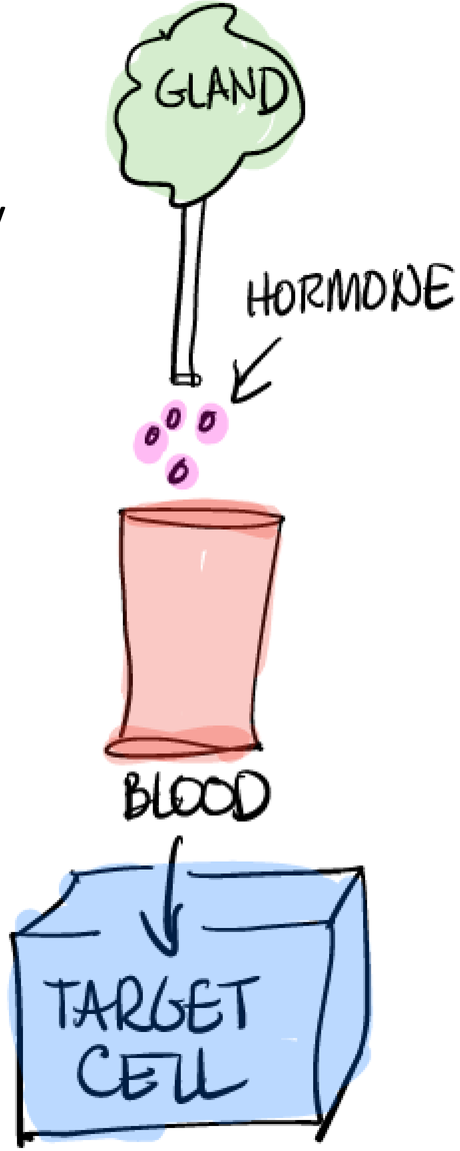
Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Patterns of communication in the nervous system:

Networks of interconnected neurons of the Autonomic Nervous System work together to activate tissues all over the body.



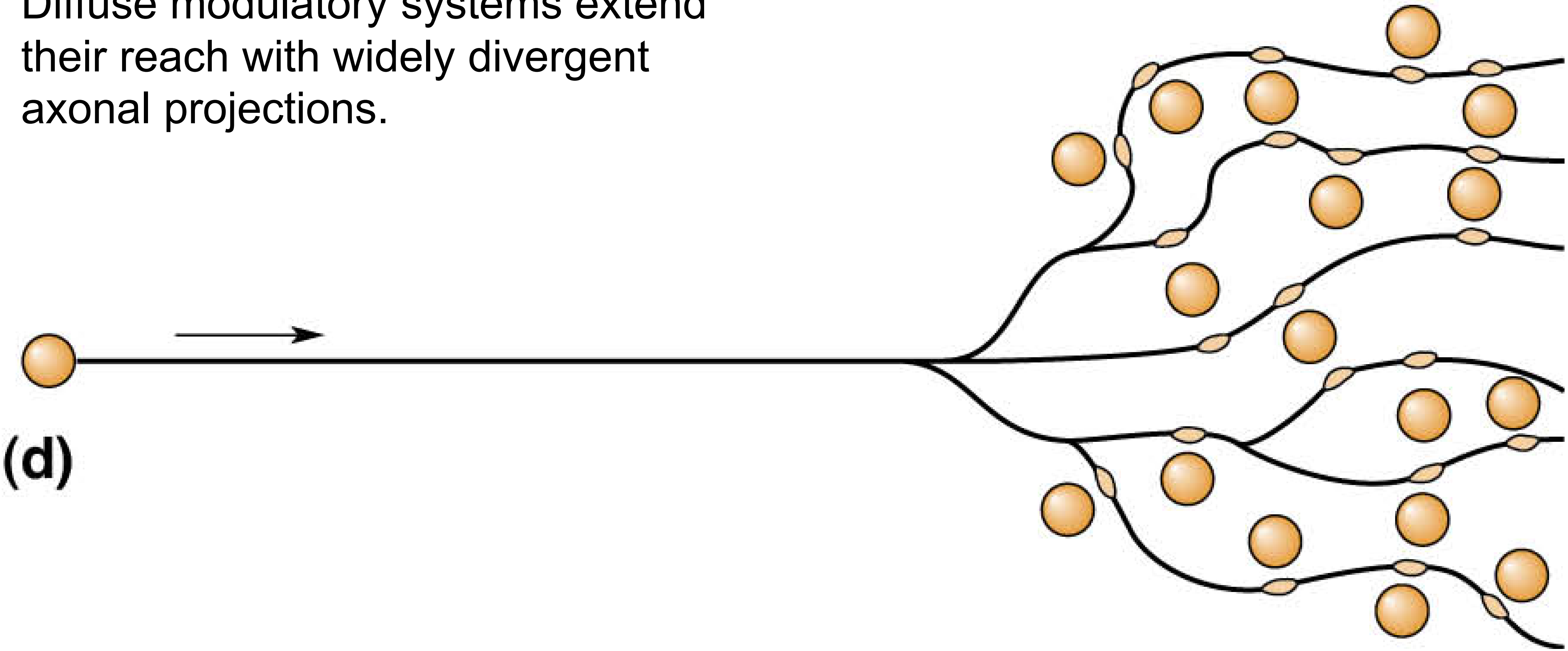
The ANS simultaneously controls the responses of many internal organs, blood vessels and glands.



Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Patterns of communication in the nervous system:

Diffuse modulatory systems extend their reach with widely divergent axonal projections.

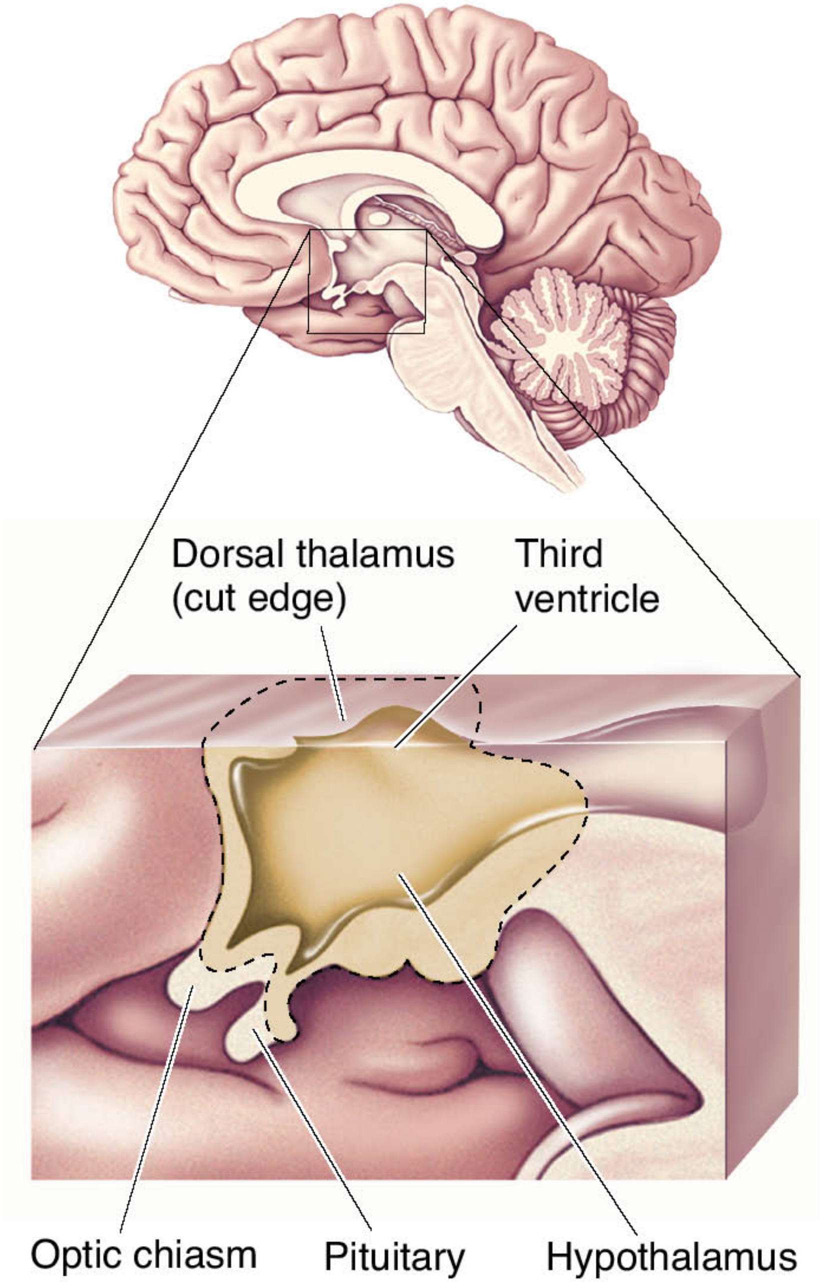


(d)

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

The Secretory Hypothalamus

- Hypothalamus integrates somatic and visceral responses.
- Hypothalamus has enormous influence on the brain and body.
- A lesion in the hypothalamus can produce significant damage.



Hypothalamus sits below the thalamus along the walls of the 3^{rd} ventricle.

ichael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

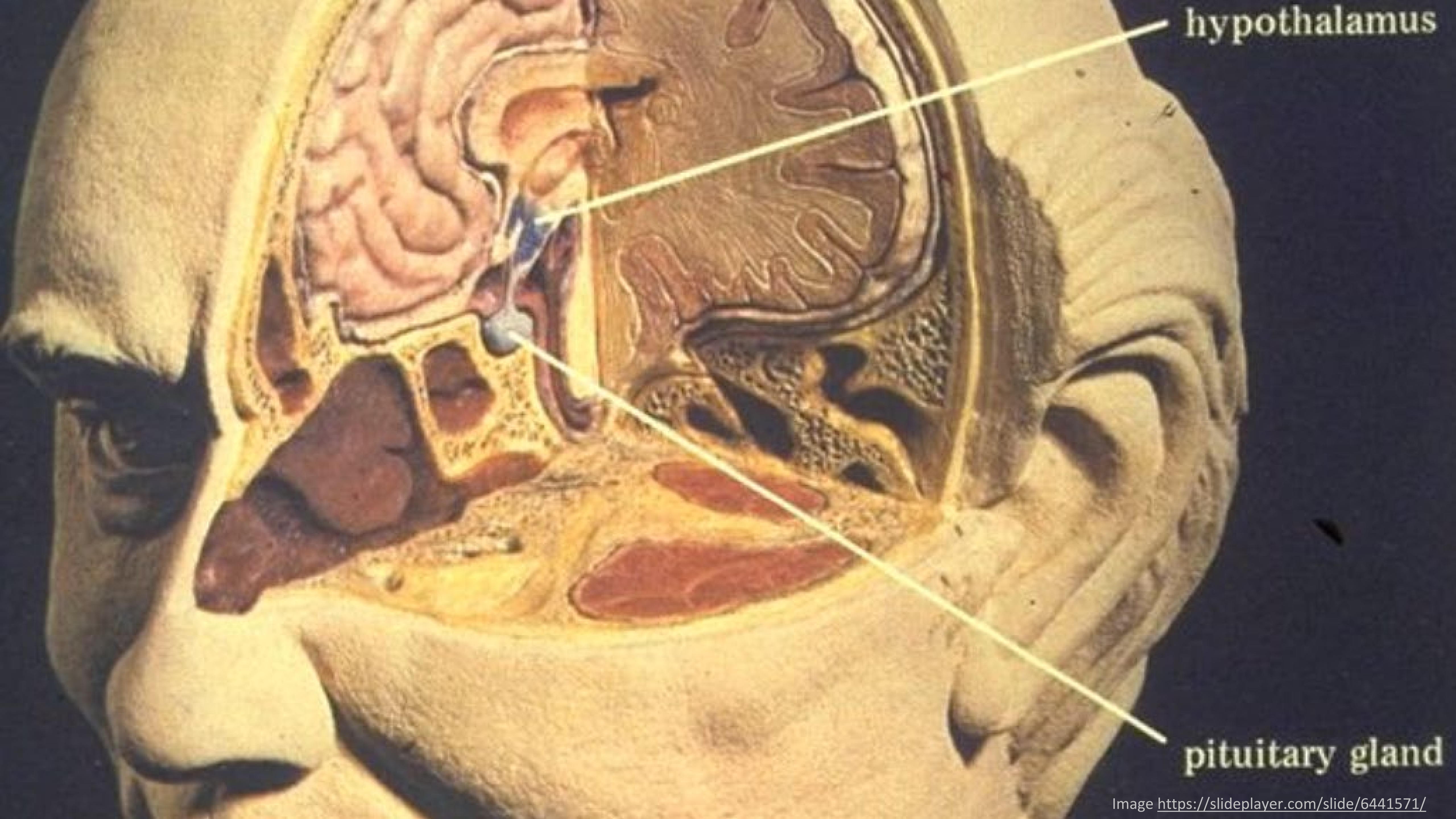


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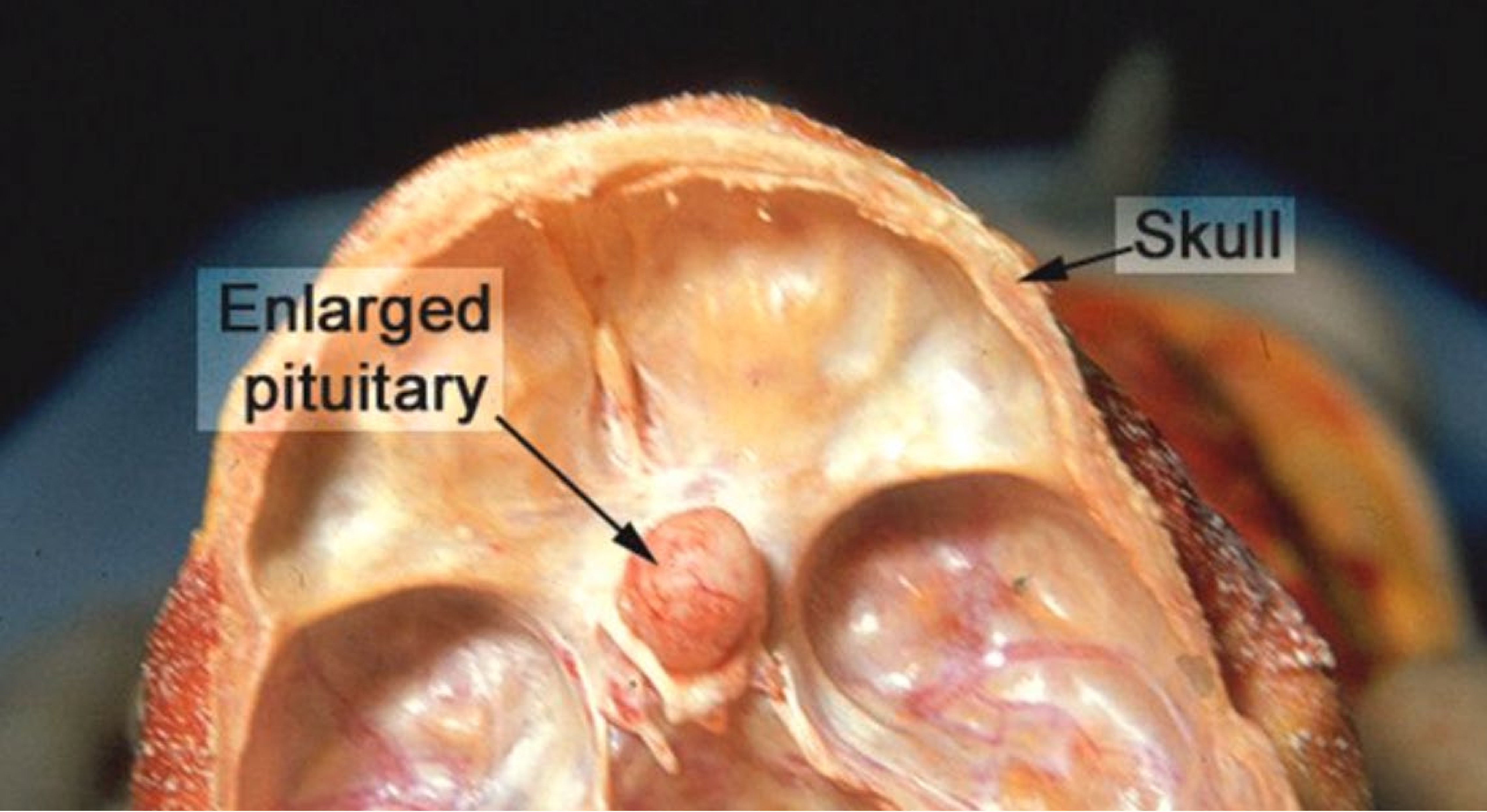
Image https://slideplayer.com/slide/6441571/



- Three components of nervous system with great reach of influences:
  - Secretory hypothalamus (all over the body)
  - Autonomic nervous system (all over the body)
  - Diffuse modulatory systems (all over the brain)
- At detailed level
  - Each system performs different functions.
- At general level
  - All work maintain brain homeostasis.

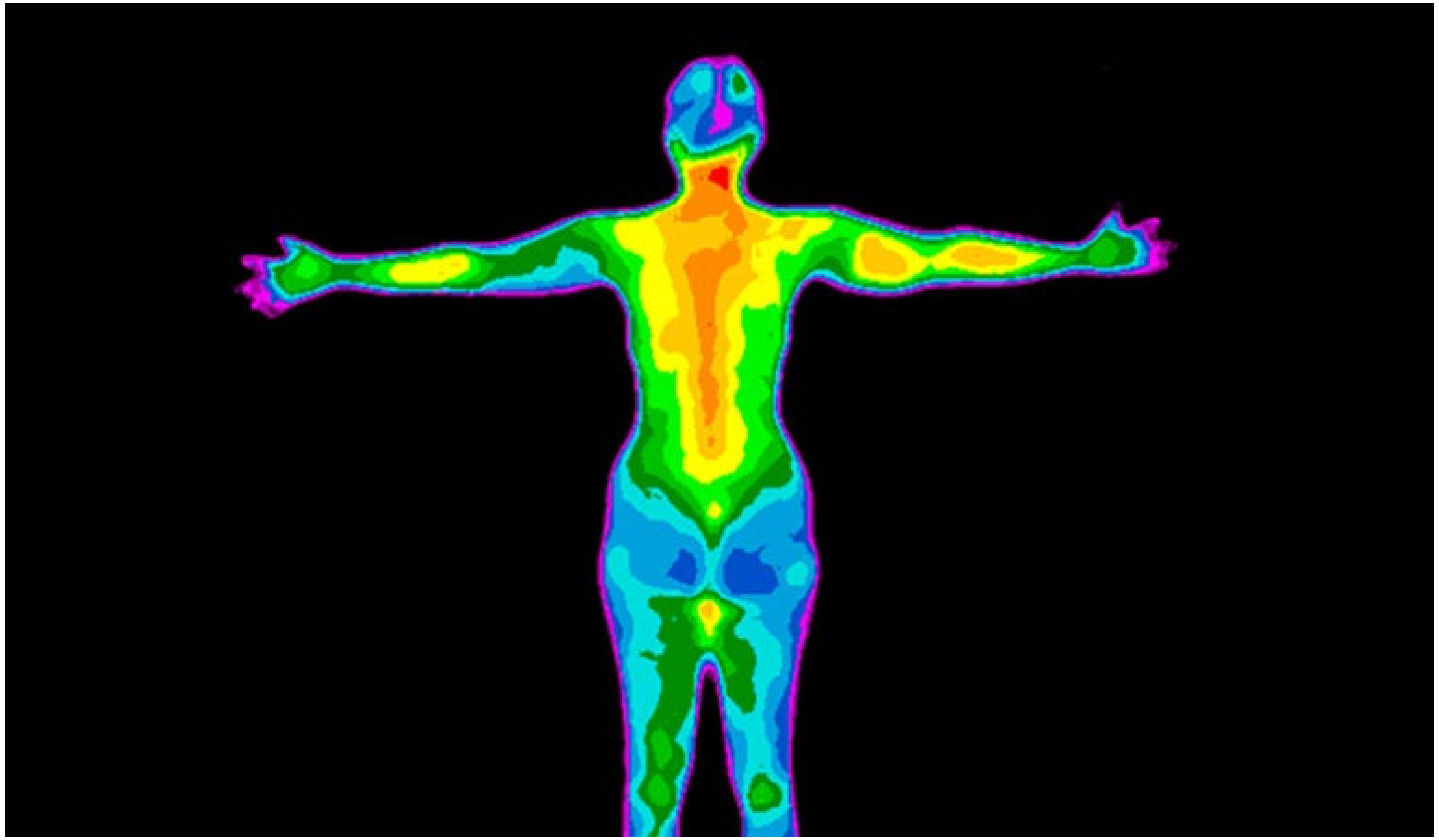
Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

The Hypothalamus, Homeostasis, and Motivated Behavior

- Homeostasis
  - Maintains internal environment within a narrow physiological range
- Role of hypothalamus
  - Regulates homeostasis
- Three components of neuronal response
  - Humoral response
  - Visceromotor response
  - Somatic motor response

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Image: https://www.sciencemusicvideos.com/



The Hypothalamus, Homeostasis, and Motivated Behavior

- Response when body is cold
  - Body shivers, blood shunted away from the body surface, urine production inhibited, body fat reserves—mobilized
- Lateral hypothalamus
  - Initiates motivation to actively seek or generate warmth—maintain homeostasis

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Image: https://www.curriculumvisions.com/search/B/bodyTemperature/bodyTemperature.html

Homeostasis: is the regulatory process that maintains the body's physiological needs.

Example: Temperature Regulation

- The hypothalamus has temperature sensitive cells.
  - The hypothalamus orchestrates the body to shiver, turn blue and get goose bumps when cold and turn red and sweat when you are hot.

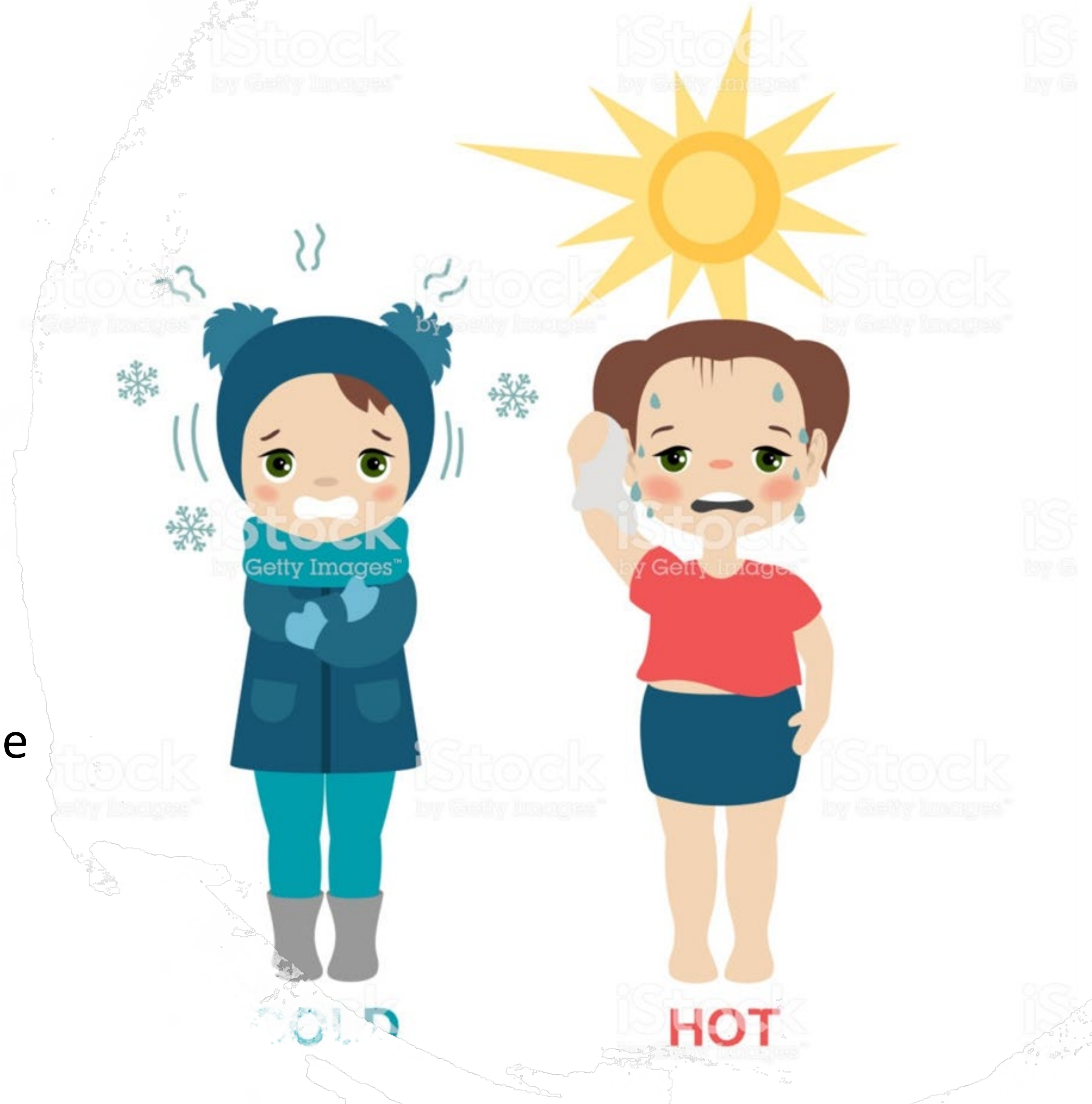


Image: https://www.istockphoto.com/

Temperature Regulation

- Cells fine-tuned for constant temperature—37°C (98.6°F)
- Neurons for temperature homeostasis
  - Clustered in anterior hypothalamus
  - Humoral and visceromotor responses
    - Neurons in the medial preoptic area of the hypothalamus
  - Somatic motor (behavioral) responses
    - Neurons of lateral hypothalamic area

Temperature Regulation—(cont.)

- Process during a fall in temperature

TSH released by anterior pituitary → TSH stimulates release of thyroxin from thyroid gland. → Increase in cellular metabolism

  - Visceromotor response: constricted blood vessels in the skin
  - Involuntary somatic motor responses
    - Shivering, seeking warmth
  - Rise in temperature: metabolism slowed by reducing TSH release, somatic responses

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Temperature Regulation

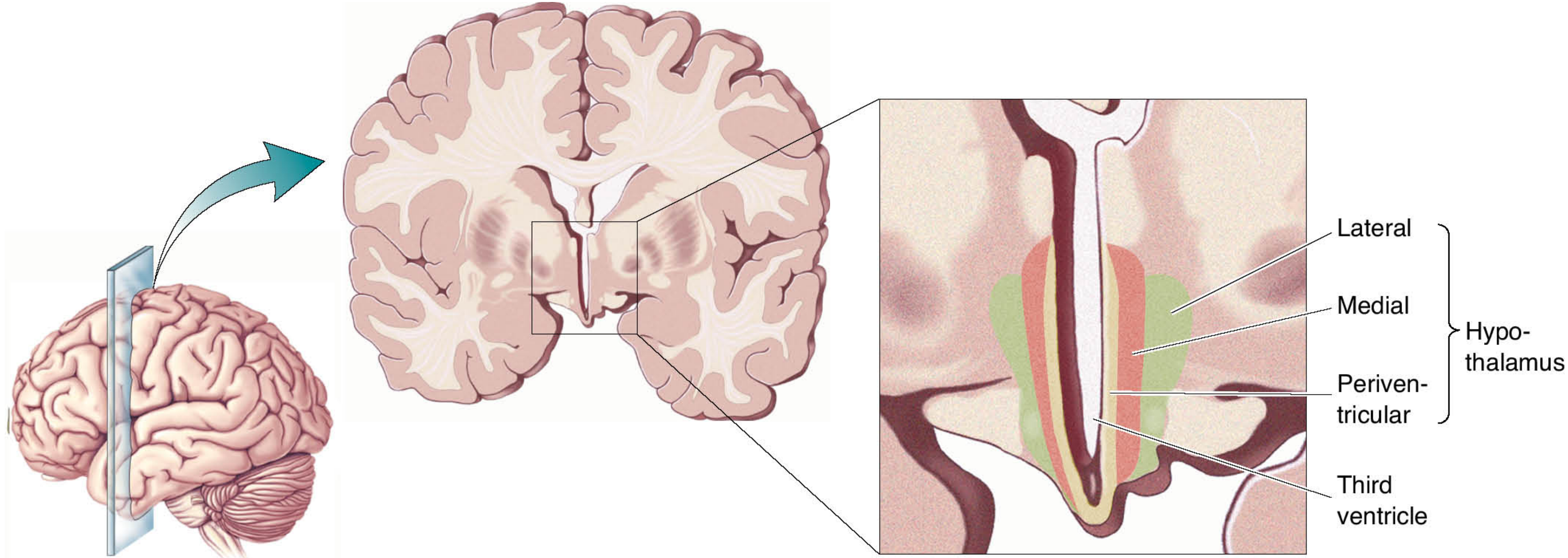
TABLE 16.1 **Hypothalamic Responses to Stimuli That Motivate Behavior**

Bloodborne Stimulus	Site of Transduction	Humoral Response	Visceromotor Response	Somatic Motor Response
Eating signals				
↓ Leptin	Arcuate nucleus	↓ ACTH ↓ TSH	↑ Parasympathetic activity	Feeding
↓ Insulin	Arcuate nucleus	↓ ACTH ↓ TSH	↑ Parasympathetic activity	Feeding
Drinking signals				
↑ Angiotensin II	Subfornical organ	↑ Vasopressin	↑ Sympathetic activity	Drinking
↑ Blood tonicity	OVLT	↑ Vasopressin		Drinking
Thermal signals				
↑ Temperature	Medial preoptic area	↓ TSH	↑ Parasympathetic activity	Sweating, seeking cold
↓ Temperature	Medial preoptic area	↑ TSH	↑ Sympathetic activity	Shivering, seeking warmth

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

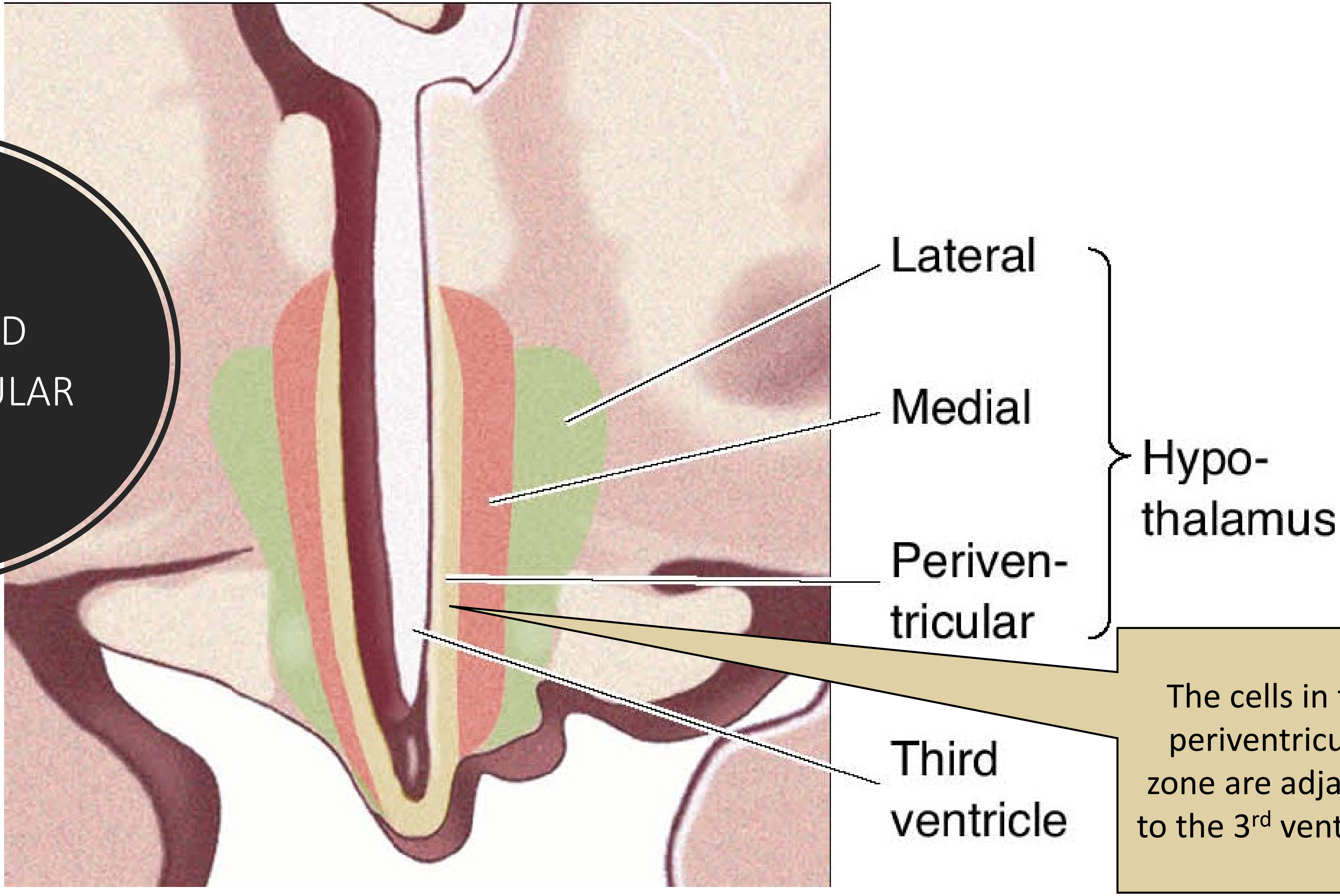
The 3 Functional Zones of the Hypothalamus

Lateral , medial and periventricular



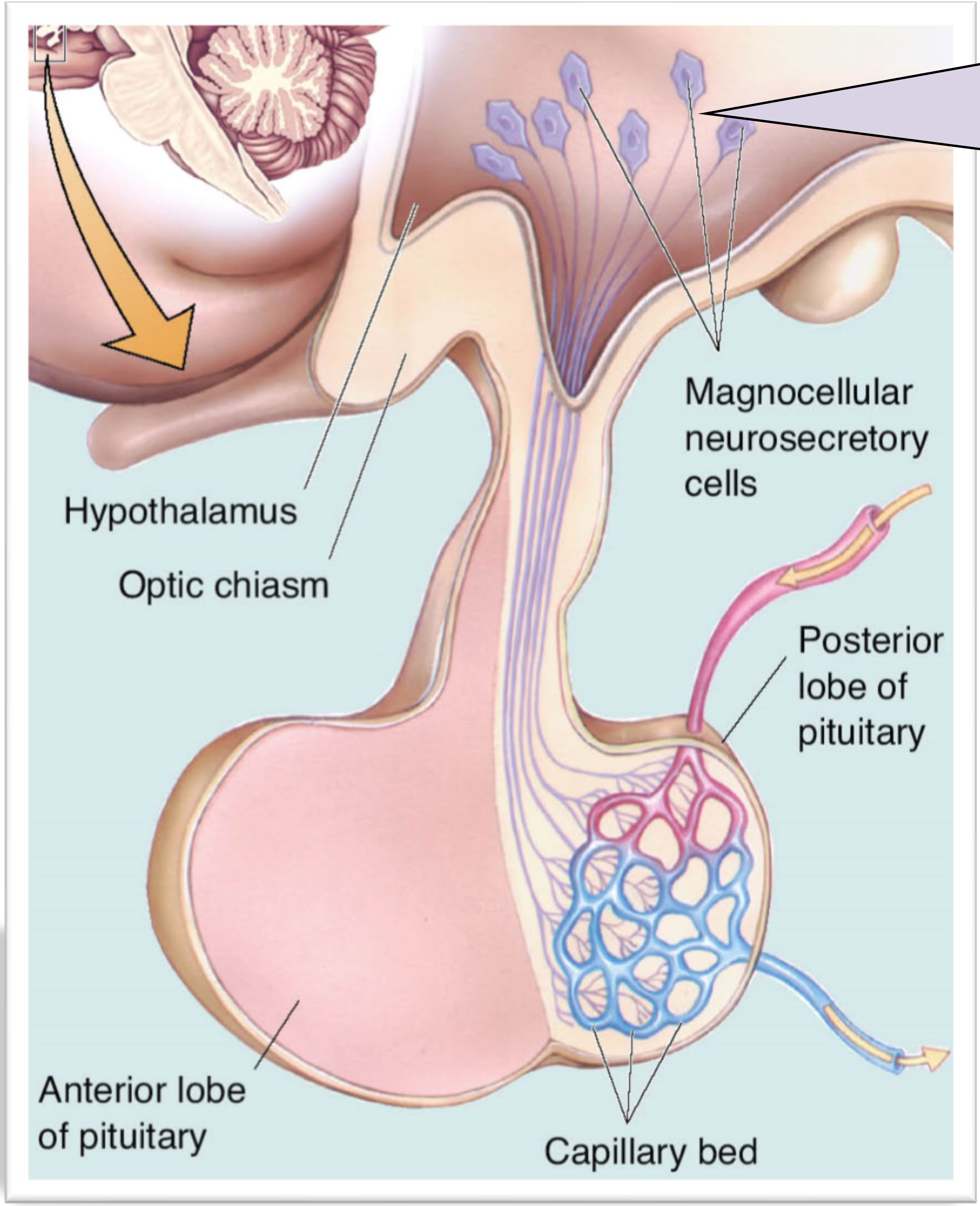
Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Lateral, medial and periventricular



The cells in the periventricular zone are adjacent to the 3rd ventricle.

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.



Magnocellular cells secrete oxytocin and vasopressin directly into the capillaries of the posterior lobe.

The magnocellular neurosecretory neurons, extend axons down towards the stalk of the posterior lobe of the pituitary.

Love,
Lactation,
Trust,
&
Bonding

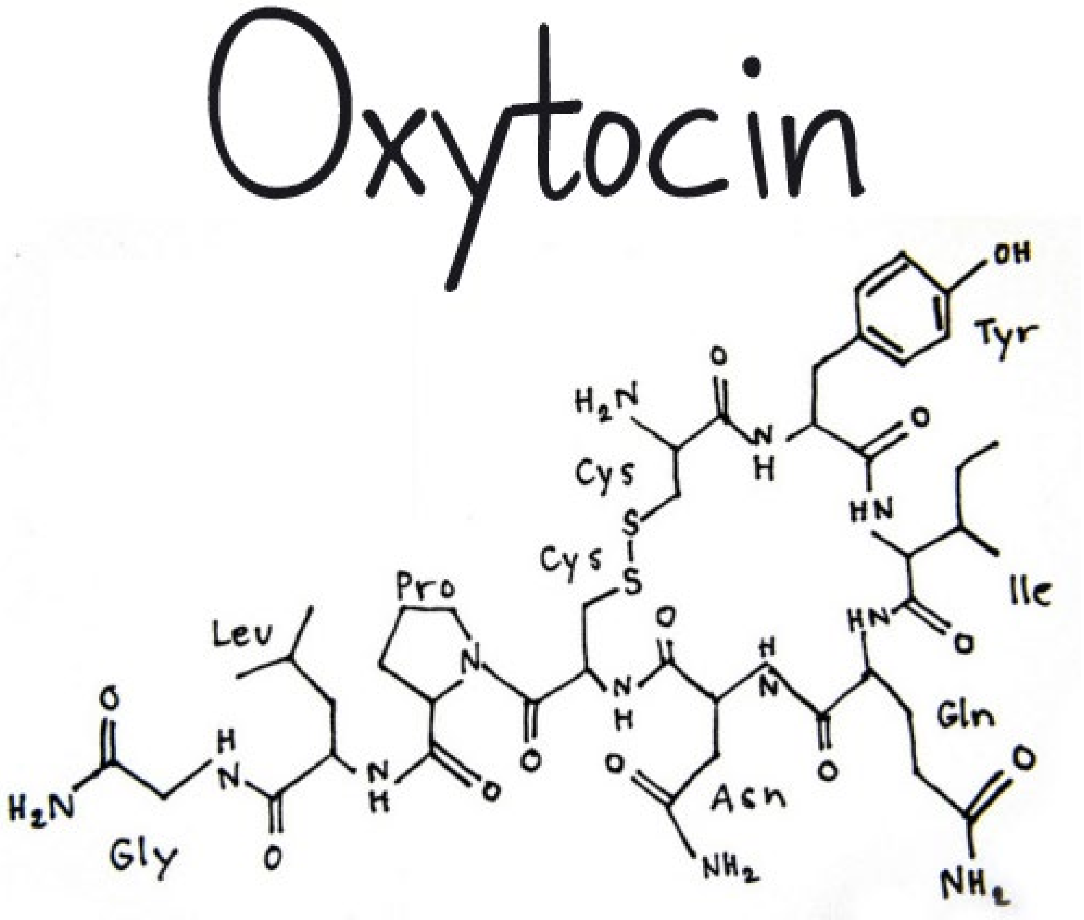
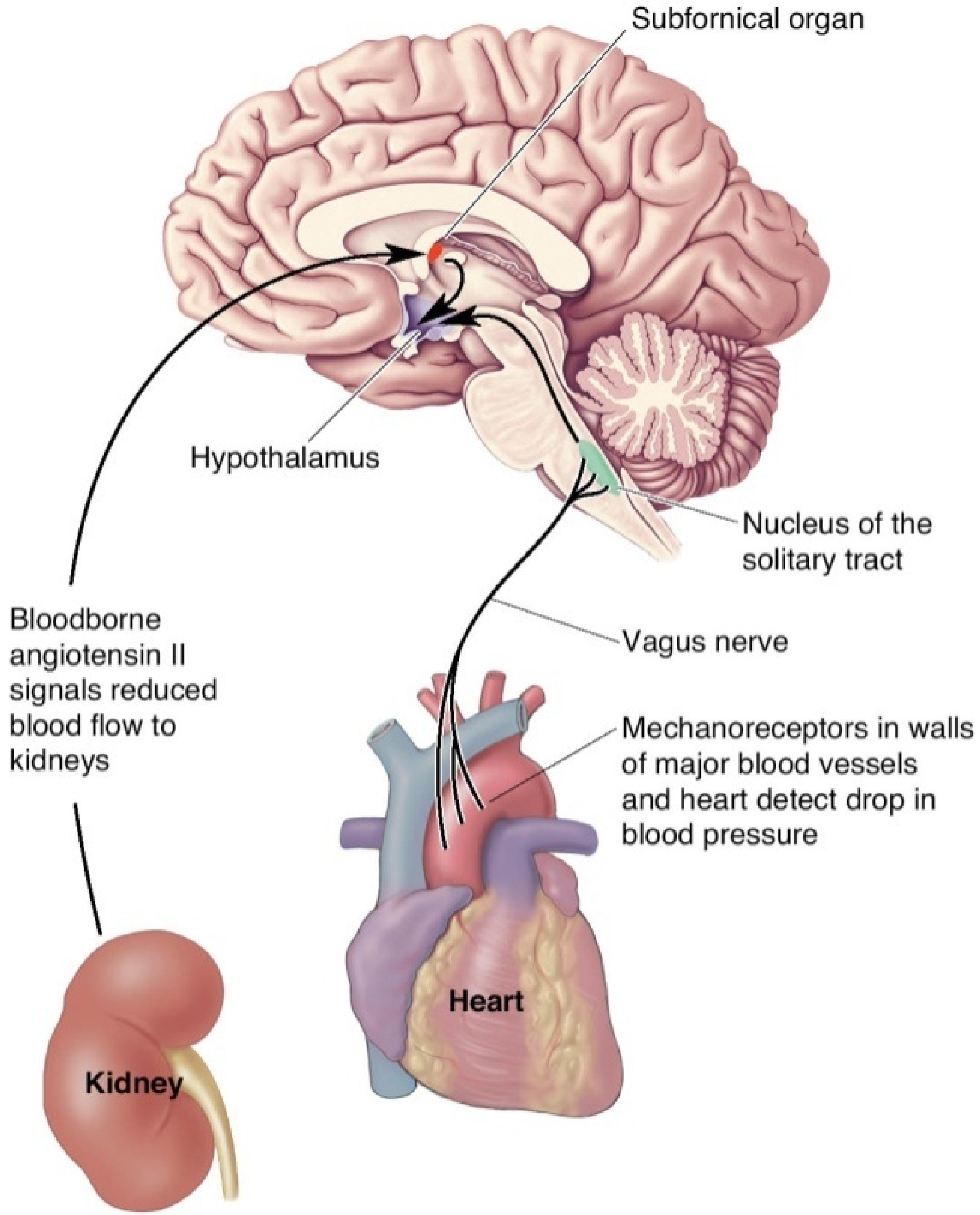


Image: https://www.designhub.it/cometa/hopes-grow-over-potential-autism-treatment-gruppo-10.html

Vasopressin acts on the kidney as an anti-diuretic.
When the body is deprived of water,
the blood volume decreases and blood salt concentration increases.
There are salt sensitive cells in the hypothalamus.

Other Motivated Behaviors: Drinking

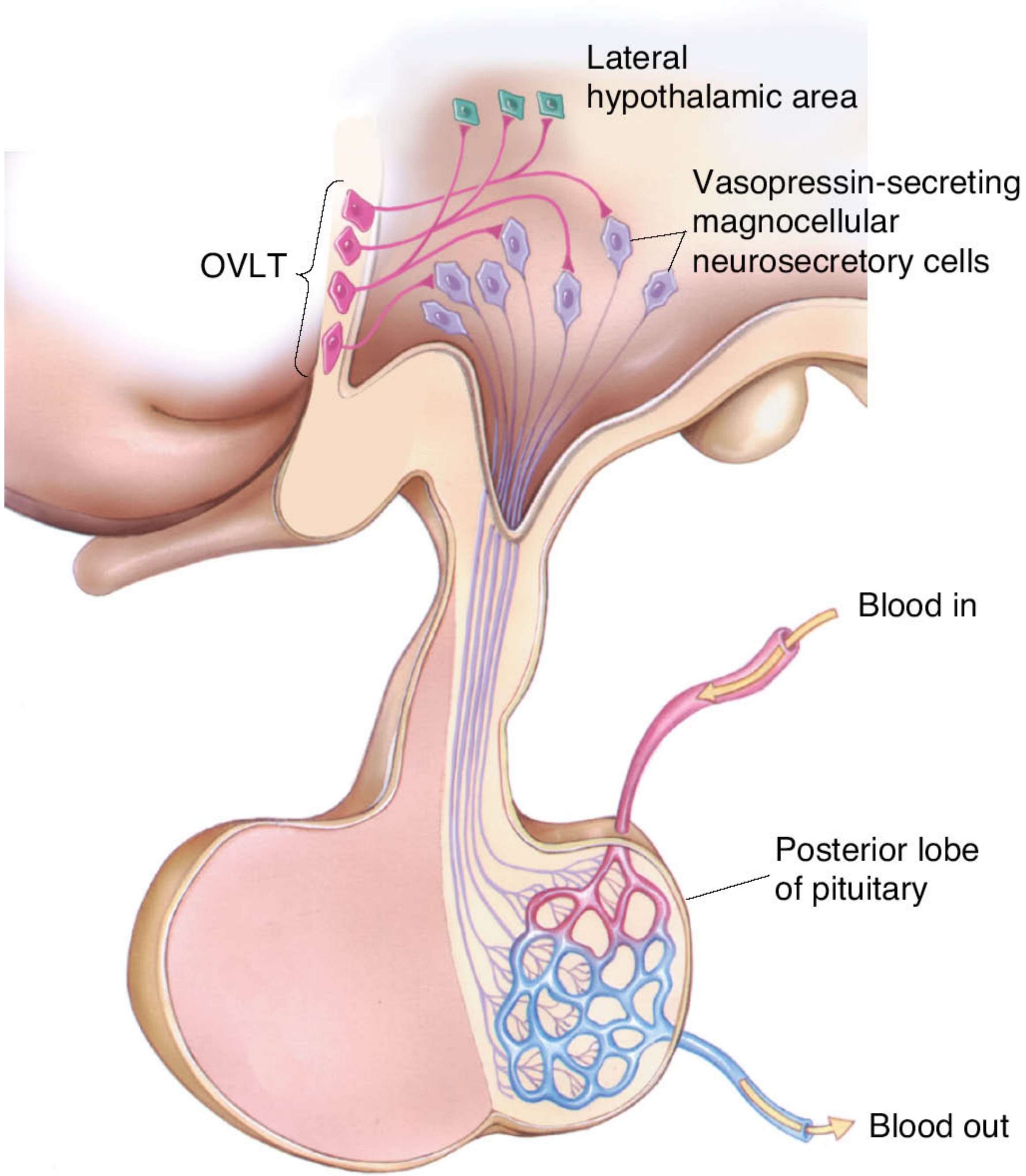
- Pathways triggering volumetric thirst
  - Hypovolemia: decrease in blood volume



Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Drinking: Pathway Triggering Osmotic Thirst

- Hypertonicity: increased concentration of dissolved substances in blood (solutes)



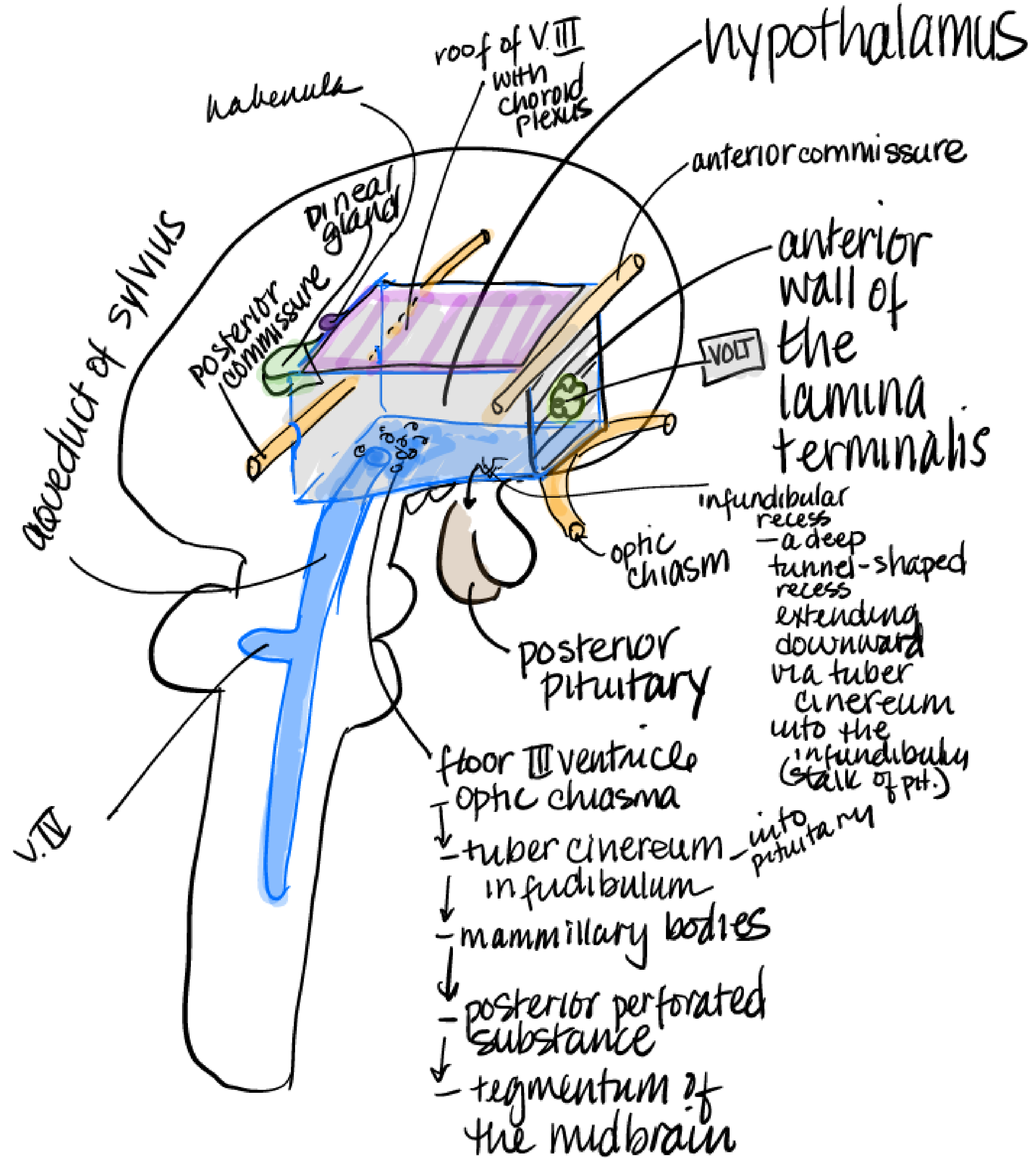
Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Drinking: Role of Vasopressin

- Vasopressin—antidiuretic hormone, or ADH
  - Acts on kidneys to increase water retention
  - Inhibits urine production
- Loss of vasopressin-secreting neurons of hypothalamus
  - Causes diabetes insipidus
    - Strong motivation to drink water

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters K

Image: https://www.medicalnewstoday.com/articles/312628.php


hypothalamus
roof of V.III with choroid plexus
habenula
pineal gland
posterior commissure
aqueduct of sylvius
anterior commissure
anterior wall of the lamina terminalis
VOLT
infundibular recess
- a deep tunnel-shaped recess extending downward via tuber cinereum into the infundibulum (stalk of pit.)
optic chiasm
posterior pituitary
V.IV
floor III ventricle
- optic chiasma
- tuber cinereum into pituitary
infudibulum
- mammillary bodies
- posterior perforated substance
- tegmentum of the midbrain

Kidney drives your thirst.

1. Lowered blood volume

2. Kidney secretes renin into blood

3. Renin promotes synthesis of angiotensin II

4. Angiotensin II excites neurons in the subfornical organ

5. Subfornical neurons stimulate the hypothalamus to release vasopressin (ADH)

6. feeling of thirst

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

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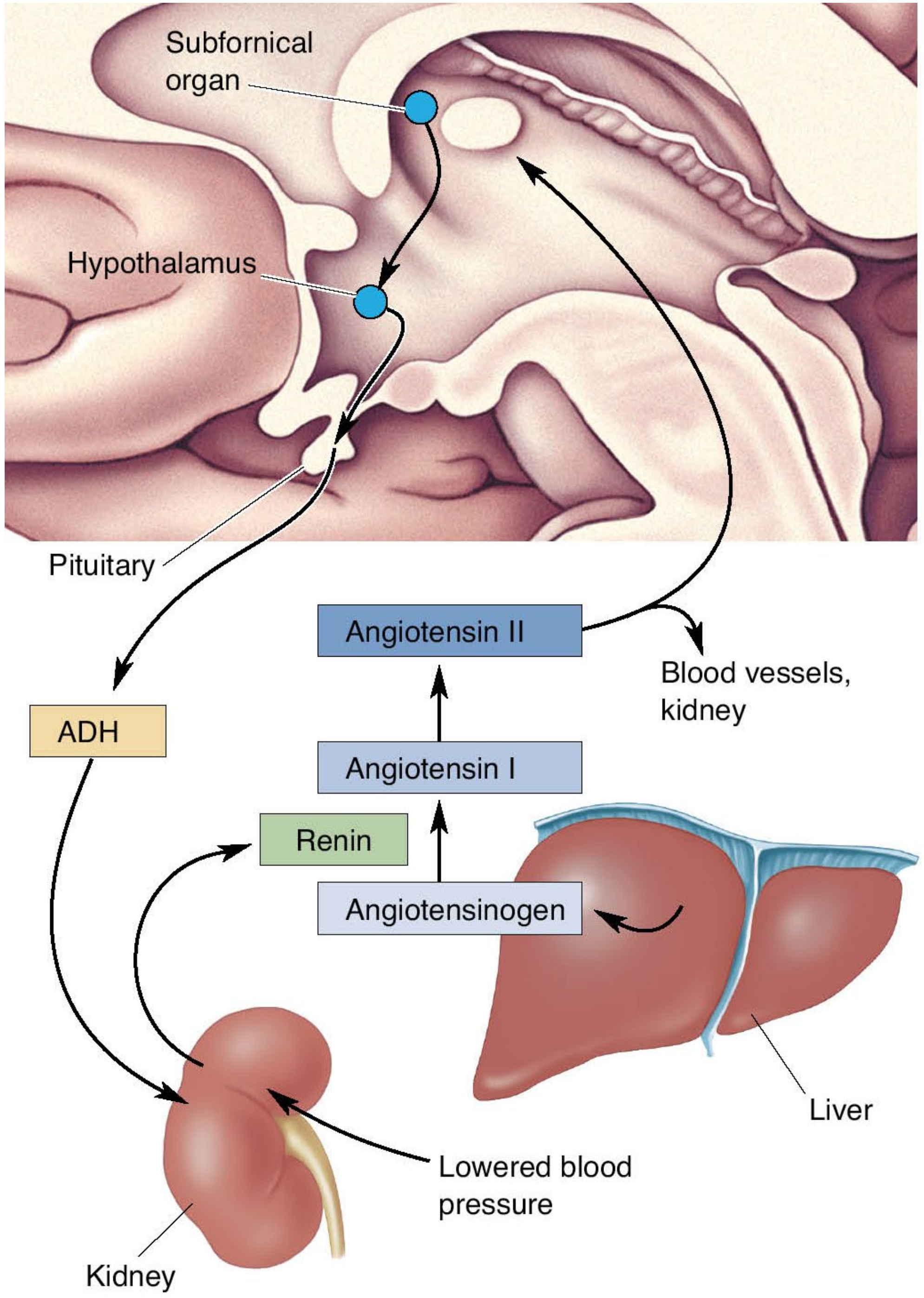
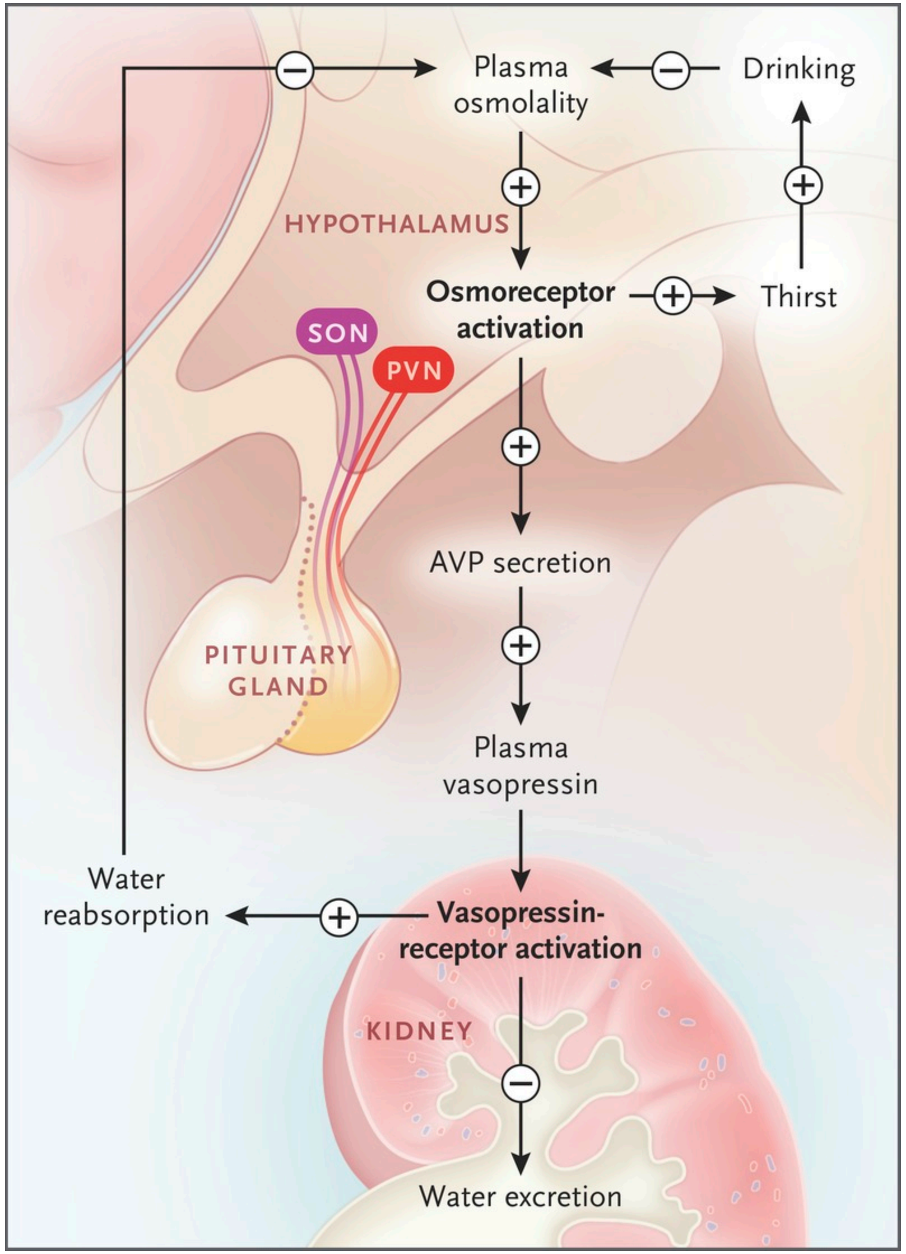




N Engl J Med 2015; 372:1349-1358 DOI: 10.1056/NEJMra1404726

Regulation of plasma volume

- ADH

Thirst

↓

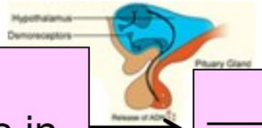
Plasma volume
Plasma osmolity

↓

Osmotic pressure

↓

Detected by osmoreceptors in ______________



→ _____ is released → _____ reabsorption → Urine

↑ Plasma volume

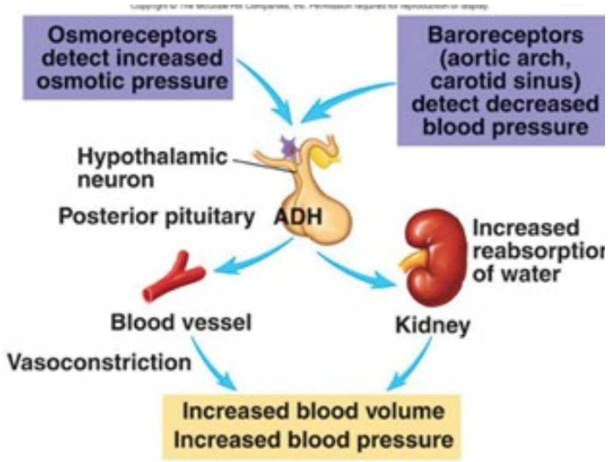
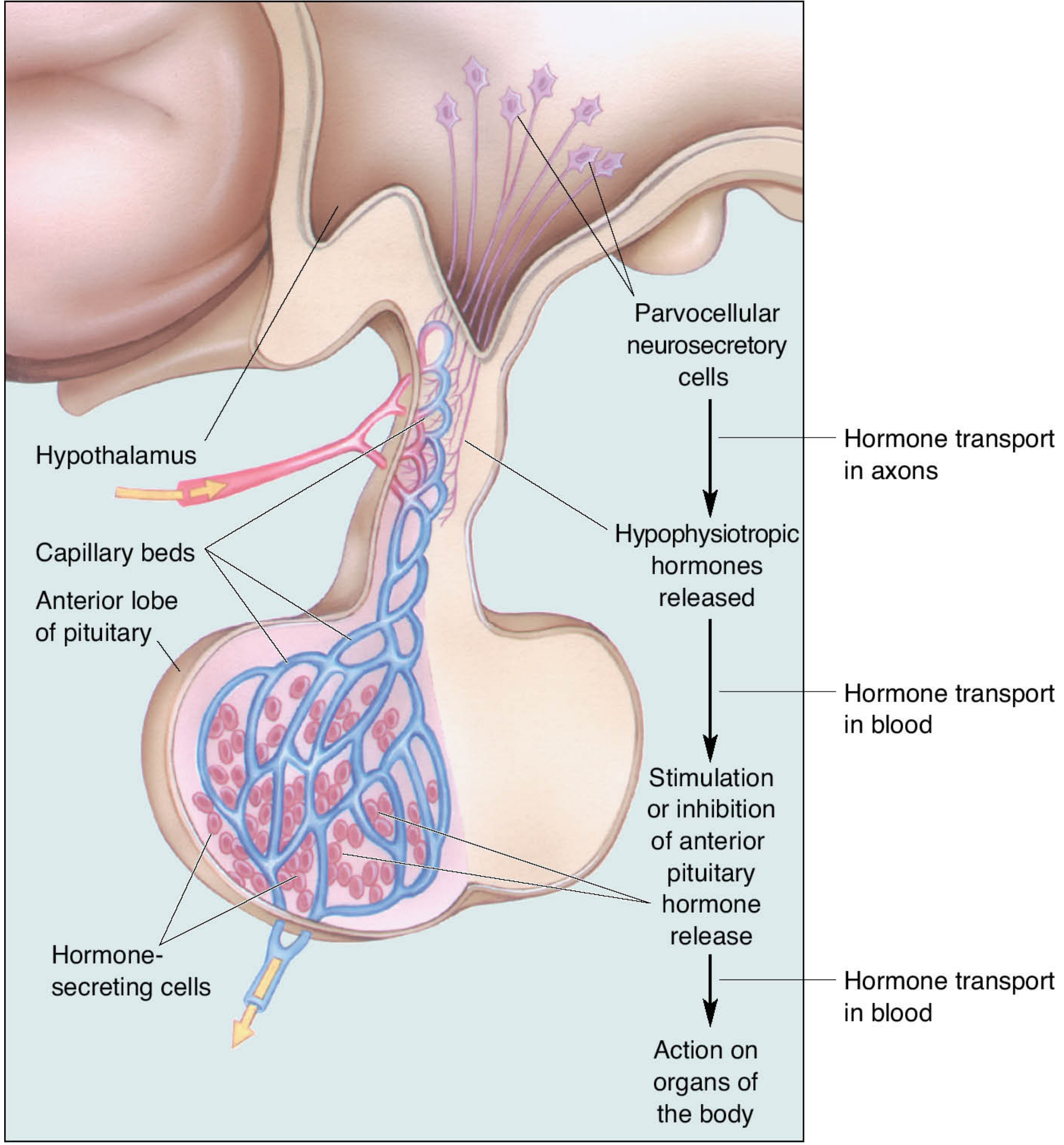


Image: https://slideplayer.com/slide/8367808/

Hypothalamus is the Master Gland of the Endocrine System

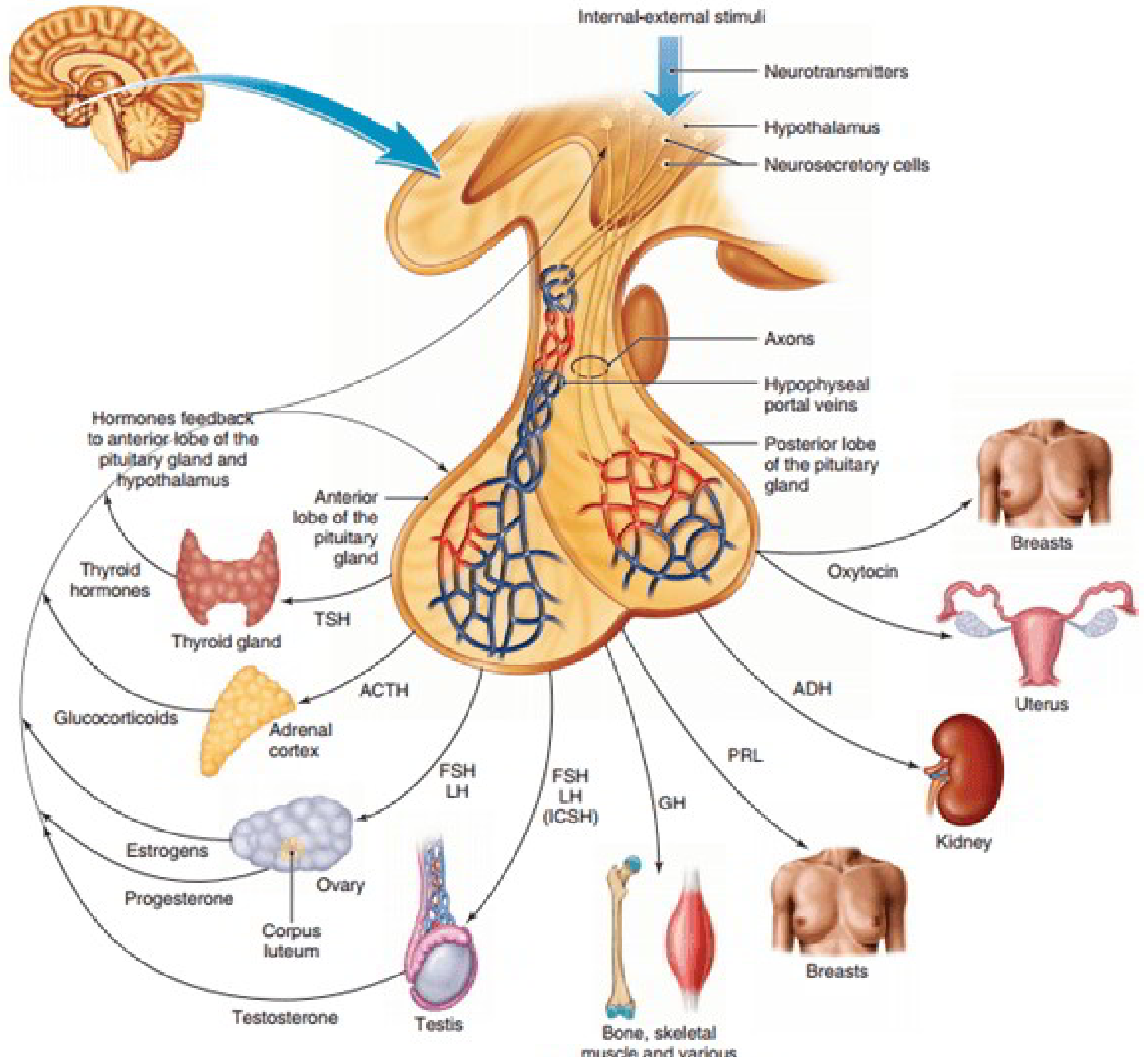
- Controlled by parvocellular neurosecretory cells
  - Secrete hypophysiotropic hormones
  - Hypothalamo-pituitary portal circulation
    - Pituitary cells secrete or stop secreting hormones.



Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Secretory Hypothalamus controls the Anterior Pituitary

The cells of the anterior lobe synthesize and secrete a wide range of hormones that regulate secretions from other glands throughout the body.



Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Image: https://me-pedia.org/wiki/File:Pituitary_diagram.jpg

TABLE 15.1 Hormones of the Anterior Pituitary

Hormone	Target	Action
Follicle-stimulating hormone (FSH)	Gonads	Ovulation, spermatogenesis
Luteinizing hormone (LH)	Gonads	Ovarian and sperm maturation
Thyroid-stimulating hormone (TSH); also called thyrotropin	Thyroid	Thyroxin secretion (increases metabolic rate)
Adrenocorticotropic hormone (ACTH); also called corticotropin	Adrenal cortex	Cortisol secretion (mobilizes energy stores, inhibits immune system, other actions)
Growth hormone (GH)	All cells	Stimulation of protein synthesis
Prolactin	Mammary glands	Growth and milk secretion

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Hypothalamus communicates with the anterior lobe of the pituitary gland by:

Neurons secrete hypophysiotropic hormones

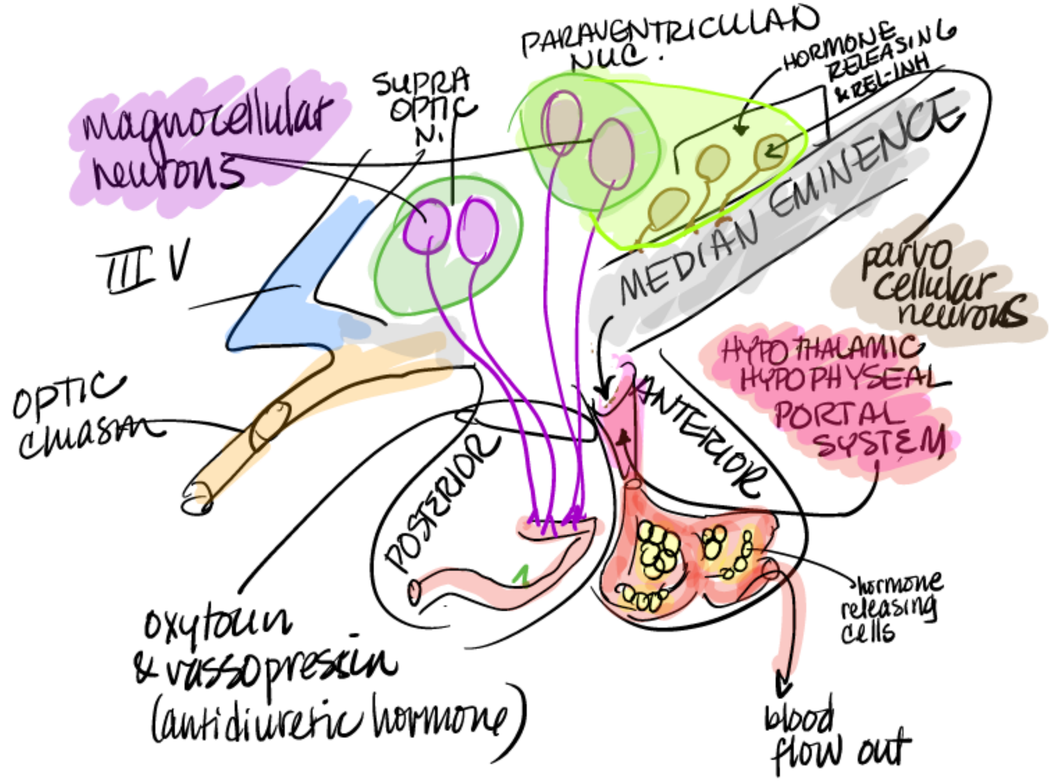
→ Into the bed at the floor of the III ventricle

→ The tiny blood vessels run down into the stalk of the pituitary and branch into the anterior lobe.

The network of blood vessels is called the hypothalamo-pituitary portal circulation

→ Hormones bind to the receptors on the cells in the pituitary

→ The activation of the receptors control the hormone release activity.



Neurons secrete hypophysiotropic hormones

Into the bed at the floor of the III ventricle

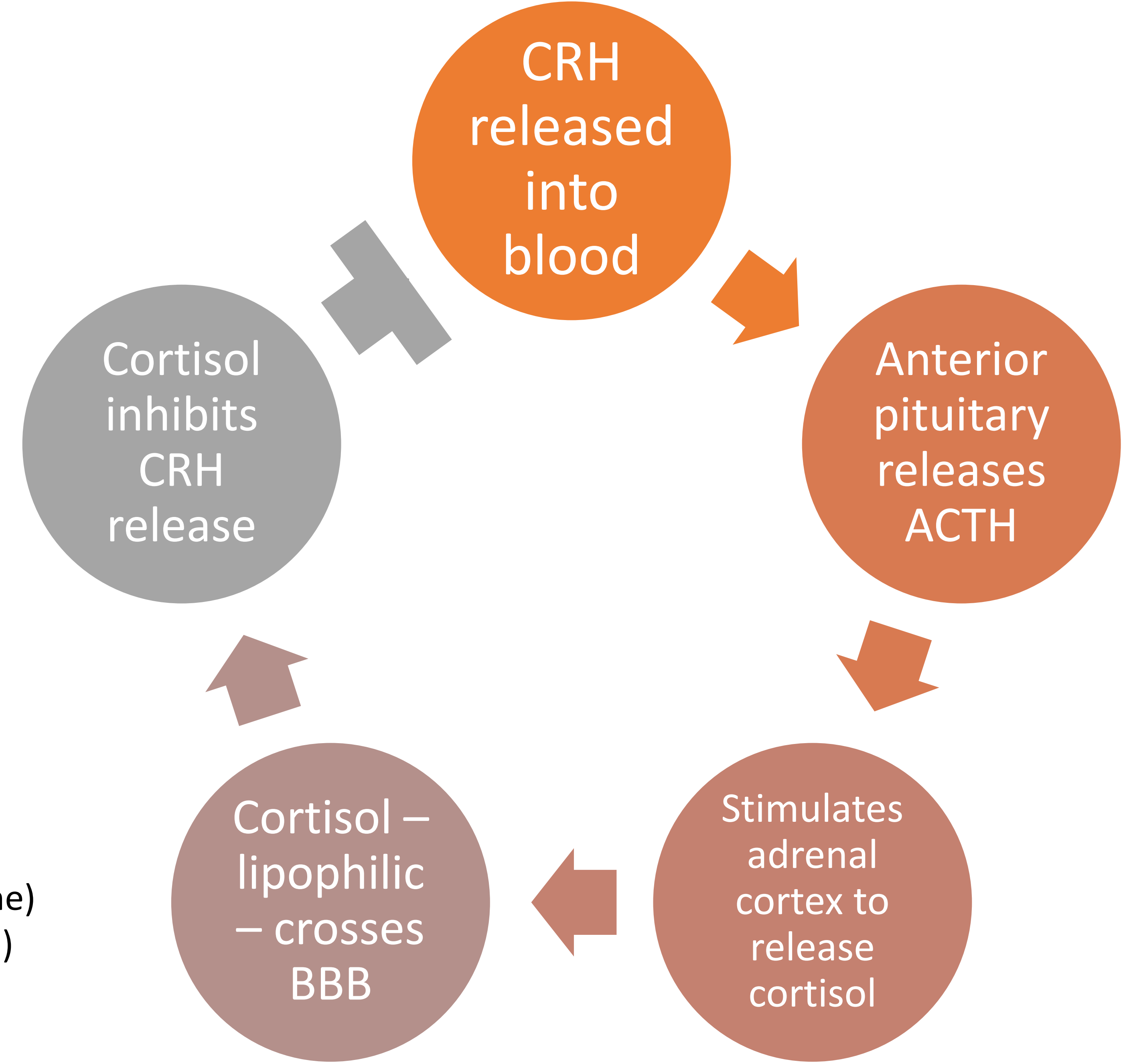
The tiny blood vessels run down into the stalk of the pituitary and branch into the anterior lobe.

The network of blood vessels is called the hypothalamo-pituitary portal circulation

Hormones bind to the receptors on the cells in the pituitary

The activation of the receptors control the hormone release activity.

To stress or not stress – it’s up to the parvocellular neurosecretory cells.

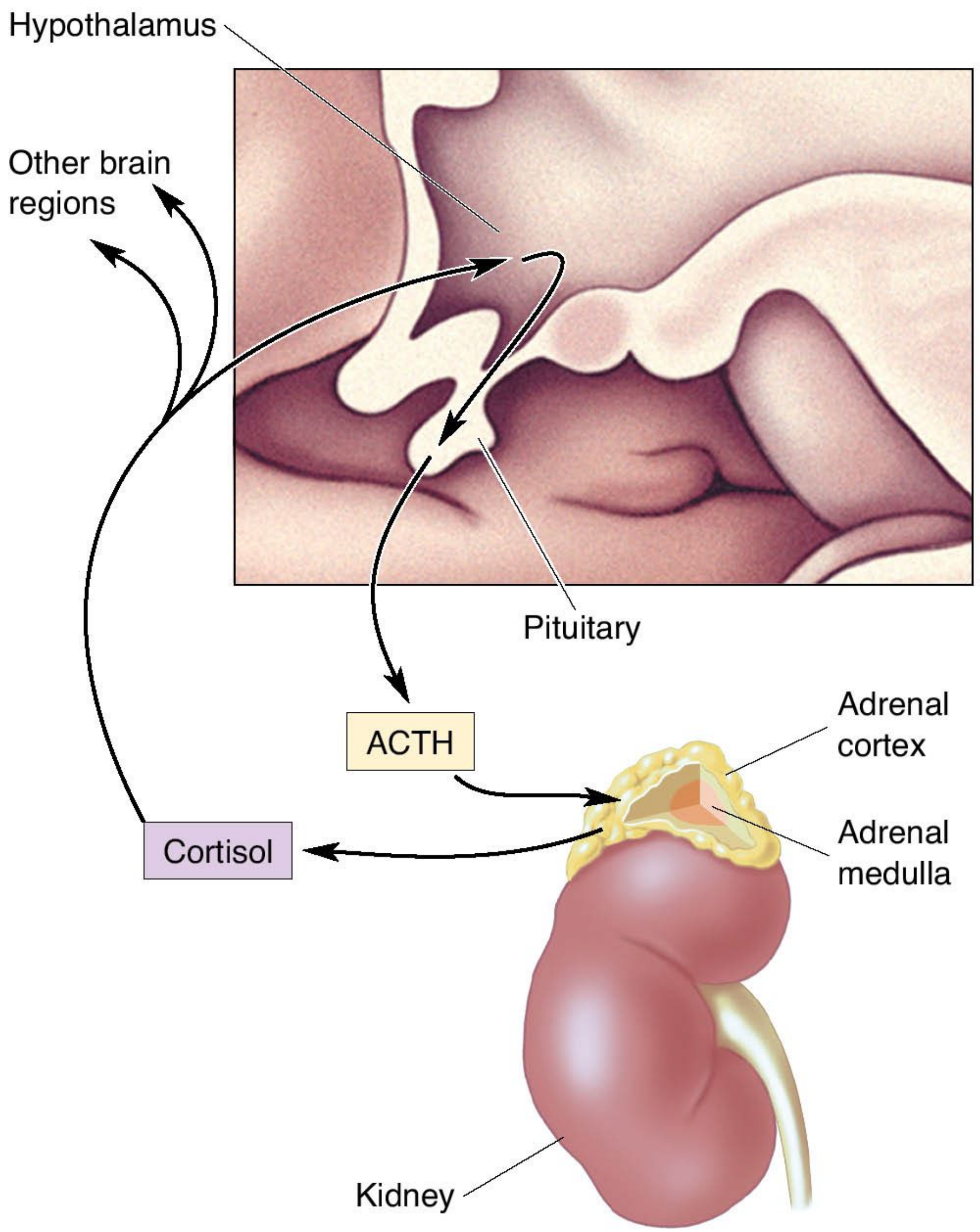


CRH (corticotropin releasing hormone)
ACTH (adrenocorticotropic hormone)
BBB (blood brain barrier)

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Stress Response

- Periventricular hypothalamus secretes CRH into portal circulation.
- ACTH (adrenocorticotropic hormone) released into circulation
- ACTH stimulates cortisol release from adrenal cortex.
- Cortisol inhibits CRH release



Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Recall:
Divisions of Autonomic Nervous System

Sympathetic division: “fight or flight”

Increased heart rate and blood pressure

Depressed digestive function

Mobilized glucose reserves

Parasympathetic division: “rest and digest”

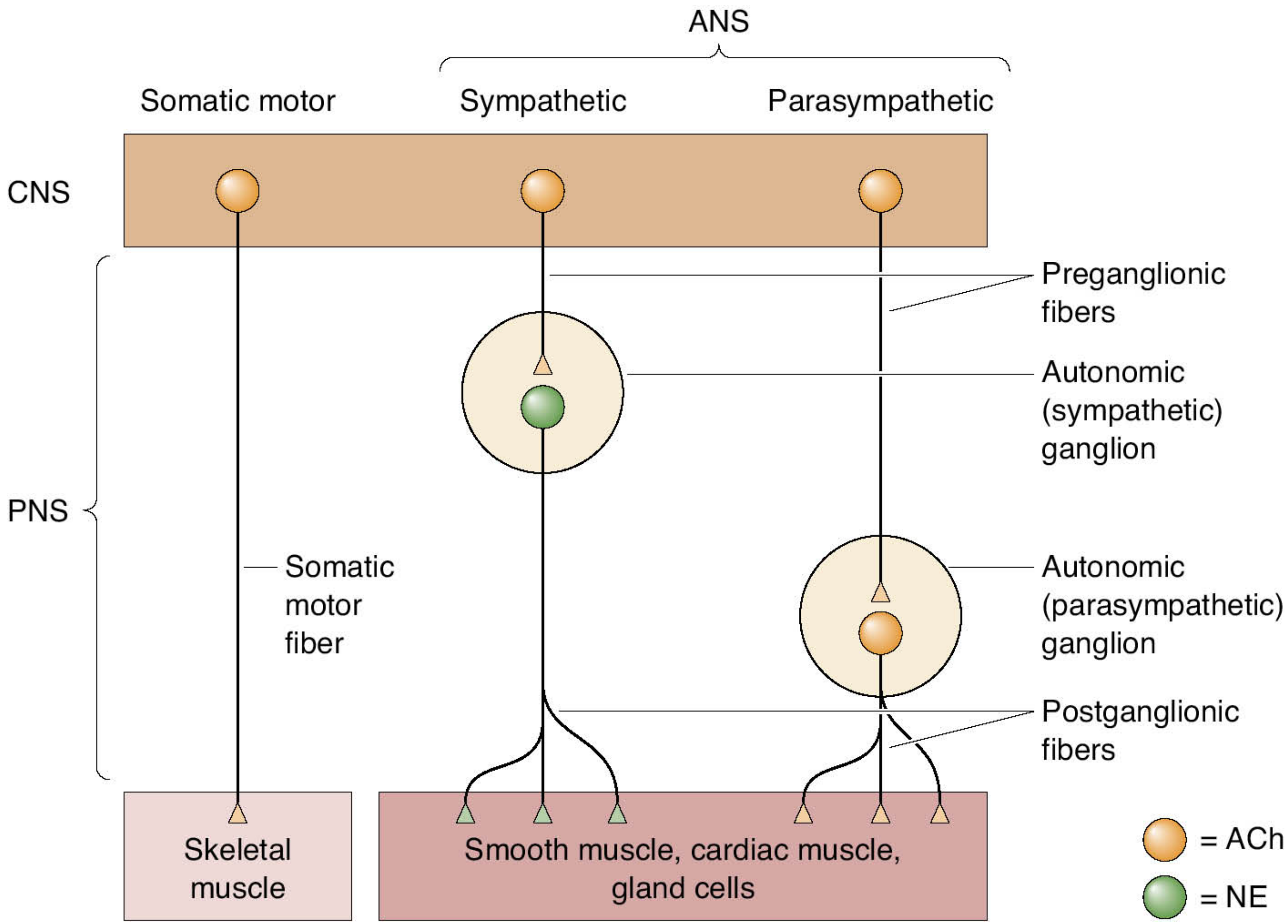
Slower heart rate, fall in blood pressure

Increased digestive functions

Stop sweating

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Recall: ANS Circuits versus Somatic Motor System



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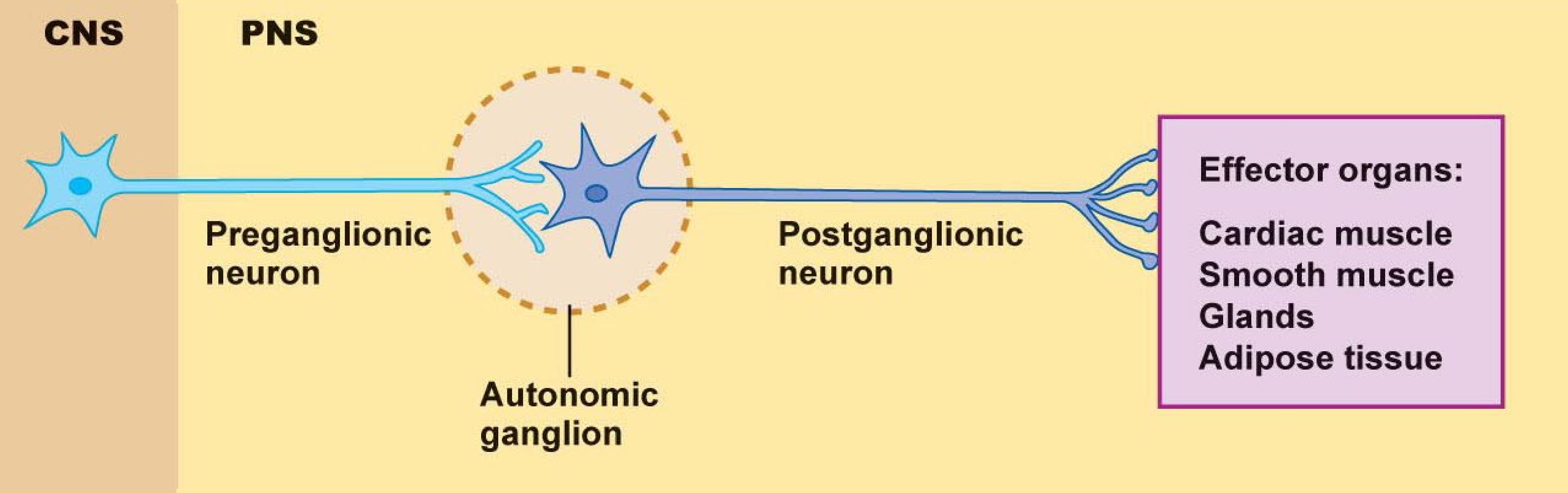


Image: http://droualb.faculty.mjc.edu/Course%20Materials/Physiology%20101/Chapter%20Notes/Fall%202007/chapter_11%20Fall%202007.htm

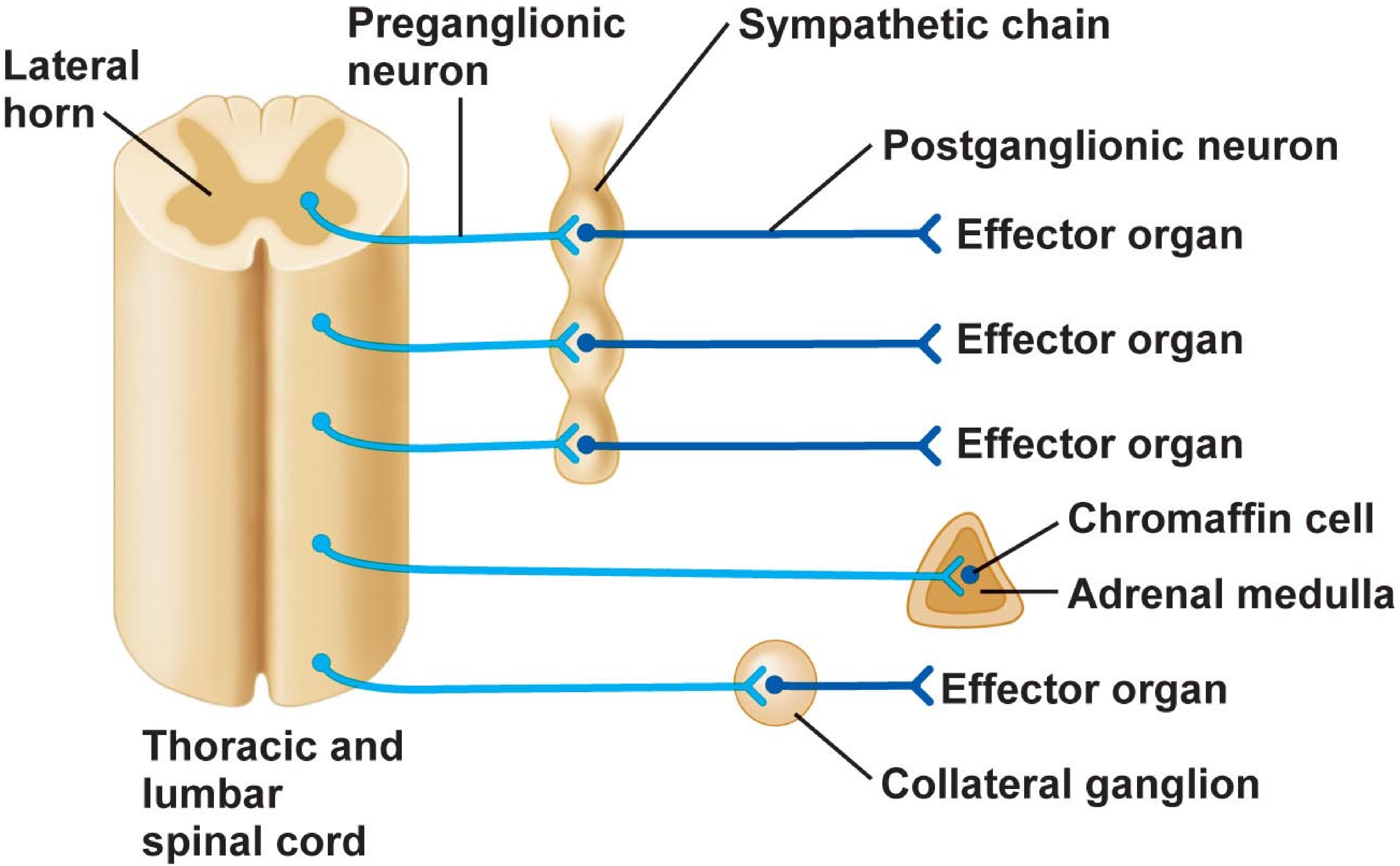
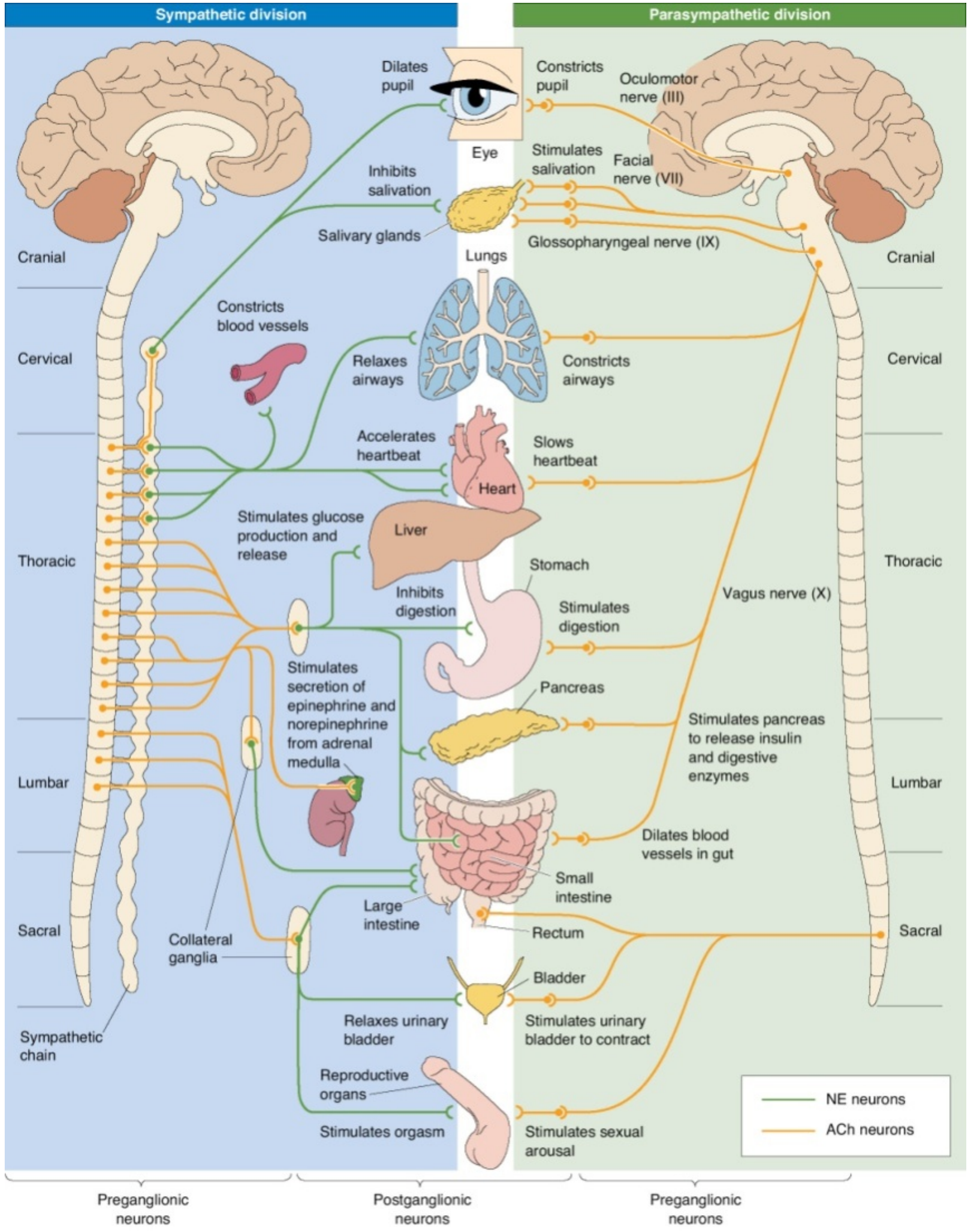
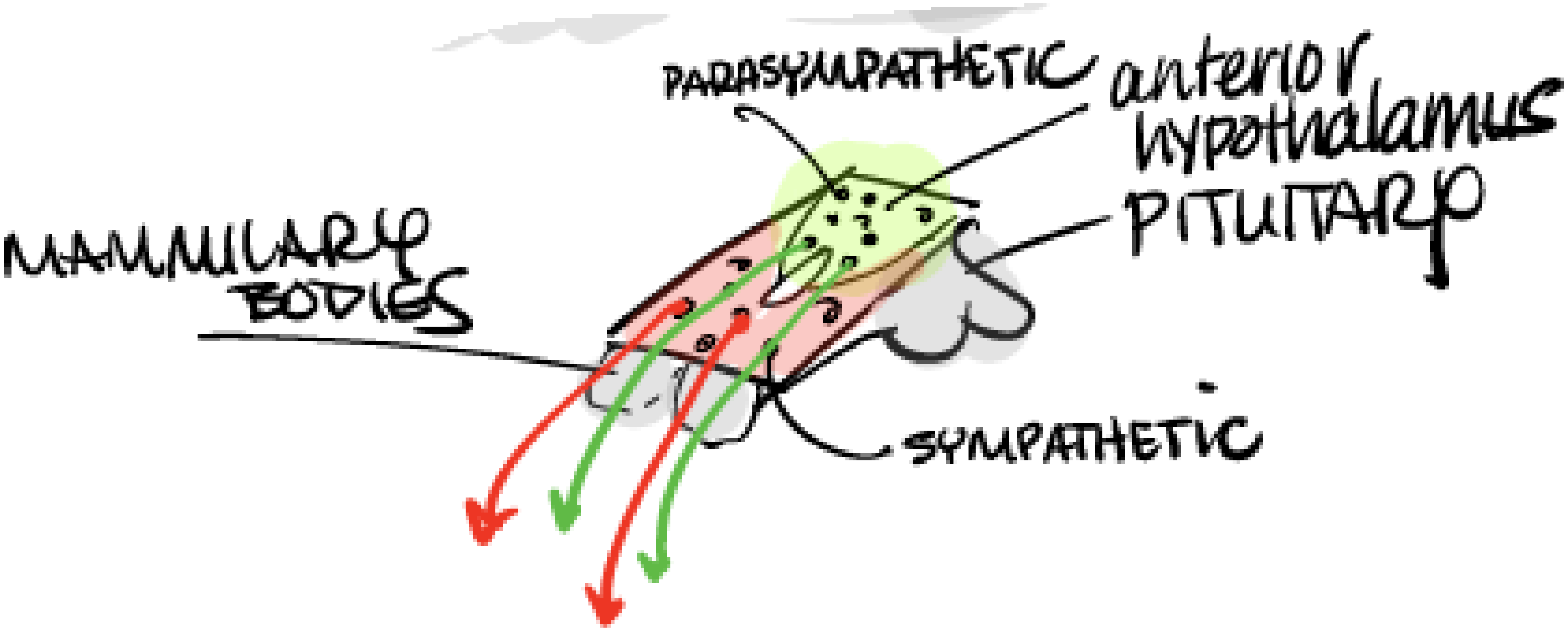


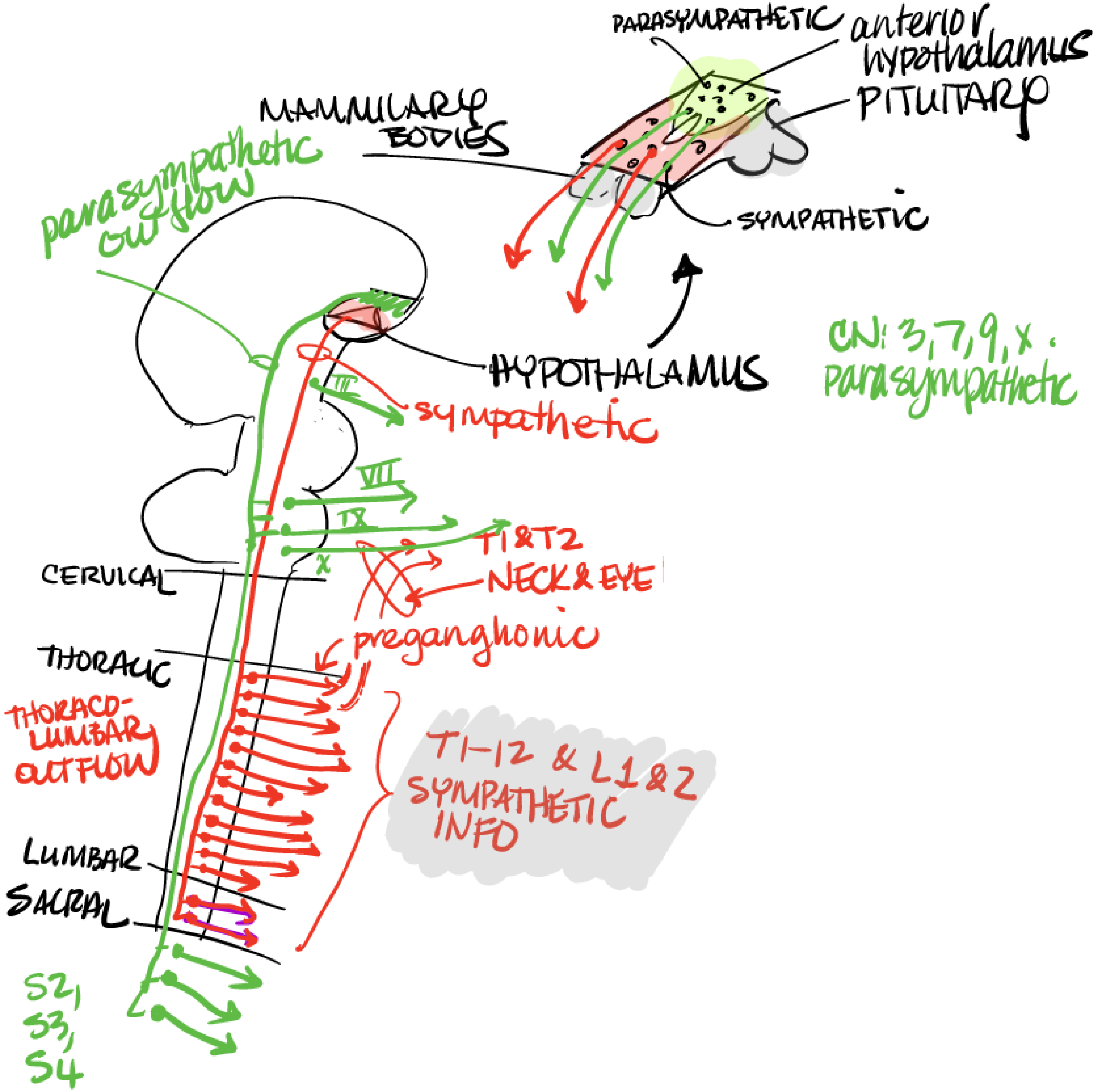
Image: http://droualb.faculty.mjc.edu/Course%20Materials/Physiology%20101/Chapter%20Notes/Fall%202007/chapter_11%20Fall%202007.htm

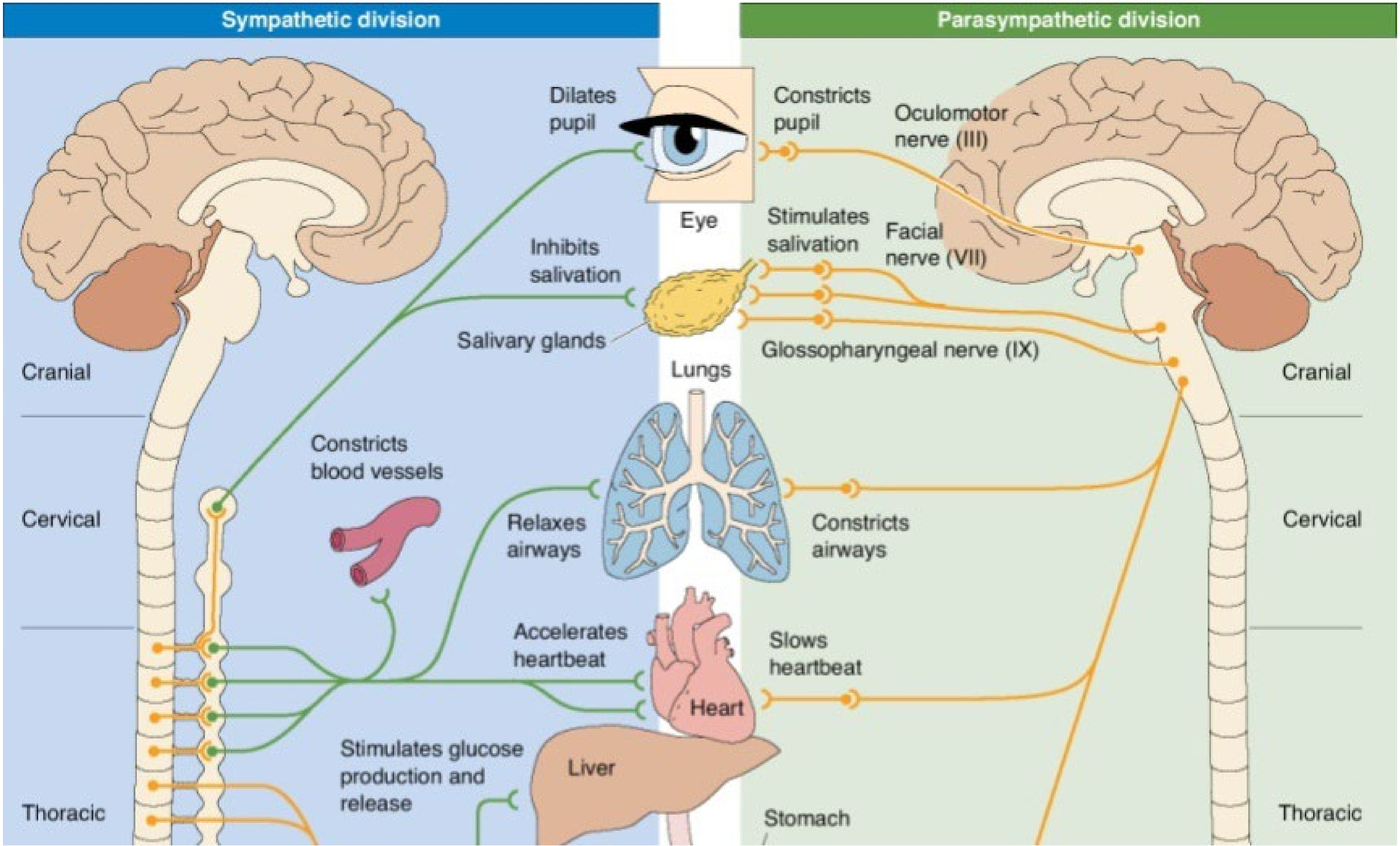
Sympathetic and Parasympathetic Divisions

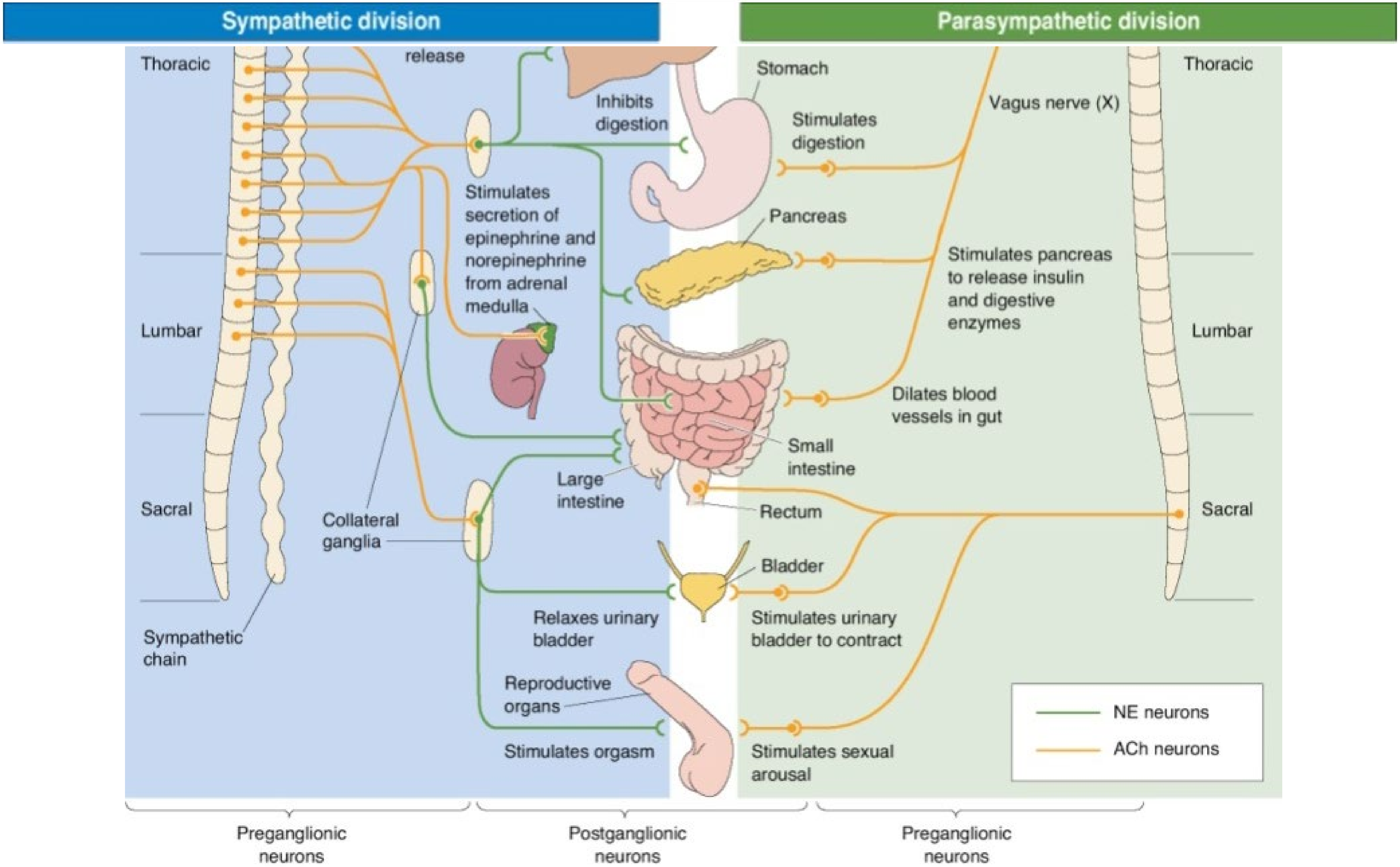


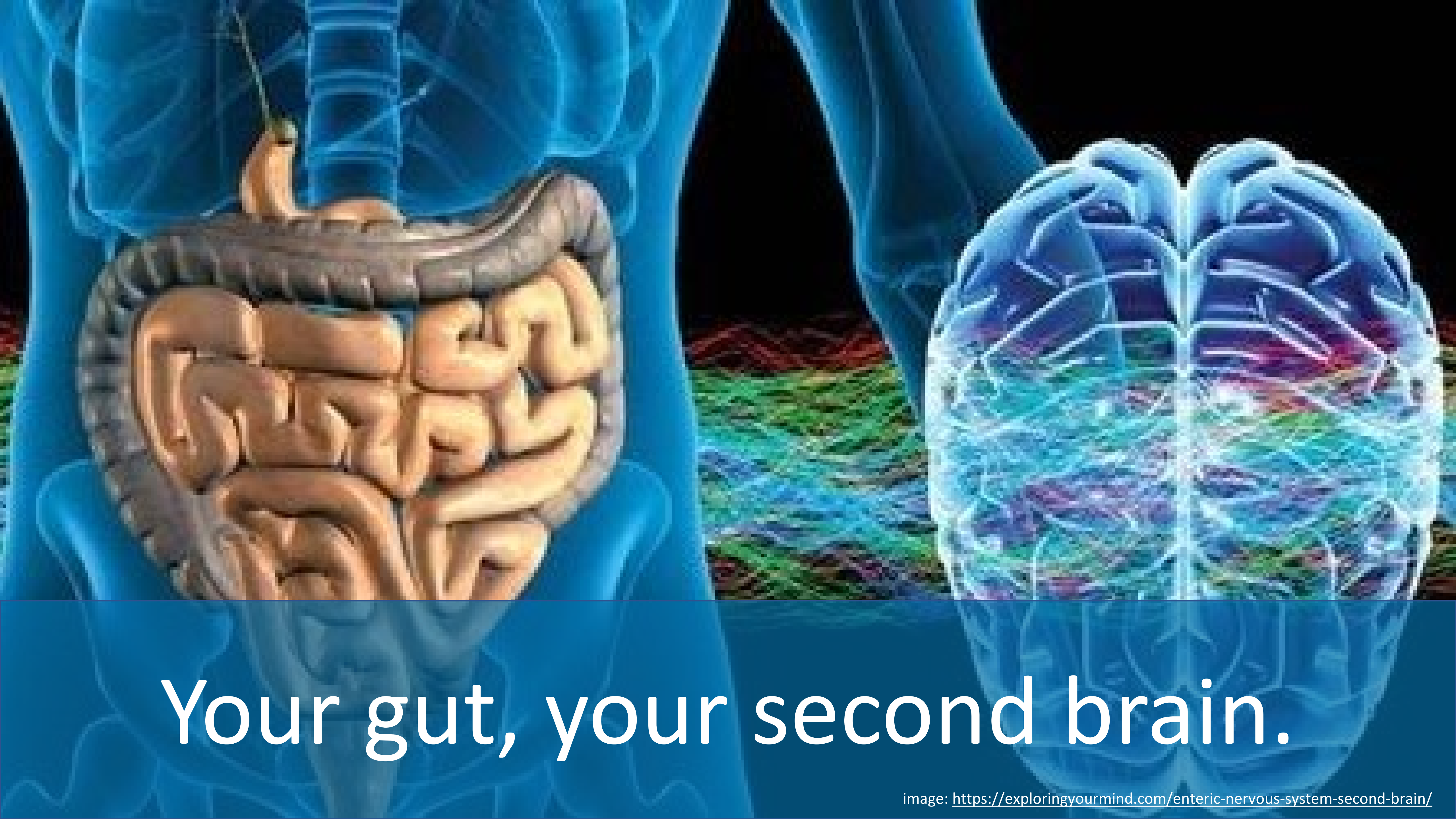
Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.


PARASYMPATHETIC
anterior hypothalamus
PITUITARY
MAMMILLARY BODIES
SYMPATHETIC


PARASYMPATHETIC
anterior hypothalamus
PITUITARY
MAMMILARY BODIES
SYMPATHETIC
parasympathetic outflow
HYPOTHALAMUS
CN: 3, 7, 9, X .
parasympathetic
III
sympathetic
VII
IX
X
T1 & T2
NECK & EYE
CERVICAL
preganglionic
THORACIC
THORACO-LUMBAR OUTFLOW
T1-12 & L1 & 2
SYMPATHETIC INFO
LUMBAR
SACRAL
S2,
S3,
S4


Sympathetic division
Parasympathetic division
Dilates pupil
Eye
Constricts pupil
Oculomotor nerve (III)
Inhibits salivation
Stimulates salivation
Facial nerve (VII)
Salivary glands
Glossopharyngeal nerve (IX)
Cranial
Lungs
Cranial
Constricts blood vessels
Cervical
Relaxes airways
Constricts airways
Cervical
Accelerates heartbeat
Slows heartbeat
Heart
Stimulates glucose production and release
Liver
Thoracic
Stomach
Thoracic


Sympathetic division
Parasympathetic division
Thoracic
release
Inhibits digestion
Stomach
Stimulates digestion
Vagus nerve (X)
Thoracic
Stimulates secretion of epinephrine and norepinephrine from adrenal medulla
Pancreas
Stimulates pancreas to release insulin and digestive enzymes
Lumbar
Lumbar
Dilates blood vessels in gut
Small intestine
Large intestine
Rectum
Sacral
Collateral ganglia
Sacral
Bladder
Relaxes urinary bladder
Stimulates urinary bladder to contract
Sympathetic chain
Reproductive organs
Stimulates orgasm
Stimulates sexual arousal
NE neurons
ACh neurons
Preganglionic neurons
Postganglionic neurons
Preganglionic neurons



Your gut, your second brain.

image: https://exploringyourmind.com/enteric-nervous-system-second-brain/

The Enteric Division

- Location: lining of esophagus, stomach, intestines, pancreas, and gallbladder
- Two complicated networks: myenteric (Auerbach's) plexus and submucous (Meissner's) plexus
- Function: control physiological processes involved in transport, digestion of food
- Input indirectly from brain via axons of the sympathetic and parasympathetic divisions

Image: https://www.sciencemag.org/news/2018/09/your-gut-directly-connected-your-brain-newly-discovered-neuron-circuit

Central Control of the ANS

Connections for autonomic control

- Periventricular zone connections to brain stem and spinal cord nuclei
- Nucleus of solitary tract

Function of solitary nucleus

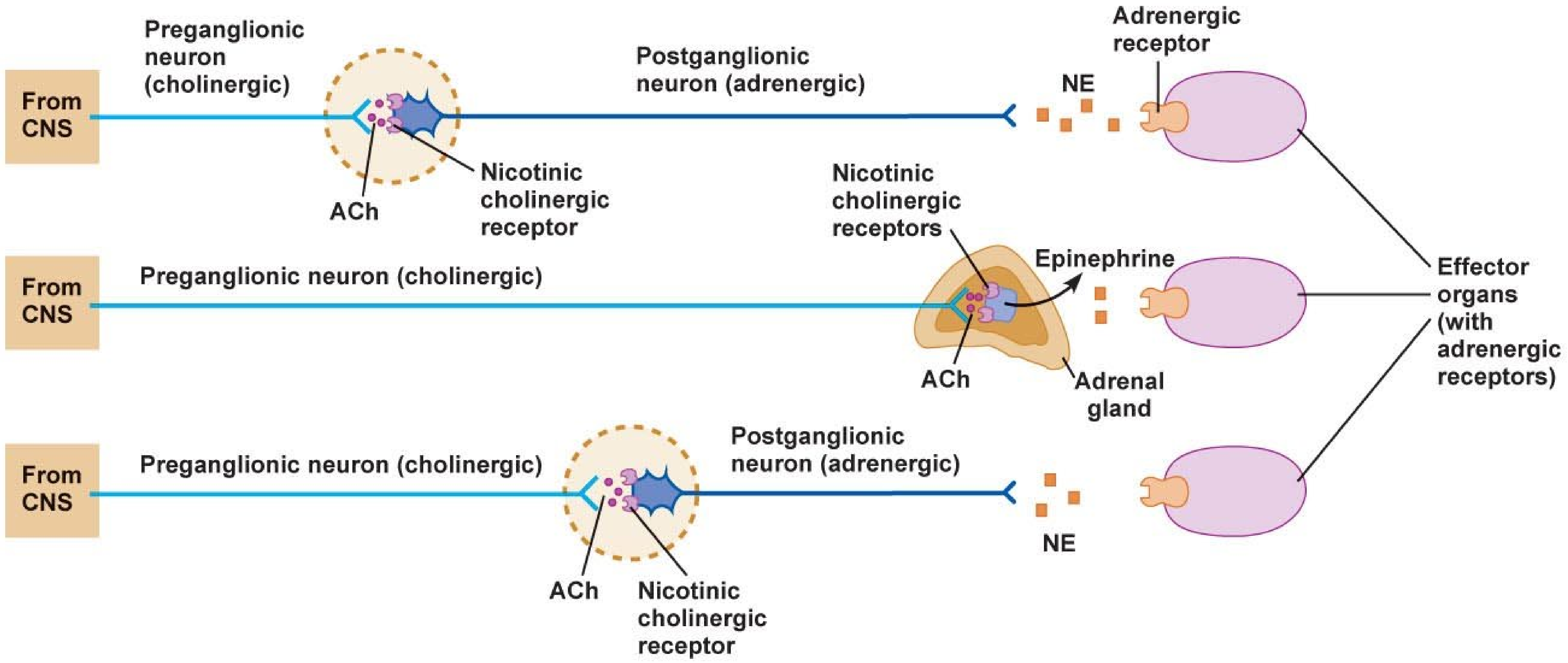
- Integrates sensory information from internal organs and coordinates output to autonomic brain stem nuclei

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Autonomic Neurotransmitters

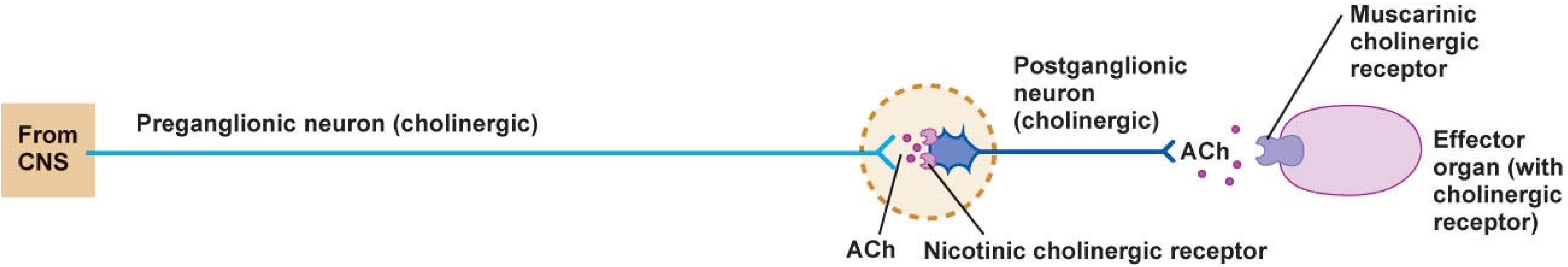
The peripheral nervous system uses two neurotransmitters:

1. **Acetylcholine** is the most common.
2. **Norepinephrine** the other neurotransmitter.



(a) Sympathetic nervous system

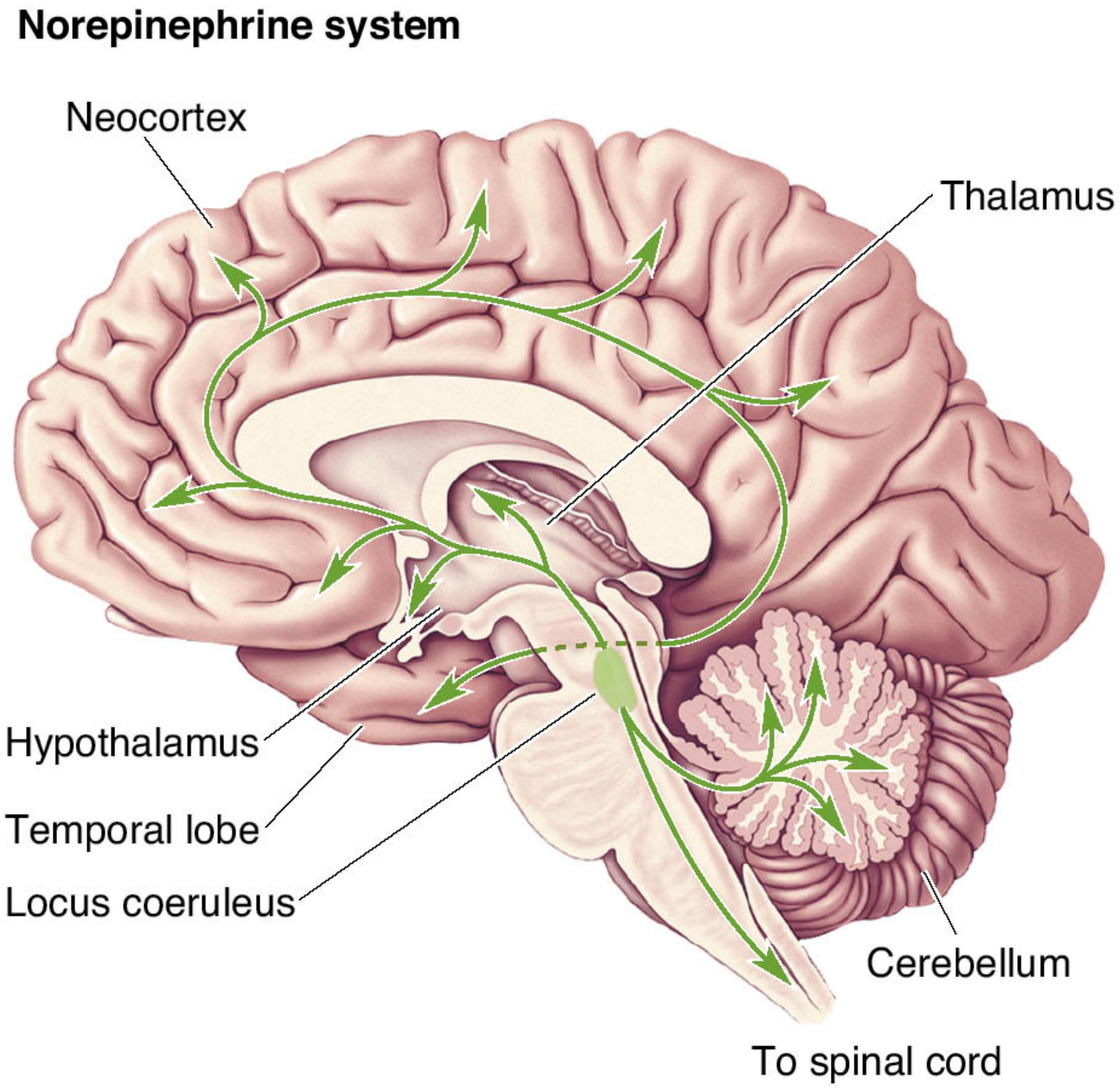
Image: http://droualb.faculty.mjc.edu/Course%20Materials/Physiology%20101/Chapter%20Notes/Fall%202007/chapter_11%20Fall%202007.htm



(b) Parasympathetic nervous system

Image: http://droualb.faculty.mjc.edu/Course%20Materials/Physiology%20101/Chapter%20Notes/Fall%202007/chapter_11%20Fall%202007.htm

The Noradrenergic Locus Coeruleus



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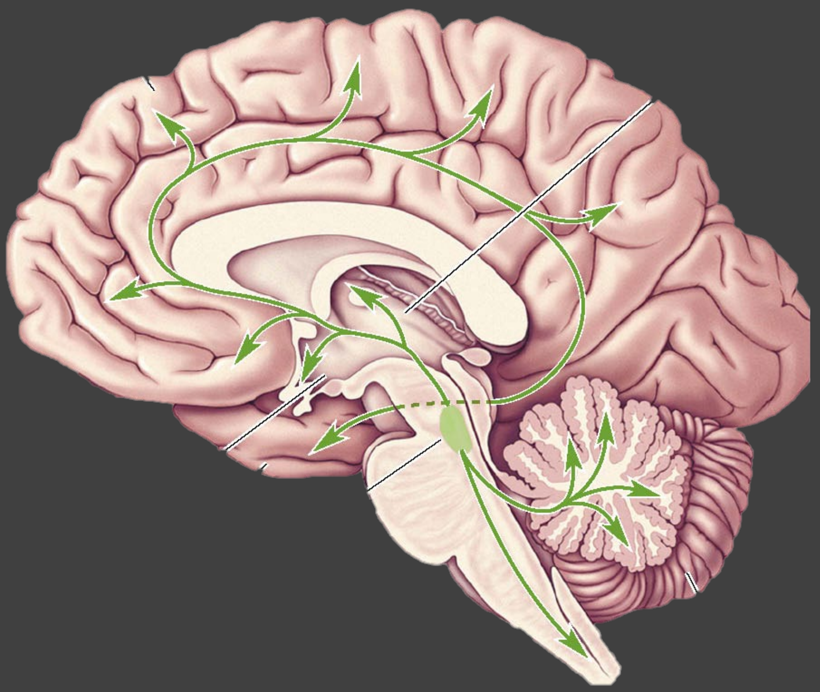
Norepinephrine system



Locus coeruleus

Path: Axons innervate cerebral cortex, thalamus, hypothalamus, olfactory bulb, cerebellum, midbrain, and spinal cord.

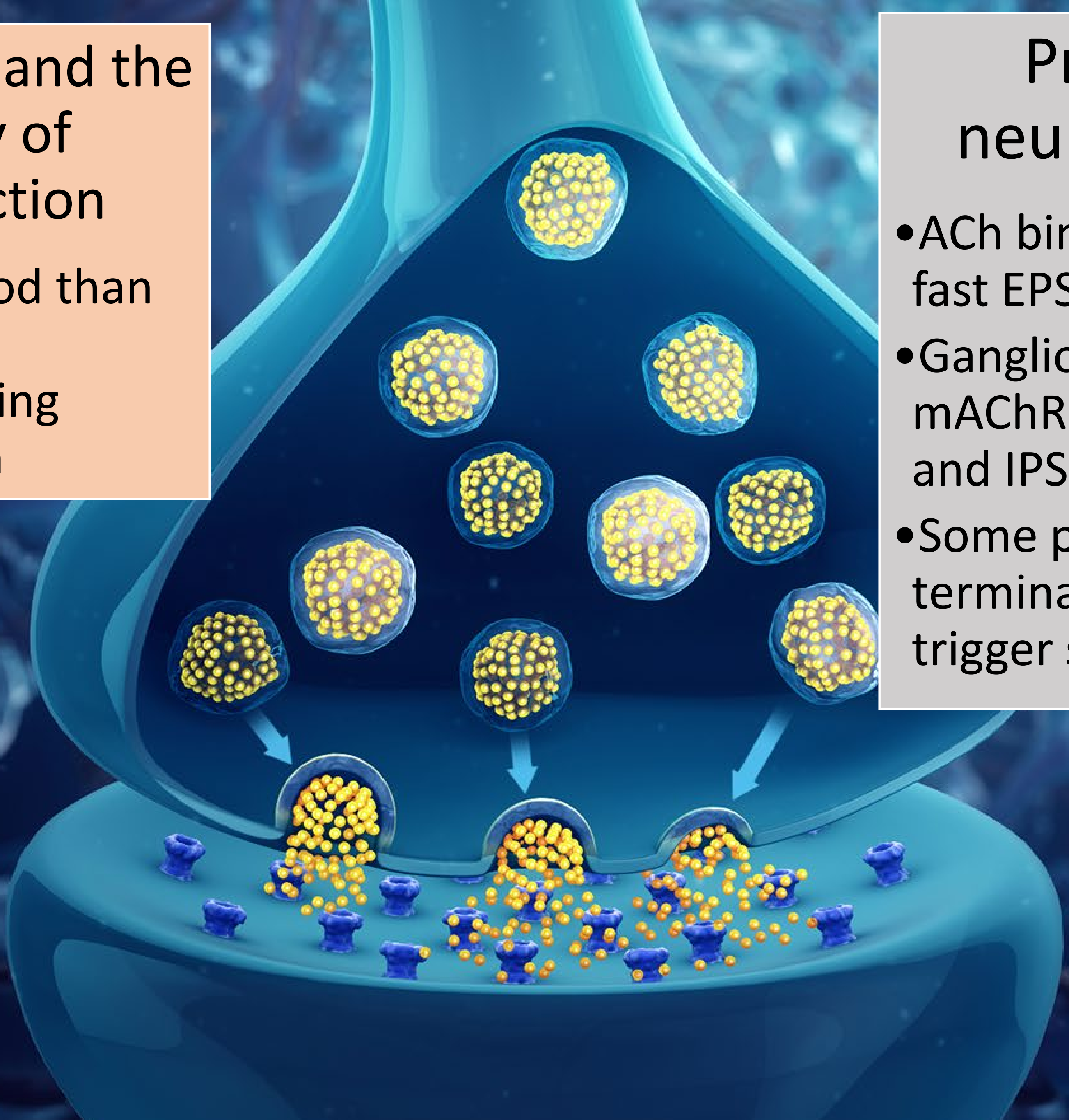
Function: regulation of attention, arousal, sleep–wake cycles, learning and memory, anxiety and pain, mood, brain metabolism

Activation: new, unexpected, nonpainful sensory stimuli

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Neurotransmitters and the pharmacology of autonomic function

- ANS better understood than the CNS—e.g., drug mechanisms influencing synaptic transmission



Preganglionic neurotransmitters

- ACh binds to nAChR, evokes fast EPSP.
- Ganglionic ACh activates mAChR, causes slow EPSPs and IPSPs.
- Some preganglionic terminals release NPY, VIP—trigger small EPSPs.

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Postganglionic Neurotransmitters

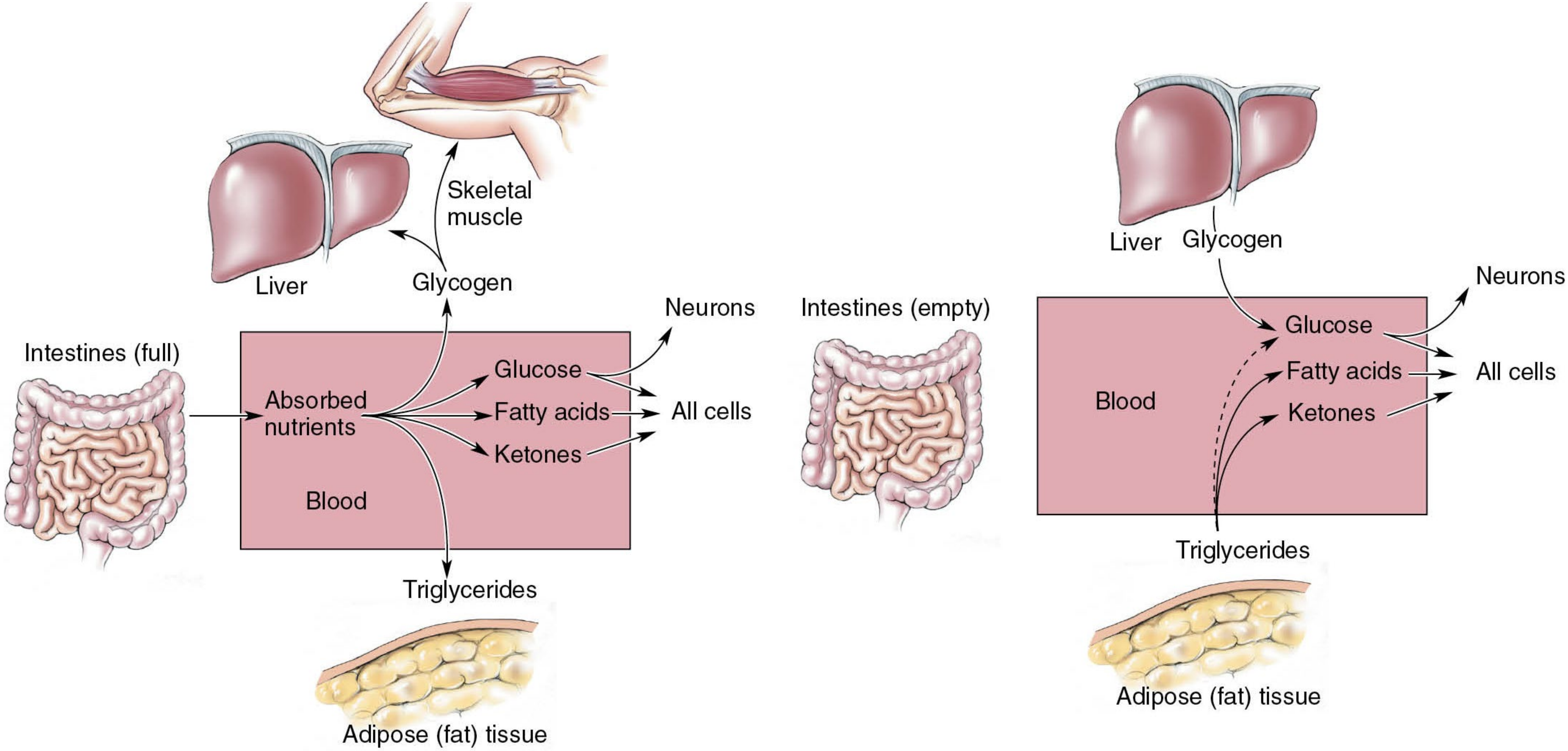
Parasympathetic: release Ach — Local effect

Sympathetic: most release NE — Far-reaching effects

Parasympathomimetic: mimic or promote muscarinic actions of ACh or inhibit actions of NE

Sympathomimetic: mimic or promote NE actions or inhibit muscarinic actions of ACh

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.



(b) Catabolism during the postabsorptive state

(a) Anabolism during the prandial state

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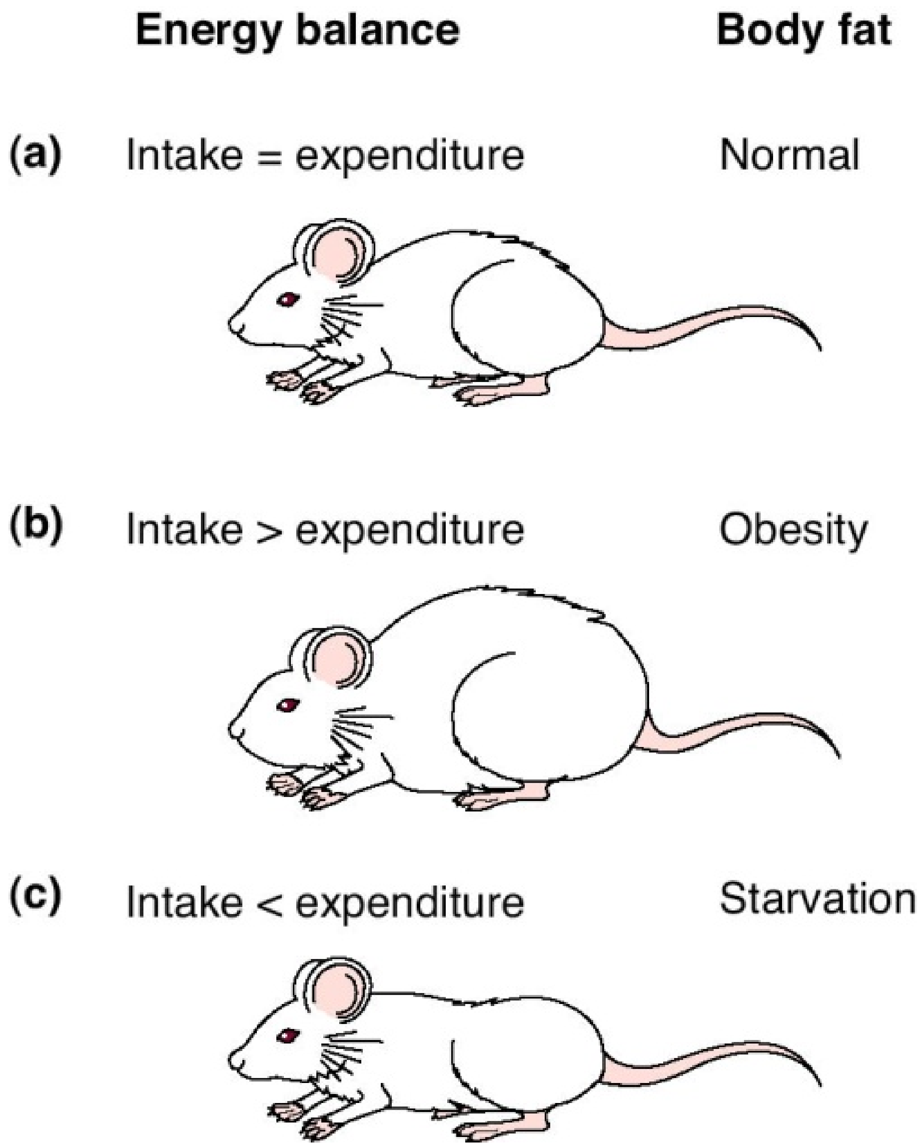
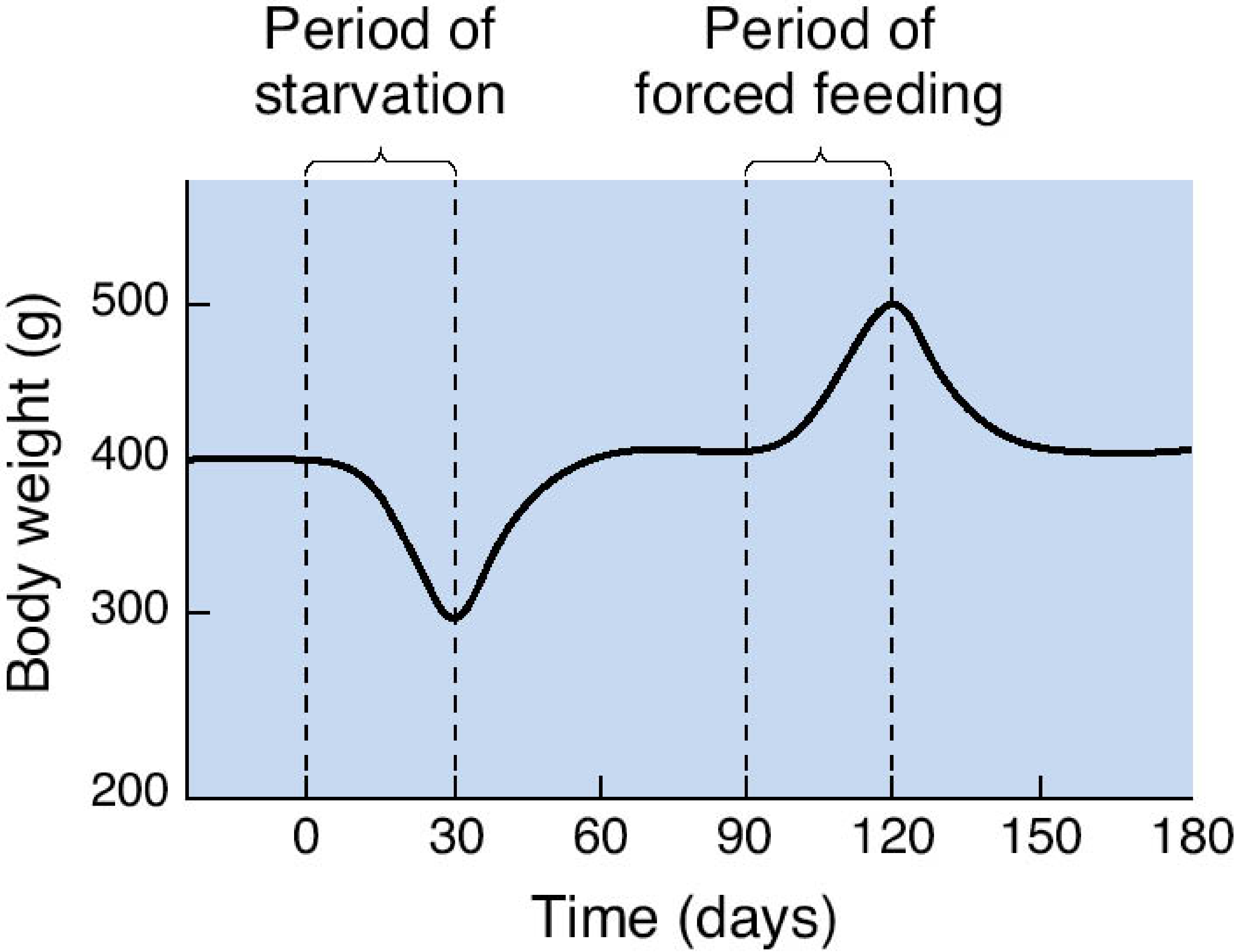


Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Body Fat and Food Consumption

- Lipostatic hypothesis
- Experiments with parabiosis
- Leptin
  - Regulates body mass
    - Decreases appetite
    - Increases energy expenditure
- Leptin depletion
  - Incites adaptive responses to fight starvation



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Energy Balance

- Prandial state—anabolism: energy storage as glycogen and triglycerides
- Postabsorptive state—catabolism: breaking down complex macromolecules for energy

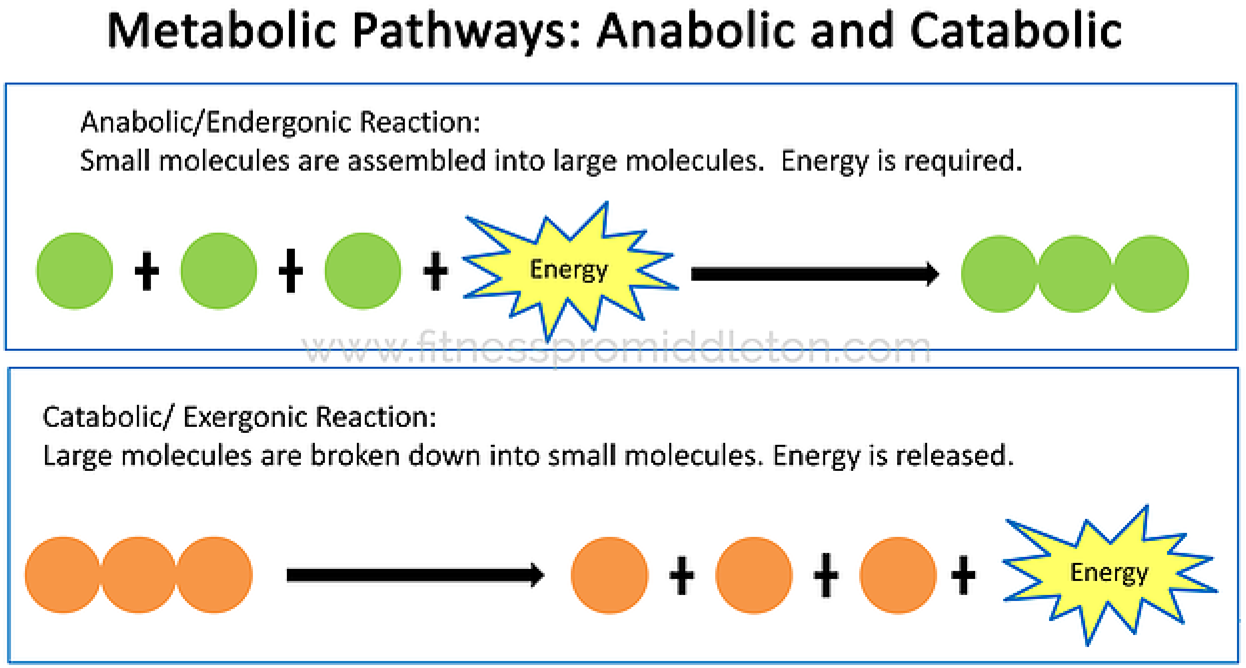

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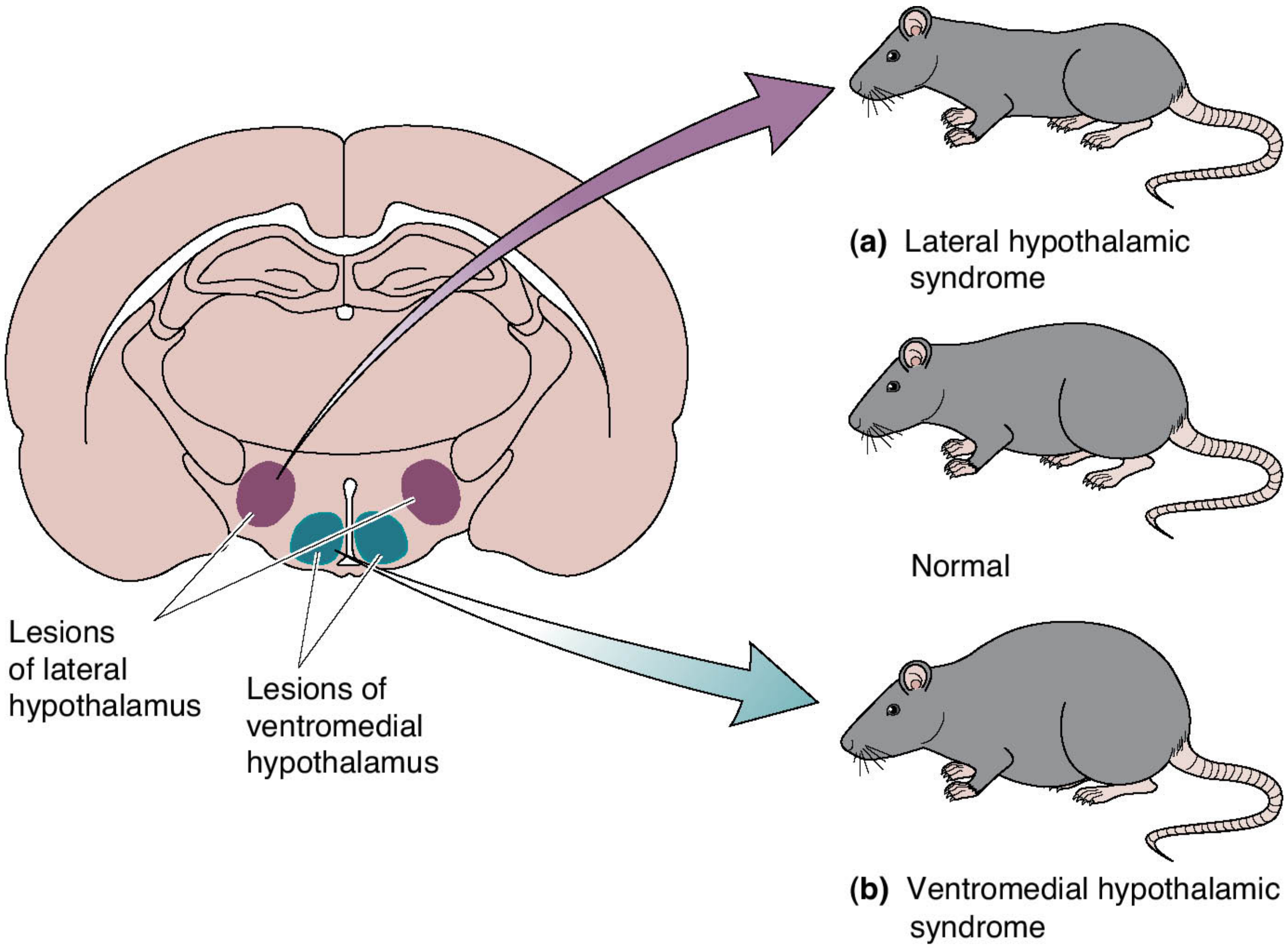
Image: https://www.myfitnesspal.com/blog/Fitnesspromiddleton?month=201604

The Hypothalamus and Feeding

- Anorexia from lateral hypothalamic syndrome
- Obesity from ventromedial hypothalamic syndrome
- Both related to leptin signaling



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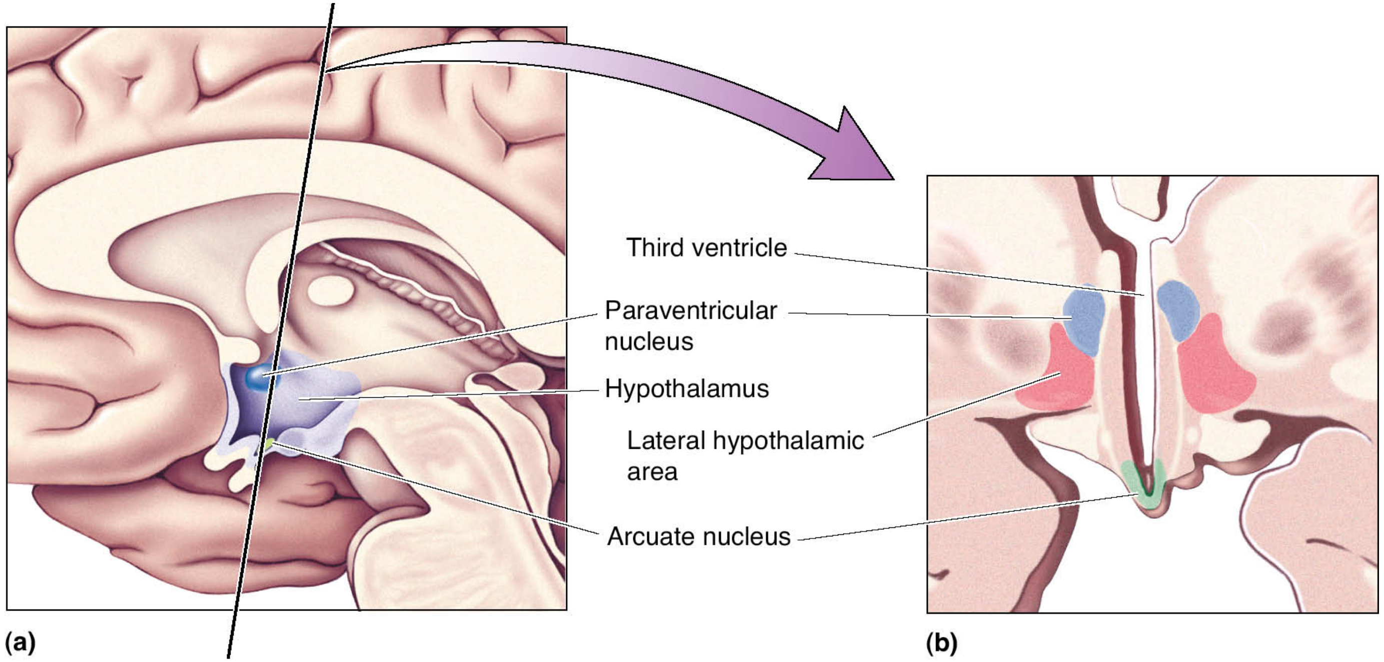
Arcuate nucleus of hypothalamus important for the control of feeding



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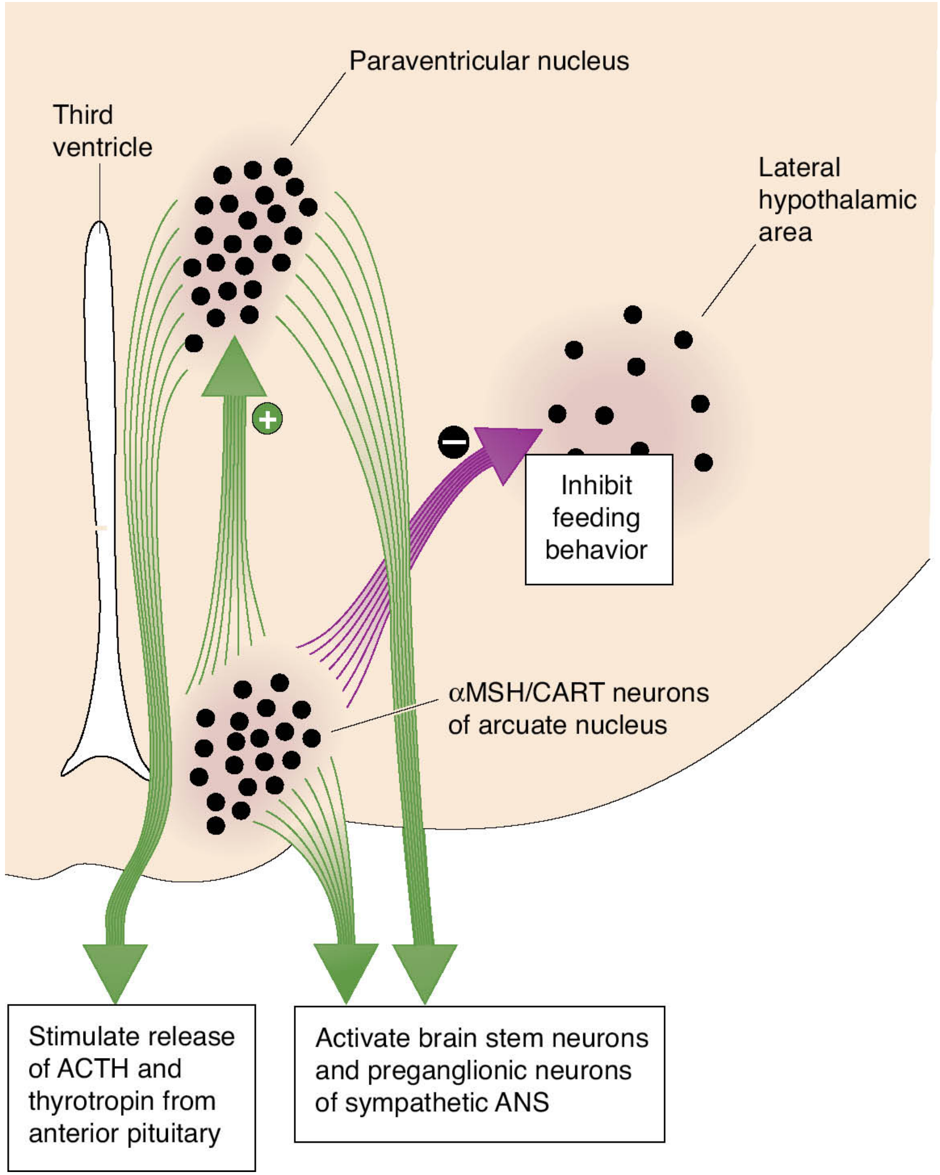
Response to Elevated Leptin Levels

- Activation of arcuate neurons that release αMSH and CART peptides
  - Anorectic peptides—diminish appetite
  - Project to regions that orchestrate coordinated response of humoral, visceromotor, and somatic responses
    - Paraventricular nucleus (humoral response)
    - Intermediolateral gray matter of spinal cord
    - Lateral hypothalamus



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Response to Decreased Leptin Levels

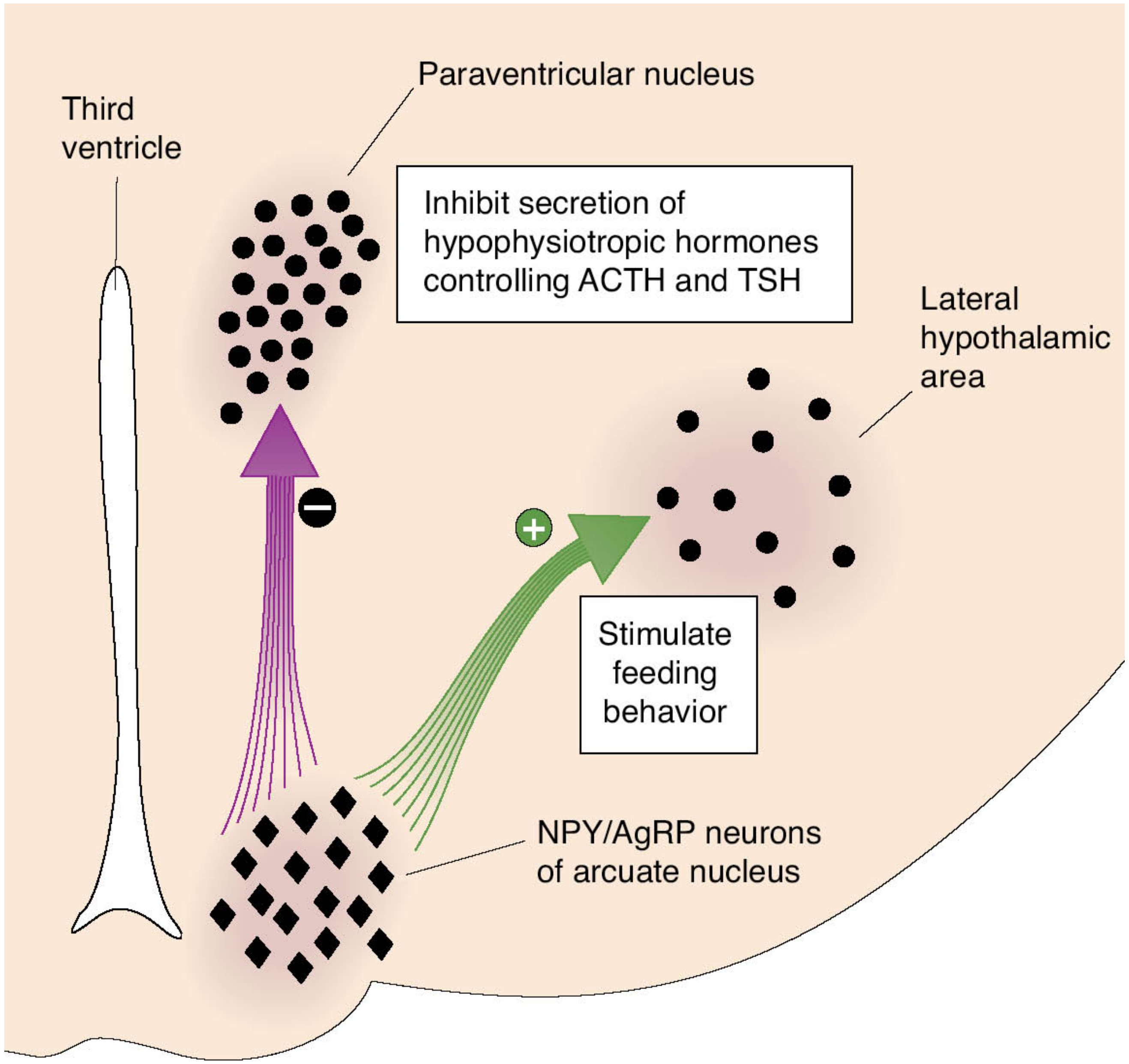
Activation of arcuate neurons that release NPY and AgRP

Effects on energy balance: opposite the effects of αMSH and CART

Orexigenic peptides—increase appetite

- NPY and AgRP inhibit secretion of TSH and ACTH
- Activate parasympathetic division of ANS
- Stimulate feeding behavior

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.



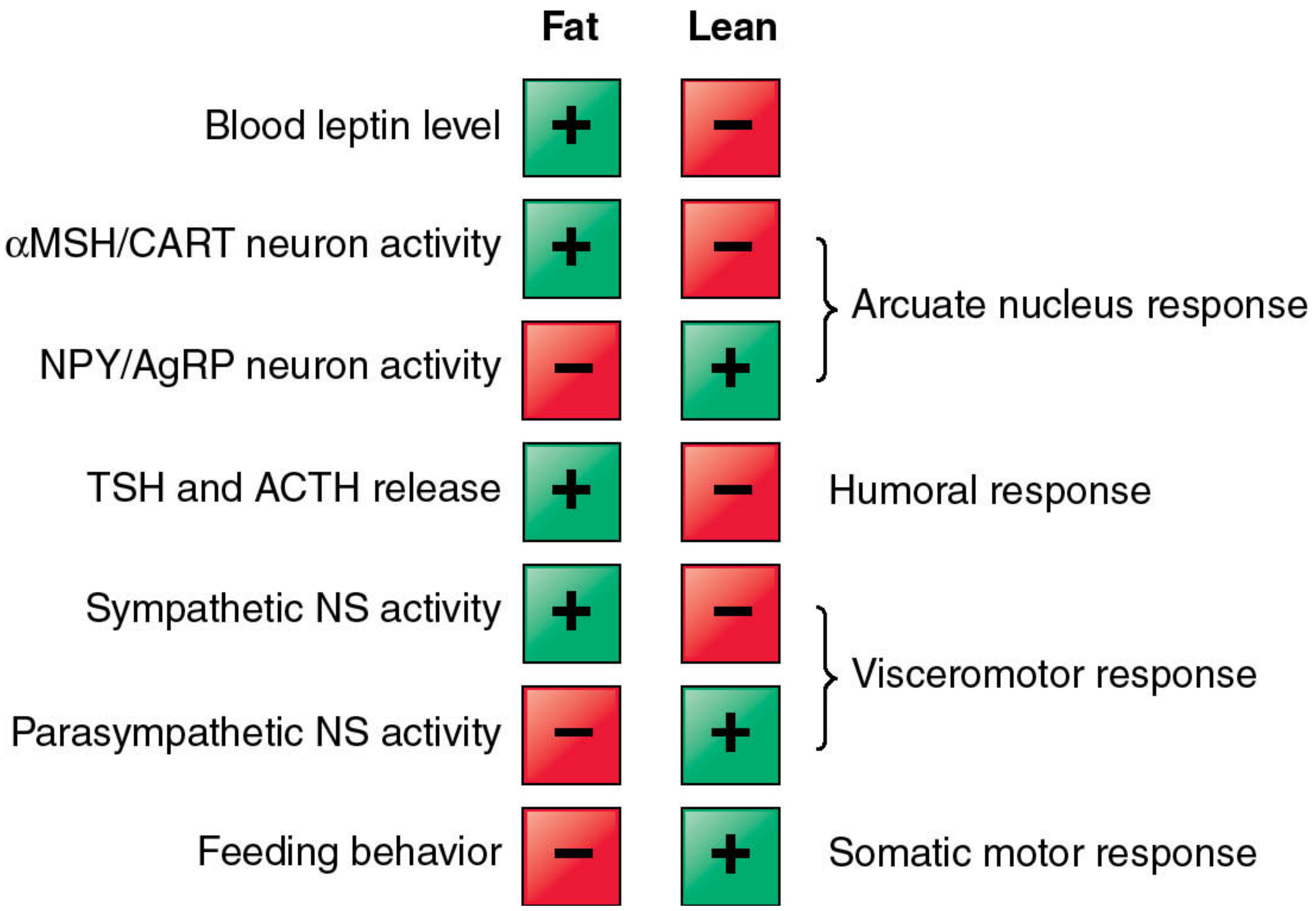
Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Control of Feeding by Lateral Hypothalamic Peptides

- LH neurons stimulating feeding behavior contain:
  - Melanin-concentrating hormone (MCH)
    - Widespread connections in the brain
    - Prolongs consumption
  - Orexin
    - Also with widespread cortical connections
    - Promotes meal initiation

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Summary of Responses to Increased and Decreased Adiposity



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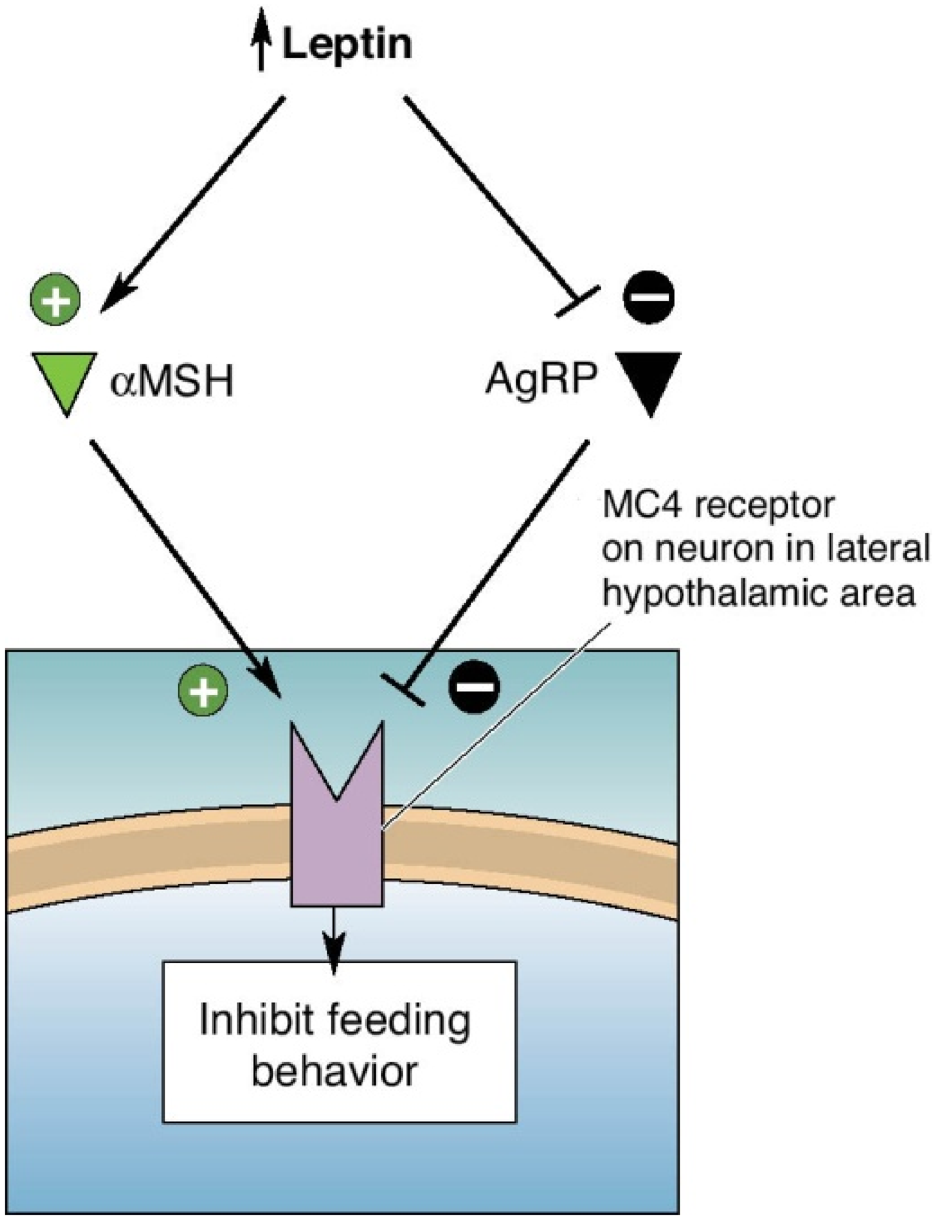
Competition for Activation of the MC4 Receptor



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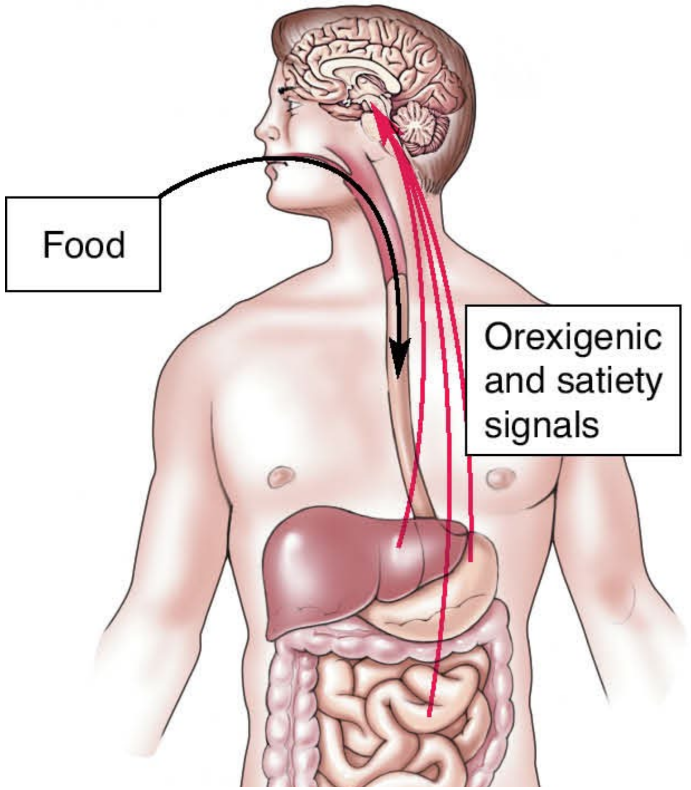
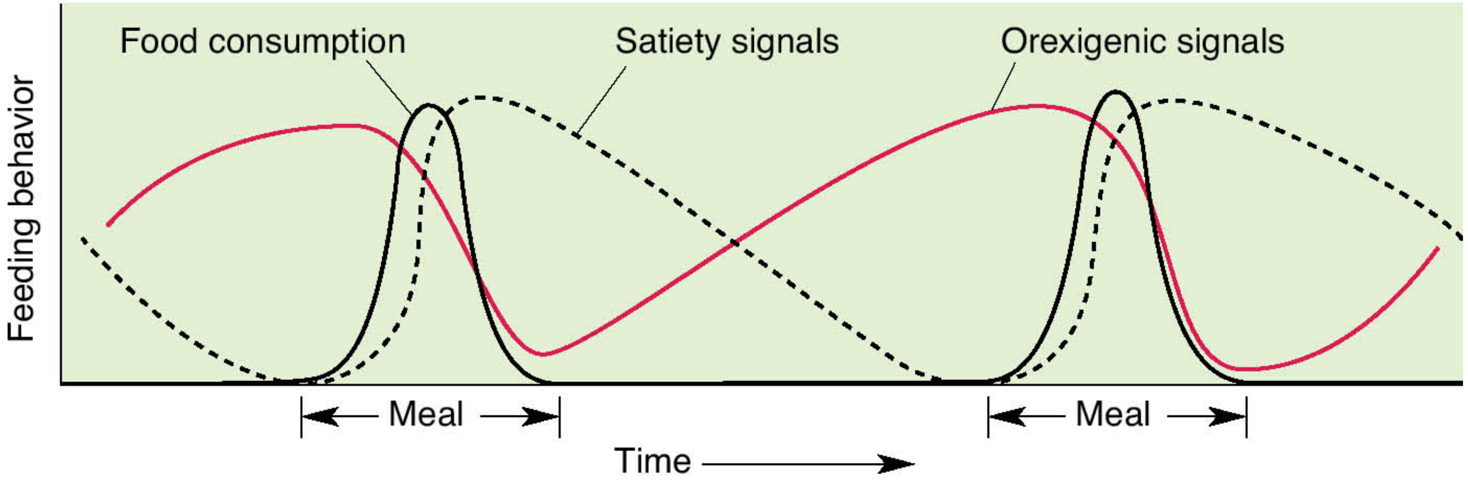
Model for Short-Term Regulation of Feeding

Three phases: cephalic, gastric, substrate





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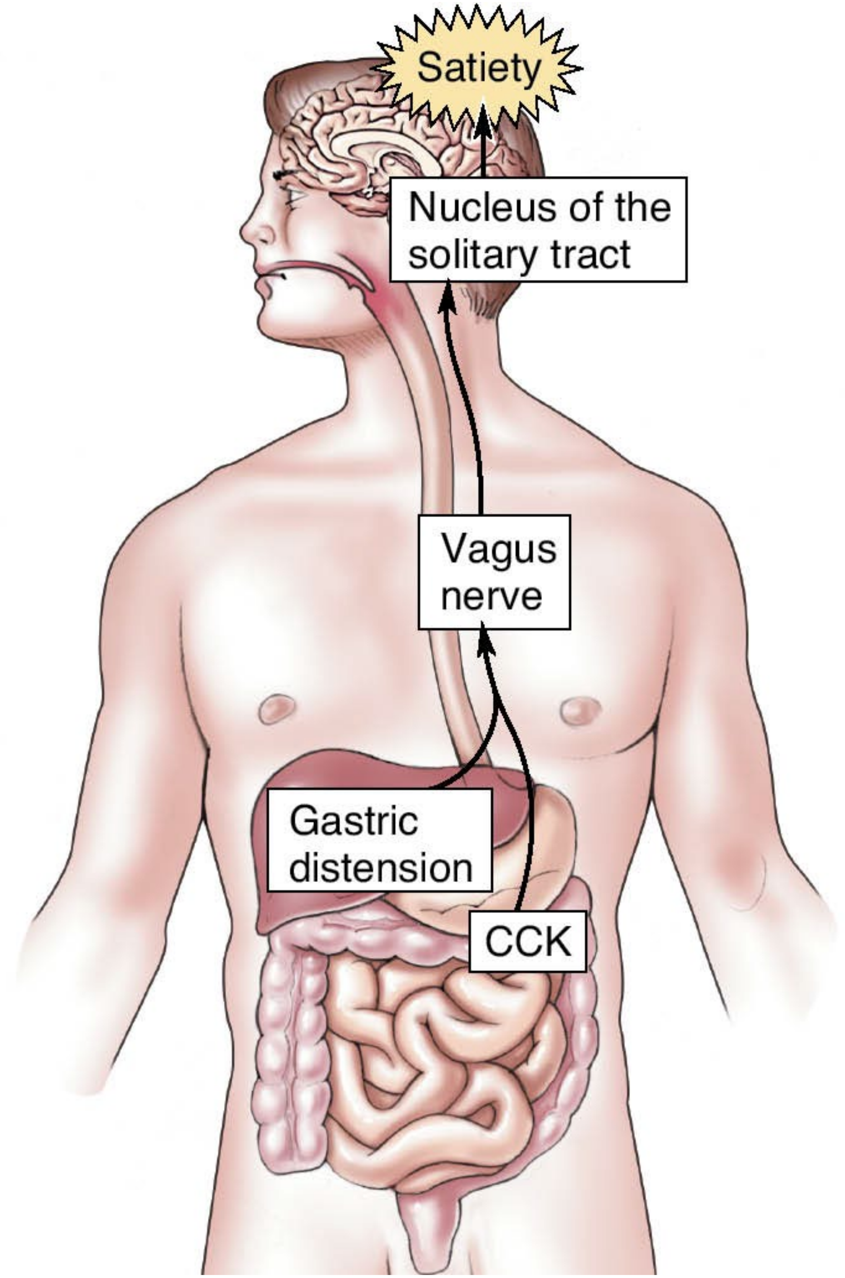
- Cephalic: hunger
  - Ghrelin released when stomach is empty
  - Activates NPY/AgRP-containing neurons in arcuate nucleus
  - Removal of ghrelin-secreting cells of stomach thought to cause loss of appetite

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Image: https://www.olyaschmidt.com/hangry-printable/

Model for Short-Term Regulation of Feeding

- Gastric: feeling full
  - Gastric distension signals brain via vagus nerve.
  - Works synergistically with CCK released in intestines in response to certain foods
  - Insulin also released by β cells of the pancreas— important in anabolism



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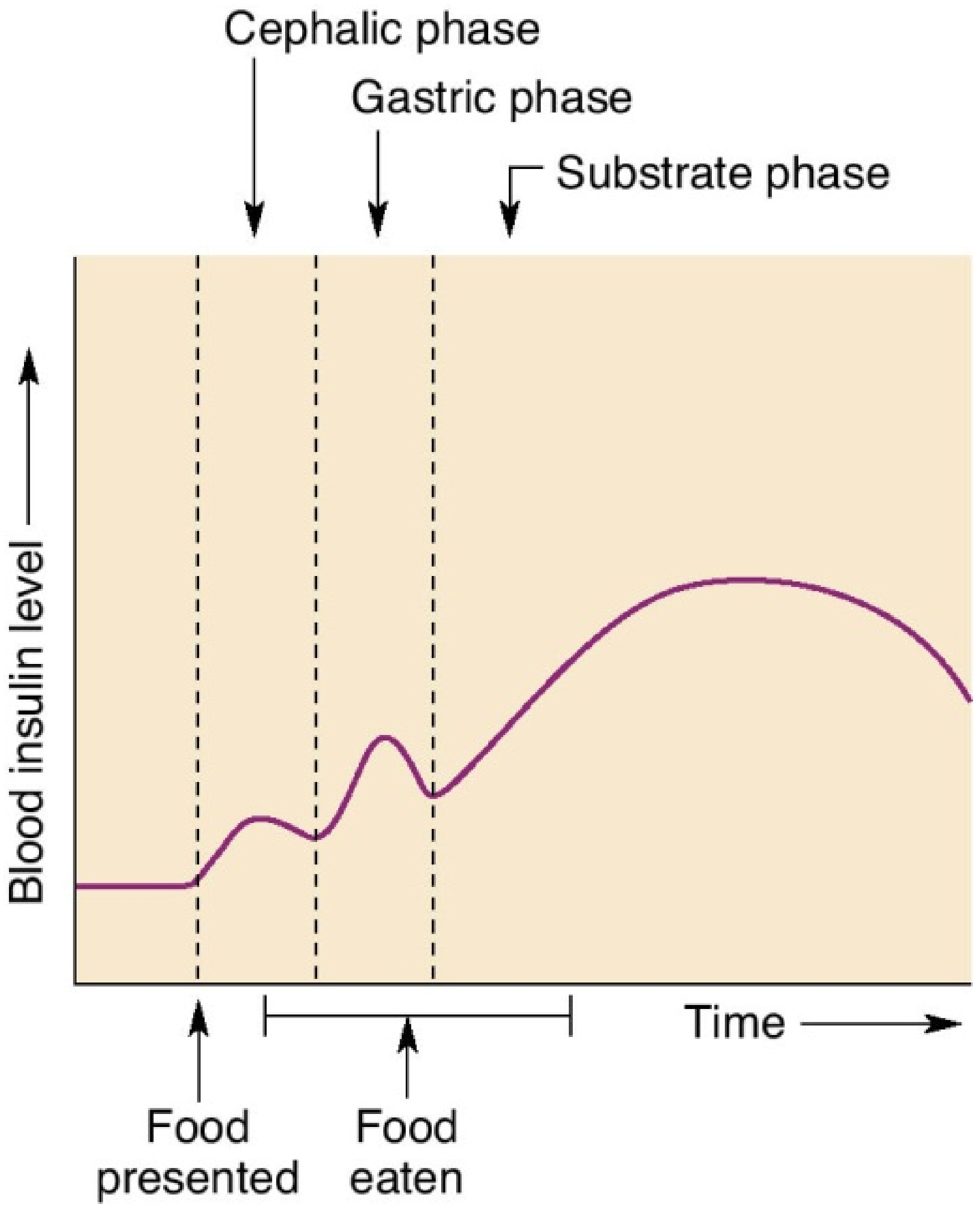
- Changes in blood insulin levels before, during, and after a meal
- Highest during substrate phase



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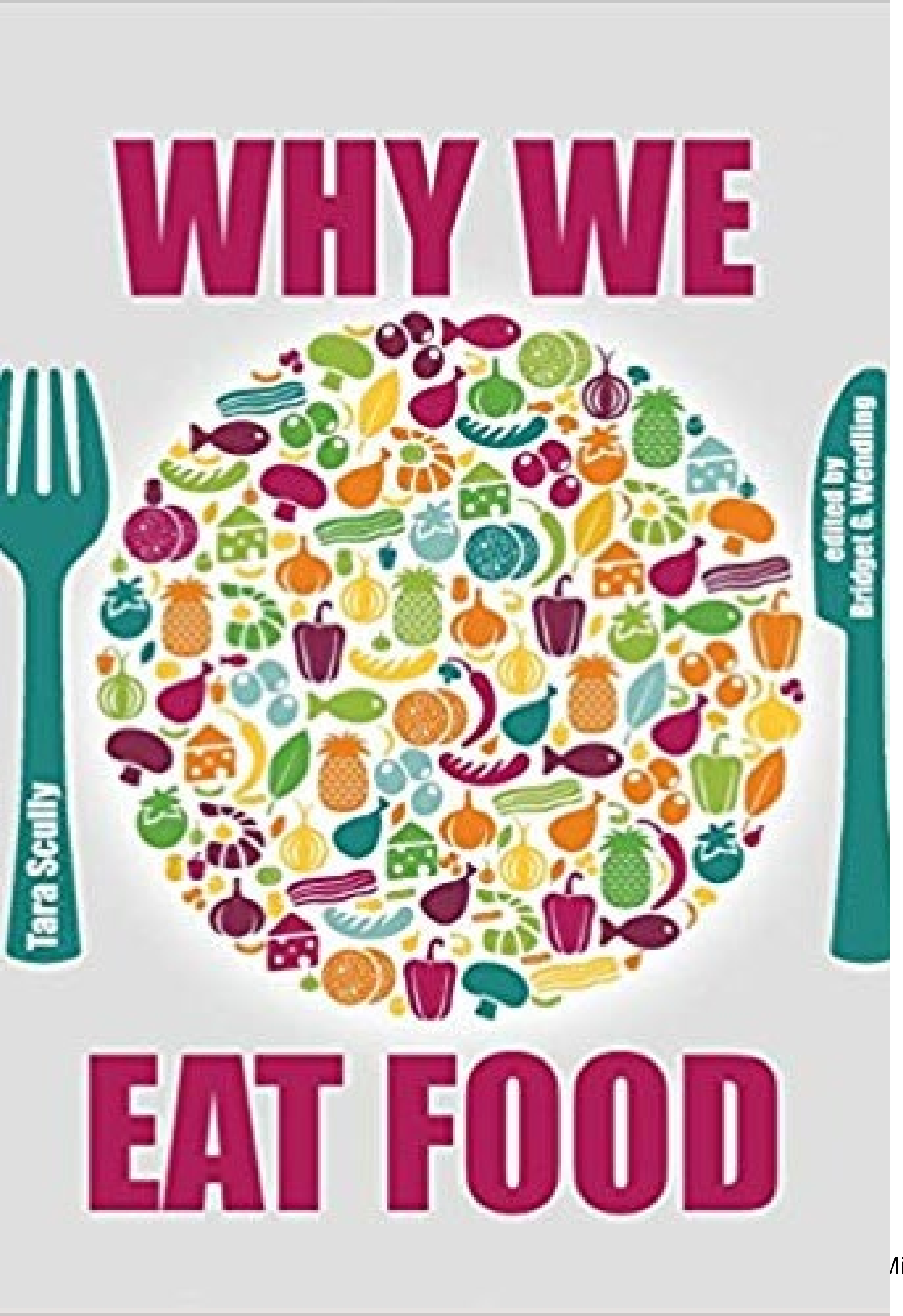
The Diffuse Modulatory Systems of the Brain

- Anatomy and functions differ:
  - Four systems with common principles
    - Small set of neurons at core
    - Neurons arise from brain stem.
    - One neuron influences many others.
    - Synapses release transmitter molecules into extracellular fluid.

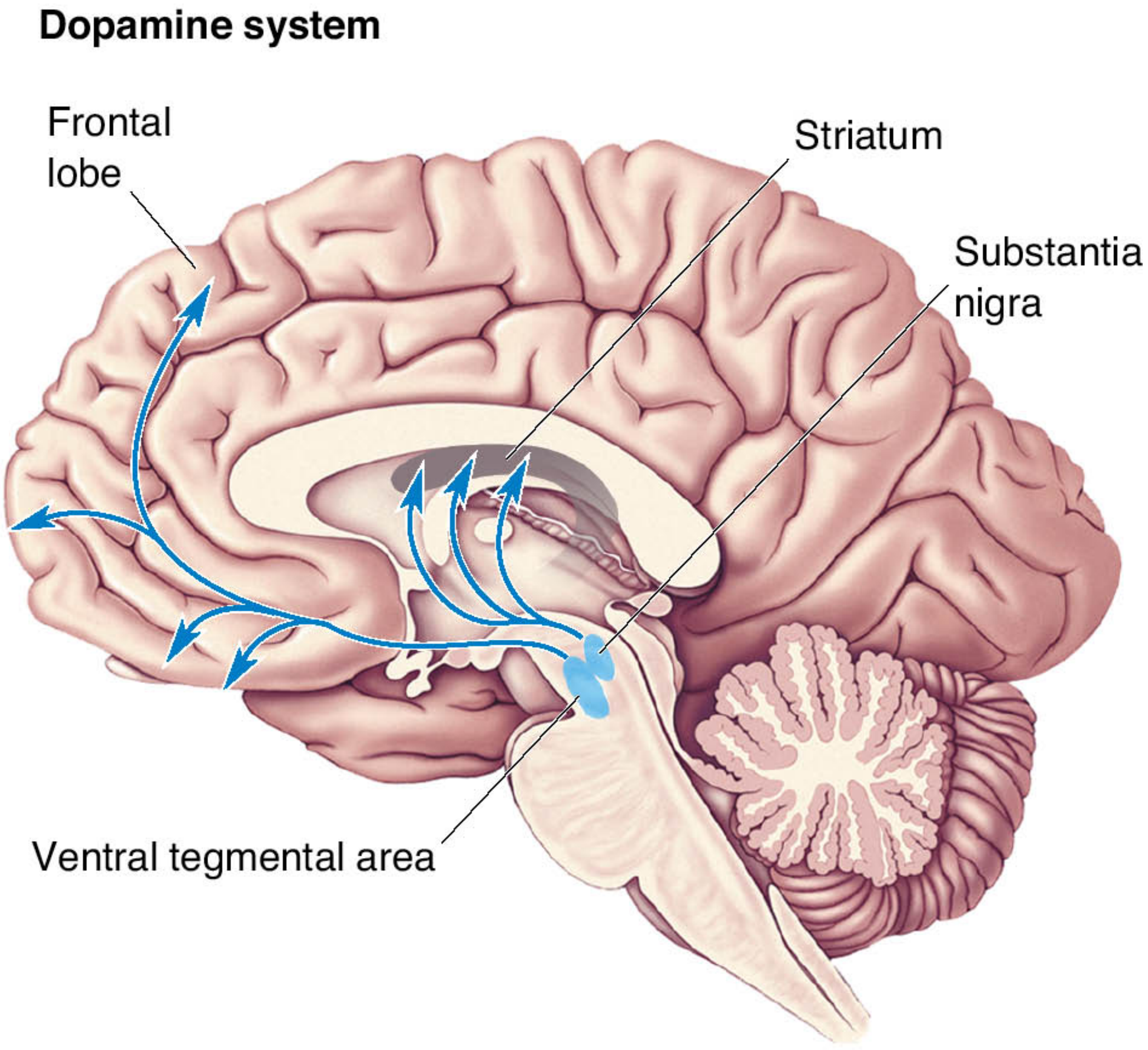


- Reinforcement and reward
  - Liking: hedonic
  - Wanting: drive reduction
  - Electrical self-stimulation experiments—identify brain sites of reinforcement
  - Effective sites for self-stimulation
    - Trajectory of dopaminergic axons in the ventral tegmental area projecting to the forebrain
  - Drugs that block dopamine receptors: reduce self-stimulation

ichael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Image: https://www.amazon.com/Why-Eat-Food-SCULLY-TARA/dp/1465298754

Dopaminergic Substantia Nigra and Ventral Tegmental Area



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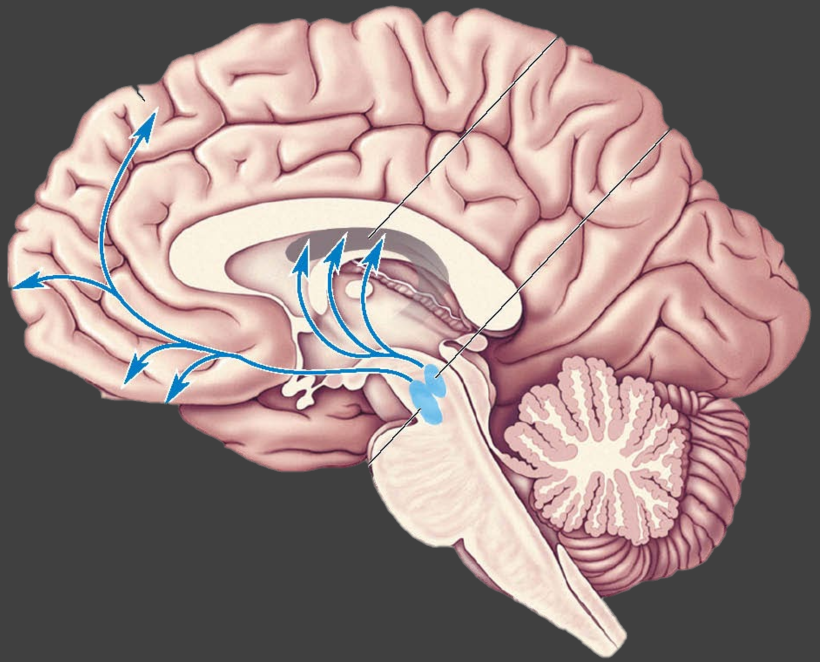
Dopaminergic system



Substantia nigra

Axons project to the striatum.

Facilitates the initiation of voluntary movements (degeneration causes Parkinson’s disease)

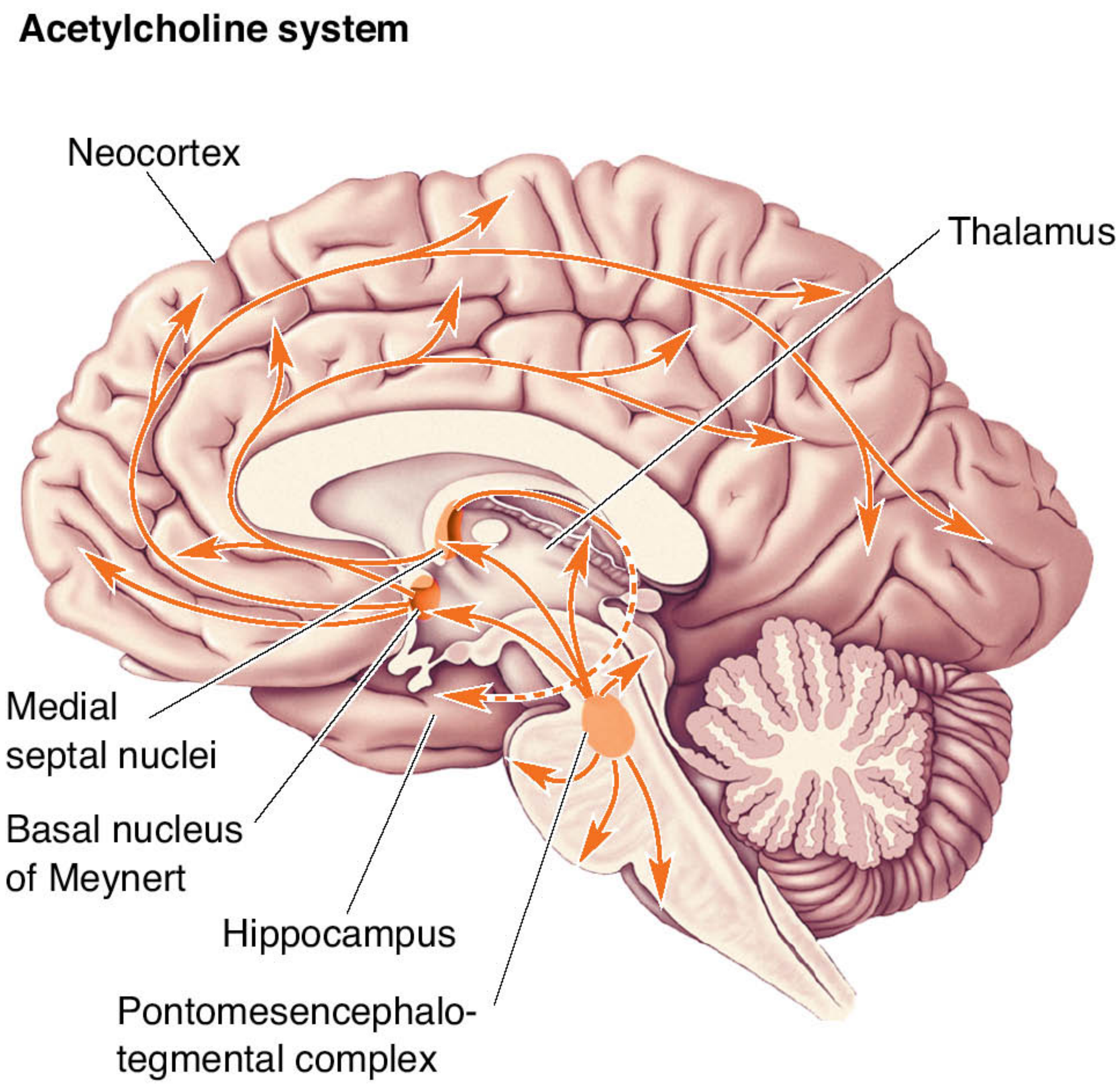
Ventral tegmental area

Innervates circumscribed region of telencephalon

- Mesocorticolimbic dopamine system: dopaminergic projection from midbrain

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

The Cholinergic Diffuse Modulatory Systems



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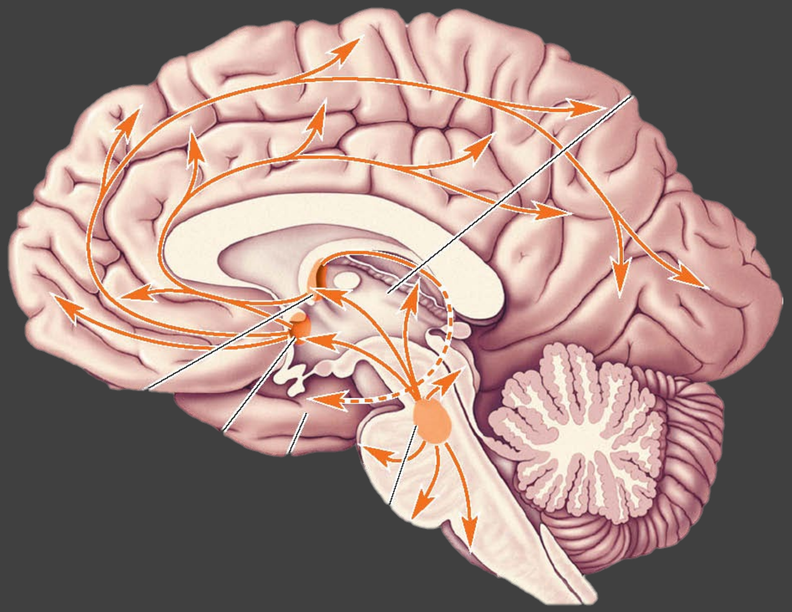
Cholinergic System



Basal forebrain complex

Core of telencephalon, medial and ventral to basal ganglia

Function: mostly unknown, participates in learning and memory

Pontomesencephalotegmental complex

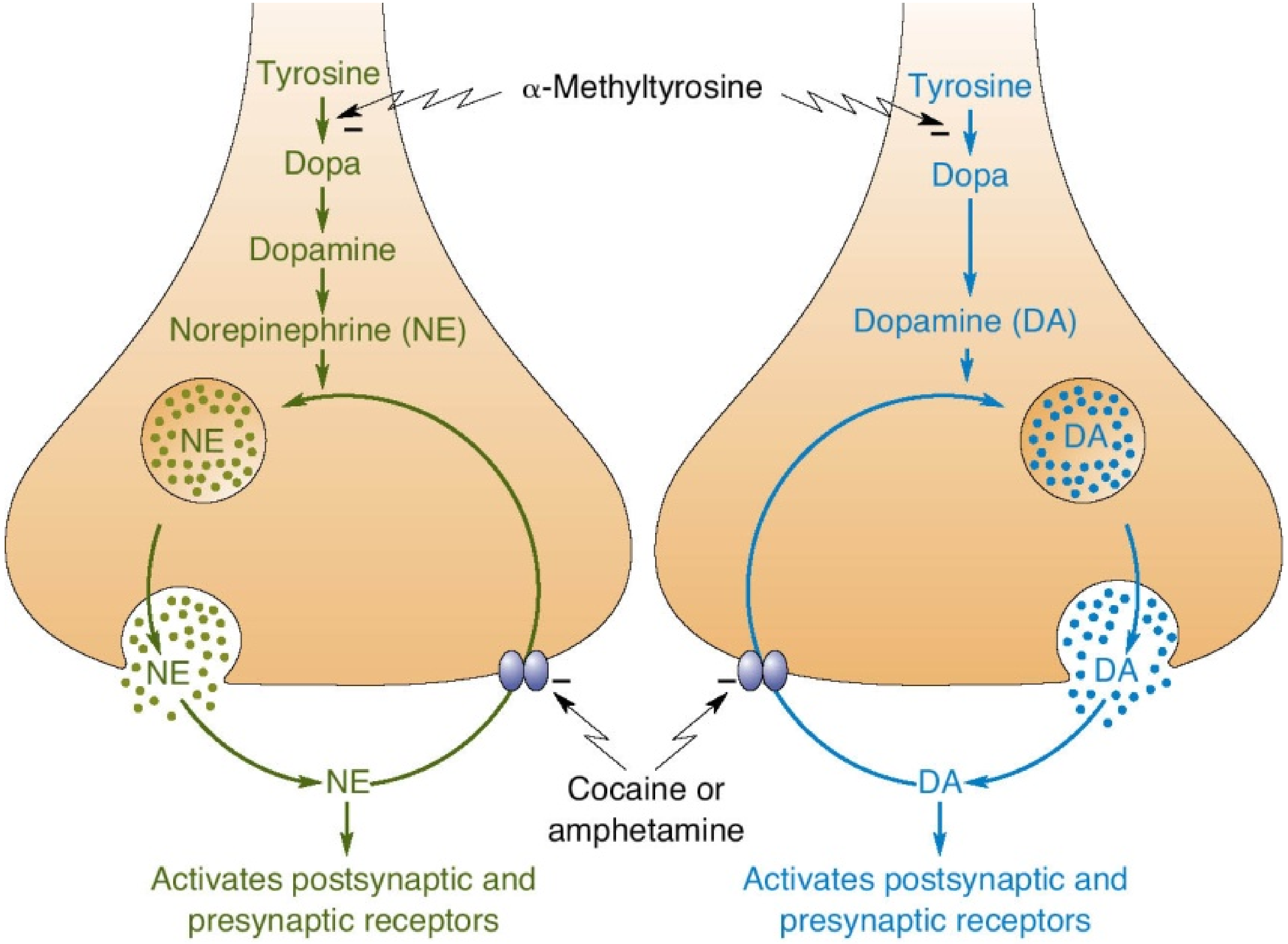
Utilizes ACh

Function: regulates excitability of thalamic sensory relay nuclei

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. *Neuroscience : Exploring the Brain*. China: Wolters Kluwer, 2016. Print.

Stimulant Drug Action on Catecholamine Axon Terminal

- Stimulants: block catecholamine reuptake
  - Cocaine targets DA reuptake.
  - Amphetamine blocks NE and DA reuptake and stimulates DA release.
  - Alpha-methytyrosine will block the effects of cocaine or amphetamine



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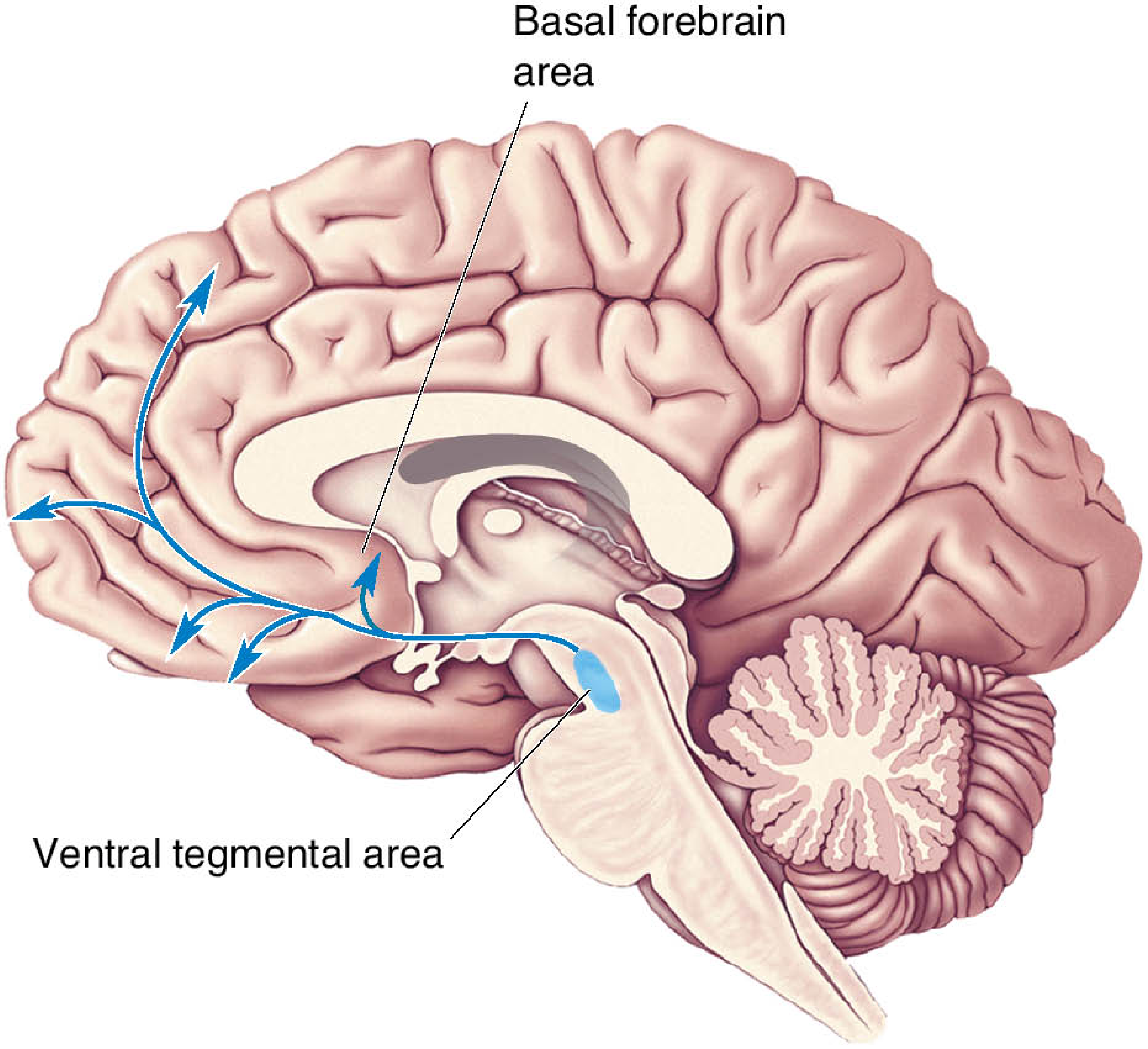
Mesocorticolimbic Dopamine System



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The Role of Dopamine in Motivation

Former belief: dopamine projection served hedonic reward

New understanding

Dopamine-depleted animals “like” food but do not “want” food.

Lack motivation to seek food but enjoy it when available

Stimulation of the dopamine axons

Produces craving for food without increasing the hedonic impact

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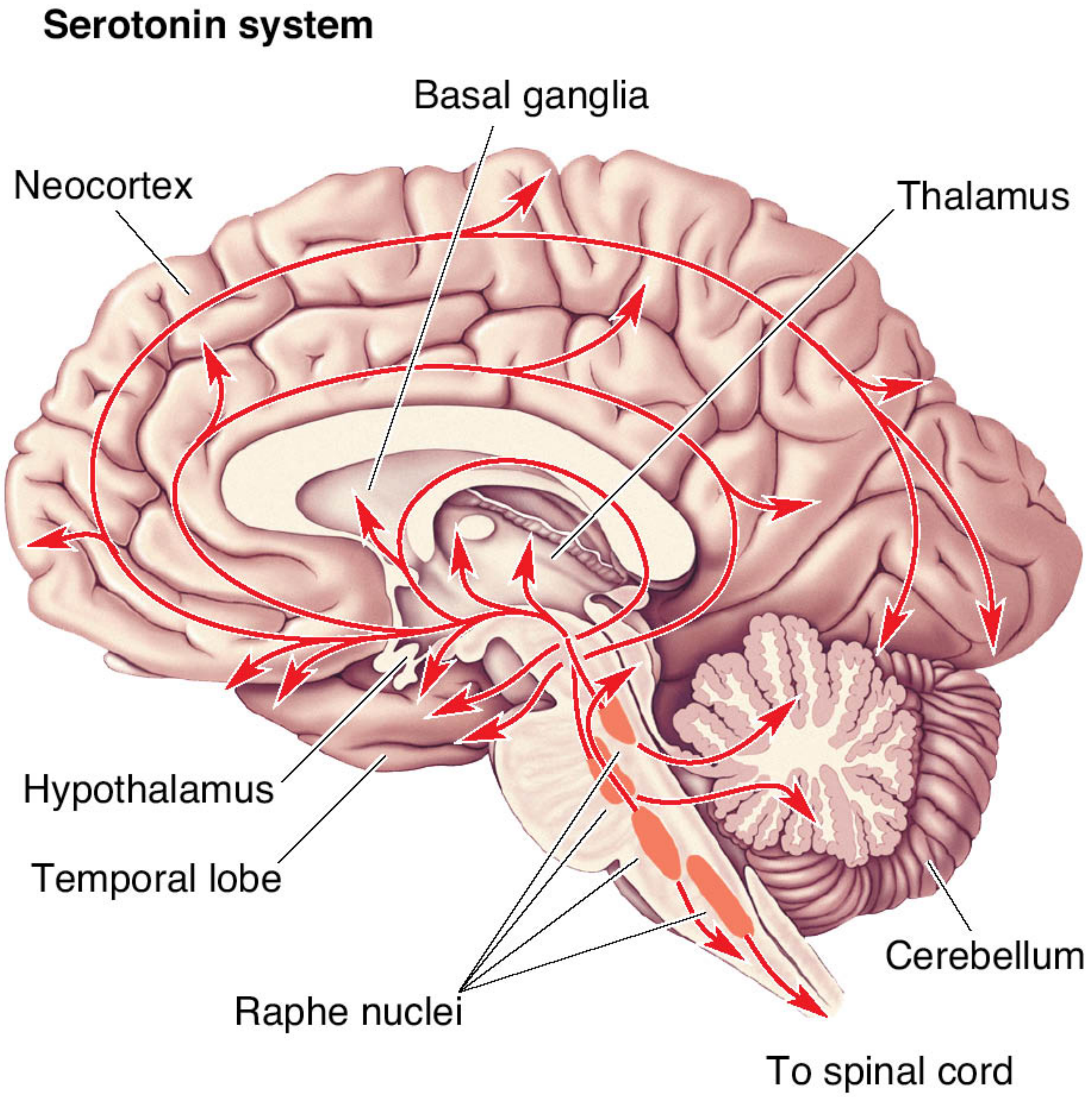
The Serotonergic Raphe Nuclei



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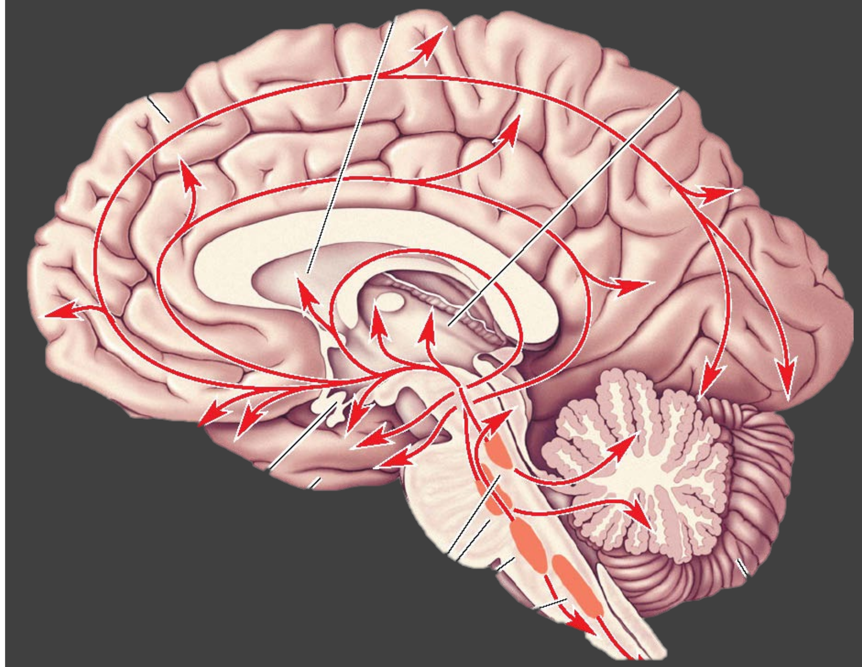
Serotonergic system



Raphe Nuclei

Path: innervate many of the same areas as noradrenergic system

Function: together with noradrenergic system, comprise the ascending reticular activating system

Particularly involved in sleep–wake cycles, mood

Other transmitters involved in coordination

Most active during wakefulness, when aroused and active

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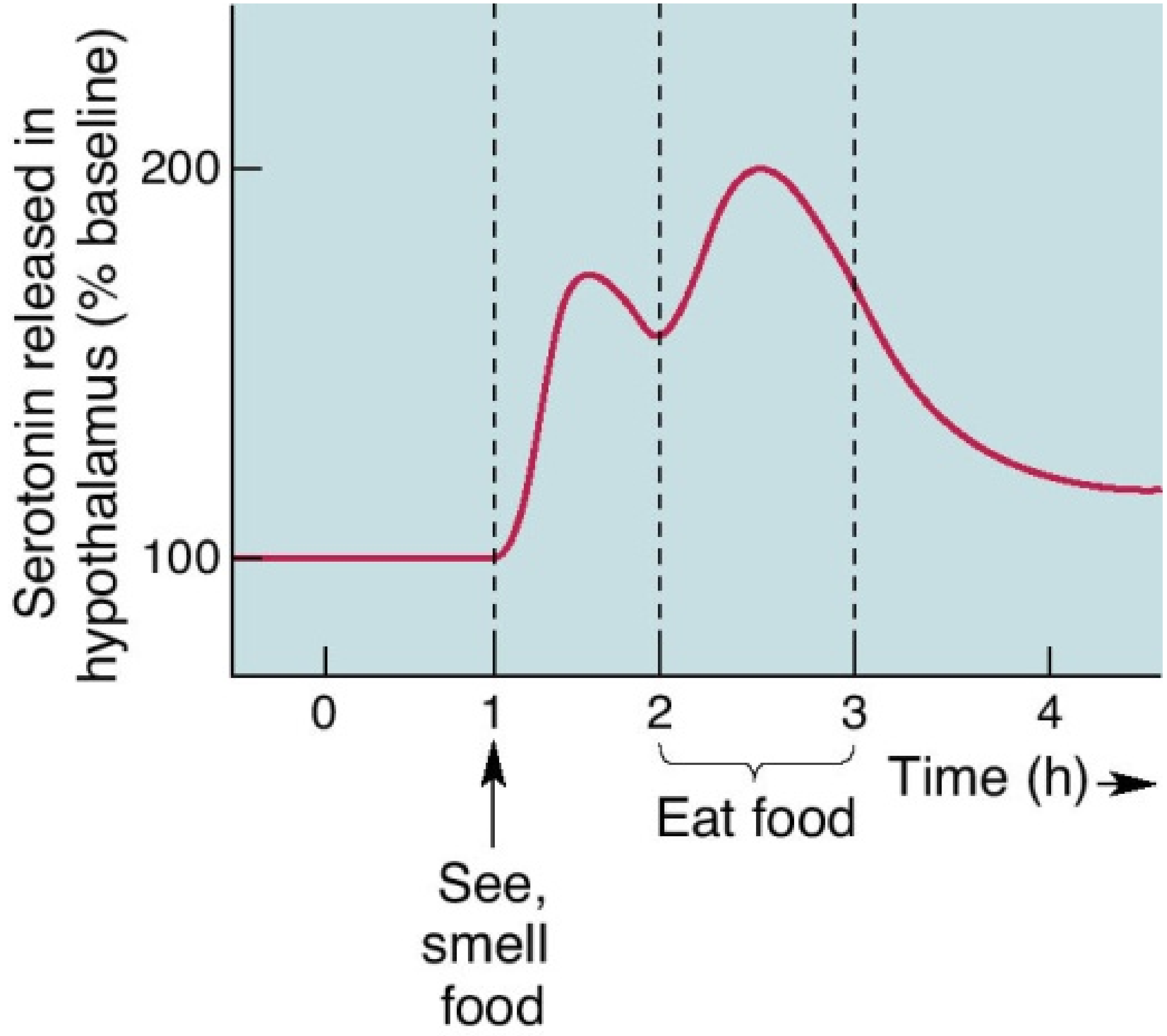
Changes in Hypothalamic Serotonin Levels Before and During a Meal

- Low in postabsorptive period
- Rise in anticipation of food
- Spike during meal
  - Mood elevation—rise in blood tryptophan and brain serotonin



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- Serotonin, food, and mood
  - Drugs that elevate serotonin suppress appetite.
    - Example: dexfenfluramine (Redux)
- Disorders in serotonin regulation: anorexia nervosa, bulimia nervosa—both often accompanied by depression
- Treatment
  - Antidepressant drugs that elevate brain serotonin levels
    - Example: fluoxetine (Prozac)

Bear, Mark F., Barry W. Connors, and Michael A. Paradiso.

Image: https://catamounttrail.org/2014/10/14/vitamin-i-a-pill-for-every-ill/

Drugs and the Diffuse Modulatory Systems

Psychoactive drugs act on CNS.

Interfere with chemical synaptic transmission

Many drugs of abuse act on modulatory systems.

LSD, *Psilocybe* mushrooms, and peyote are close to the structure of serotonin.

Cocaine and amphetamine affect dopaminergic and noradrenergic systems - sympathomimetic

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Concluding Remarks

Overview of motor systems

- The "how" questions of behavior
  - Example: How is movement initiated?

Overview of motivation systems

- The "why" questions of behavior
  - Example: Why do we drink when dehydrated?

Important discovery of neural basis for feeding behavior

- Allows us to frame new questions that will impact how we view our own behaviors

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