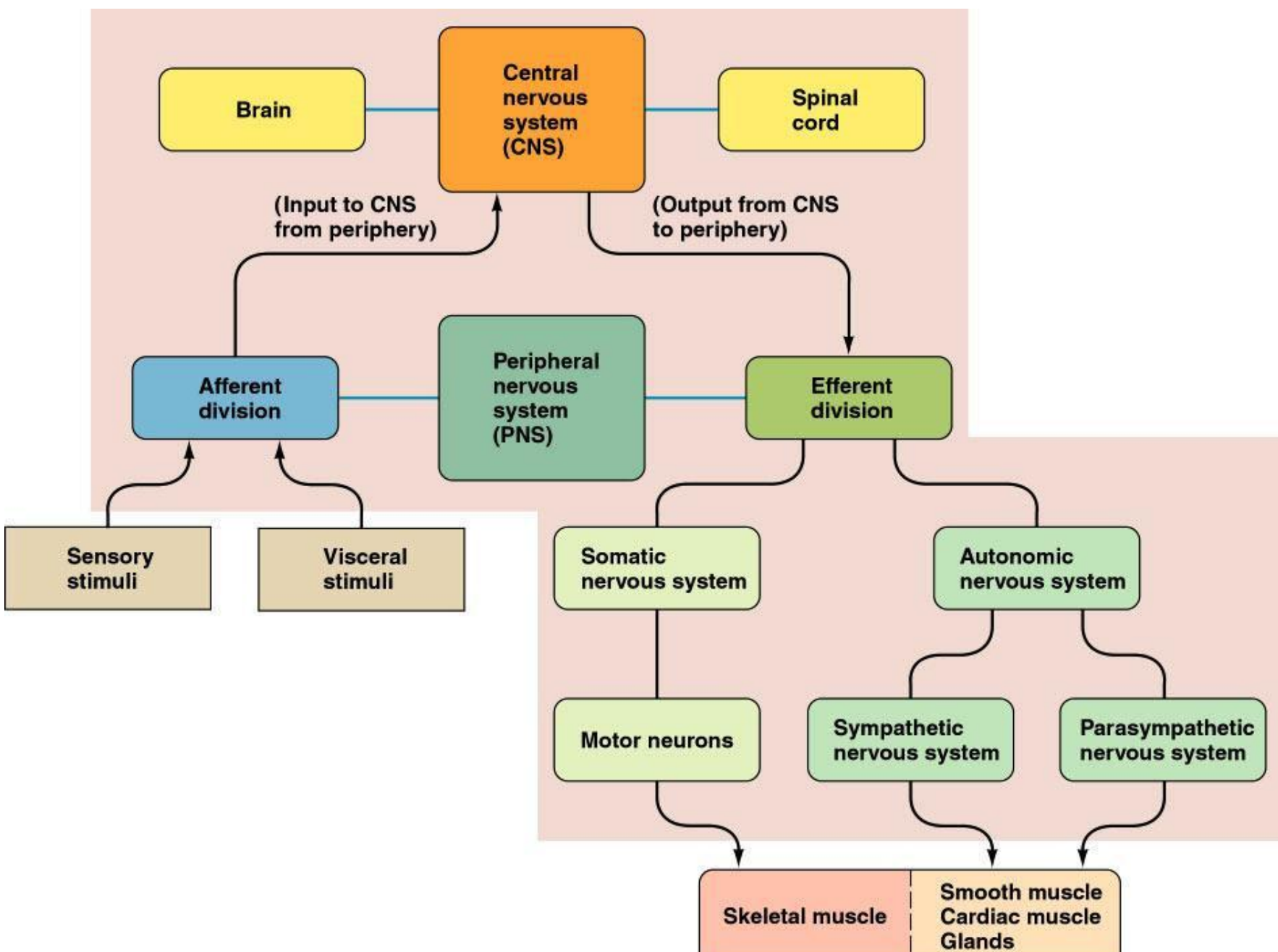
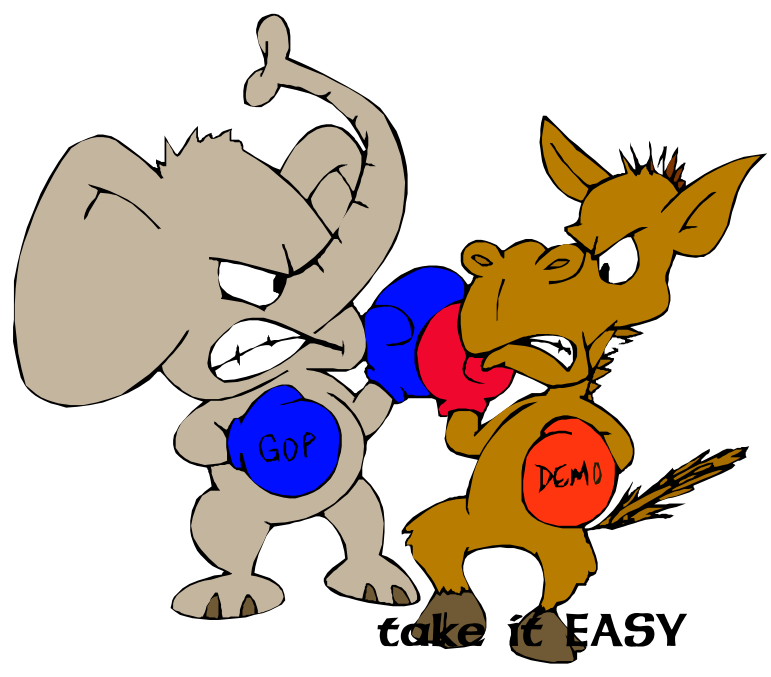
Functions

- Sympathetic & parasympathetic divisions typically function in opposition to each other.
- But this opposition is better termed complementary in nature rather than antagonistic.
- Sympathetic as accelerator and parasympathetic as brake.
- Sympathetic → quick responses.
- Parasympathetic functions with actions that do not require immediate reaction.
- Sympathetic → "fight or flight"
- Parasympathetic → "rest and digest".

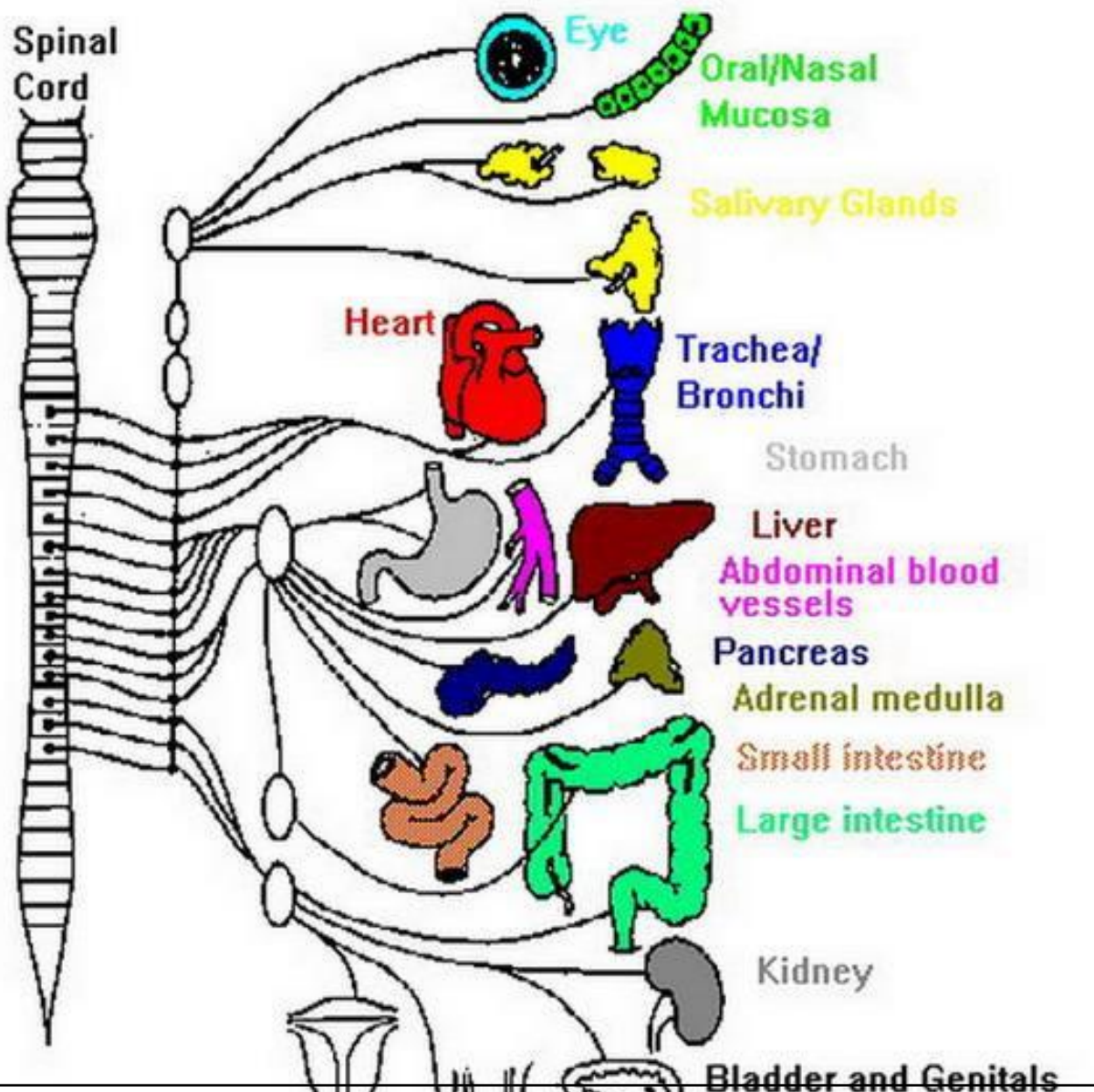


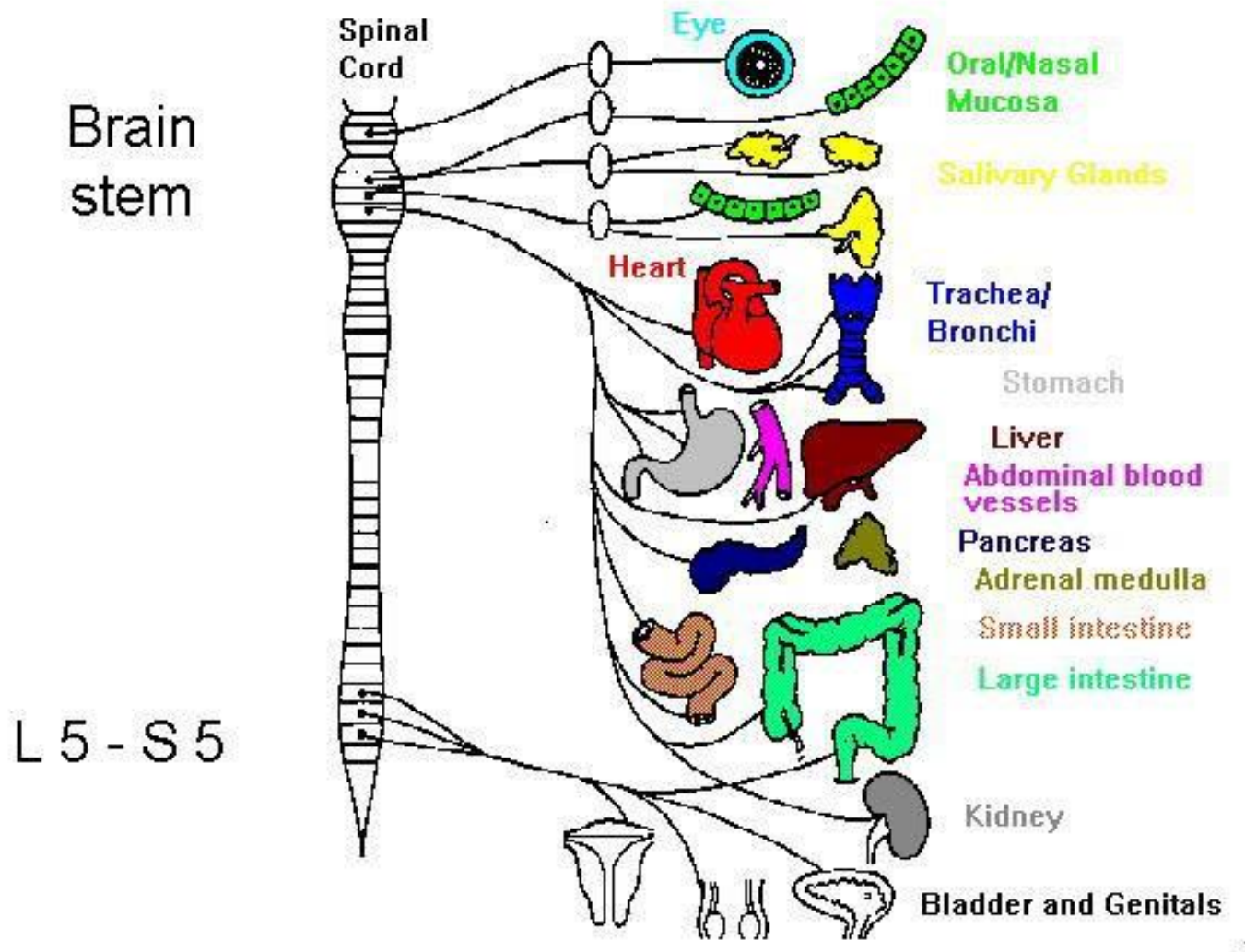
Autonomic Nervous System

- 2 divisions:
  - **Sympathetic**
    - "Fight or flight"
    - "E" division
    - Exercise, Excitement, Emergency & Embarrassment
  - **Parasympathetic**
    - "Rest and digest"
    - "D" division
    - Digestion, Defecation, & Diuresis

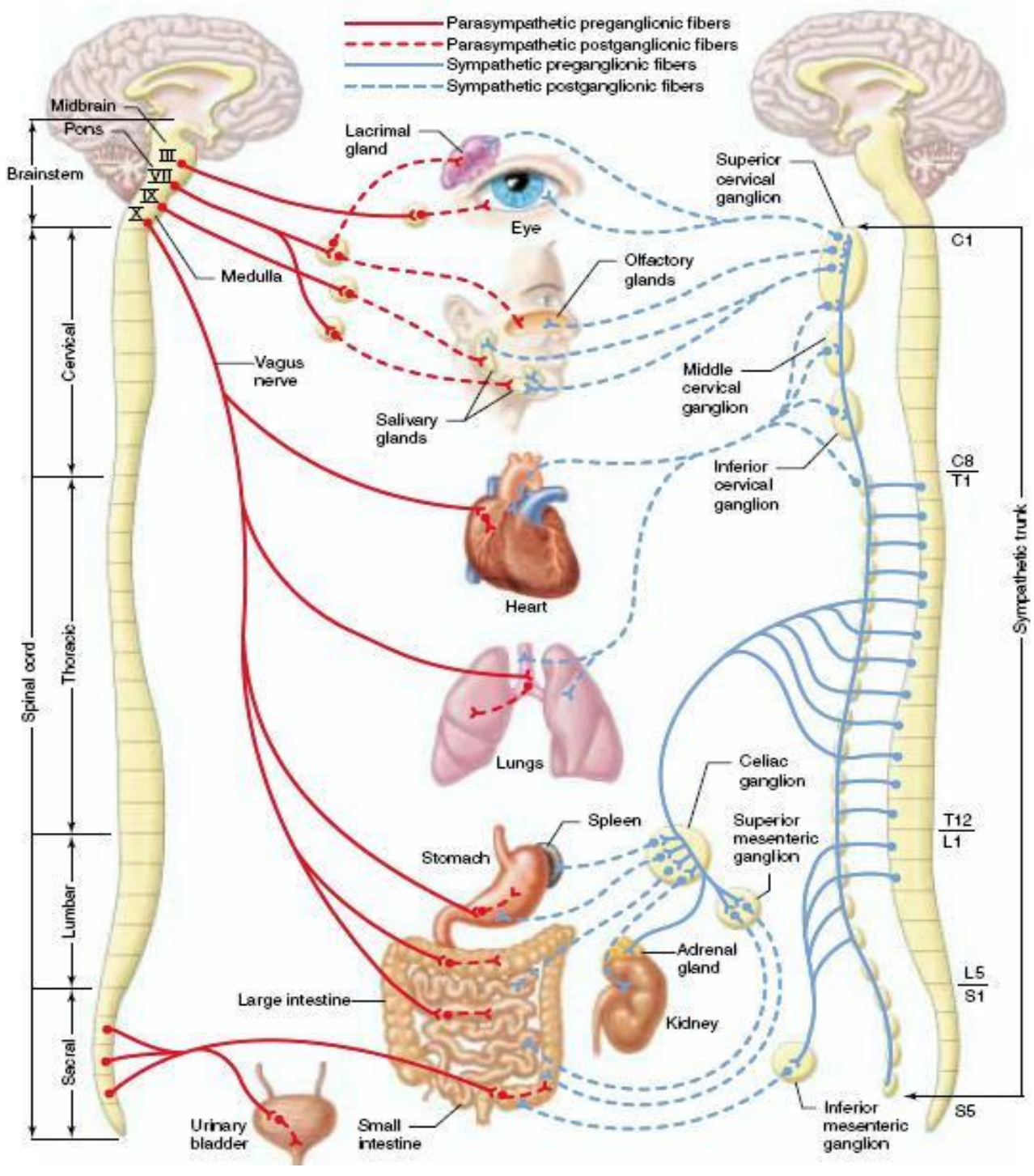


Sympathetic nervous system





The Parasympathetic Nervous System



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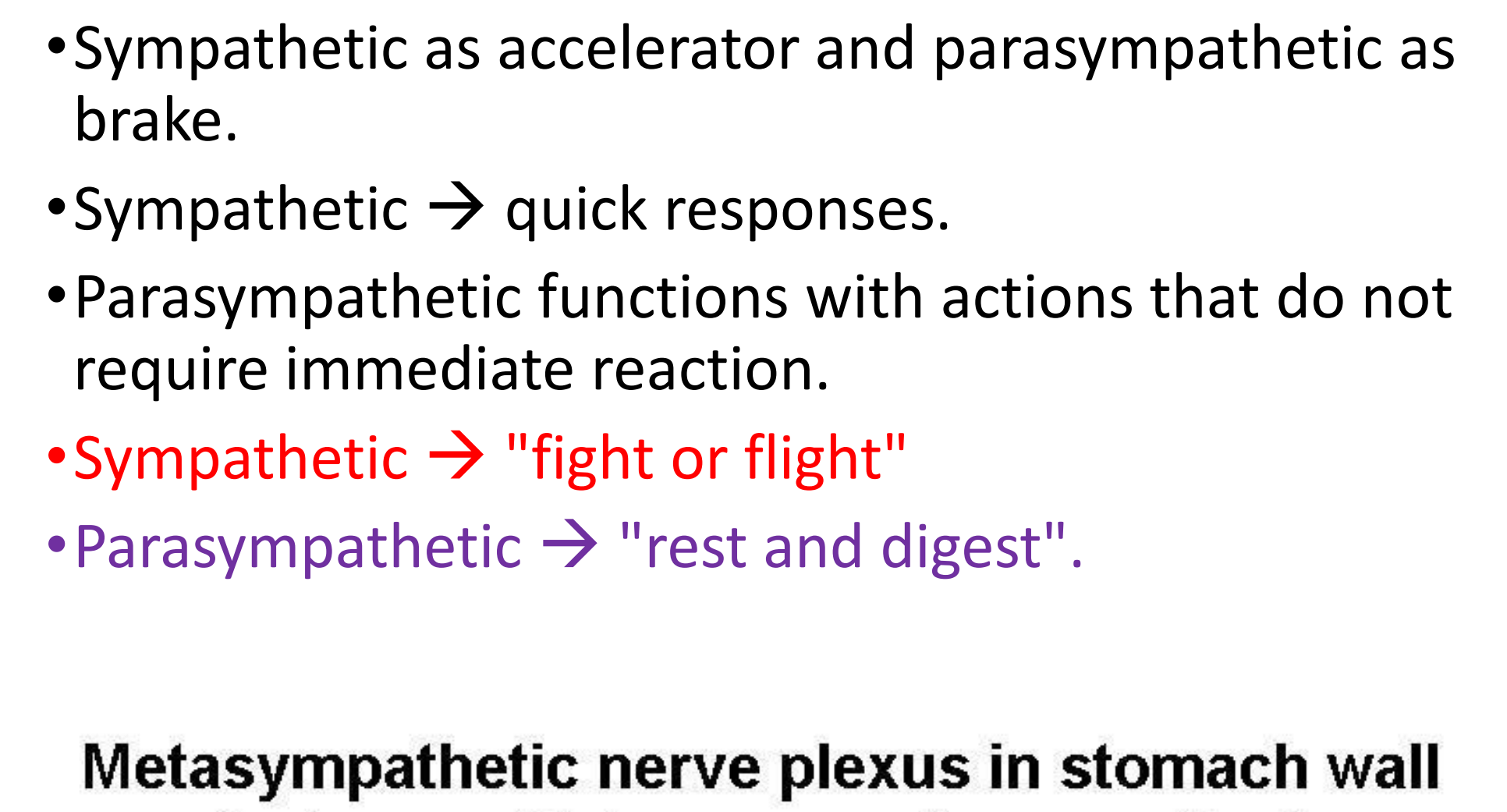
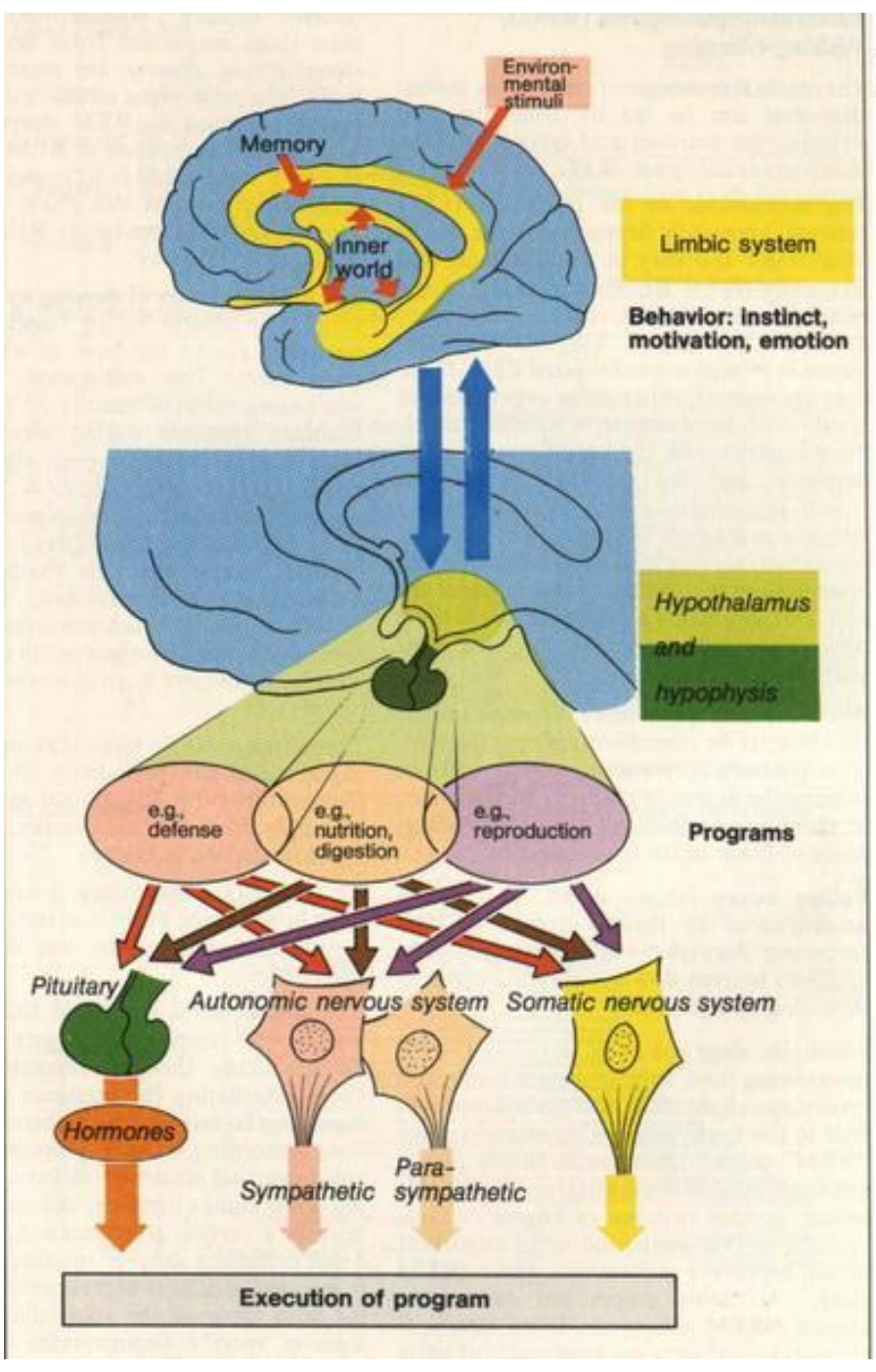
Metasympathetic nerve plexus in stomach wall (scheme of interneuronal connection)





Role of hypothalamo-hypophysial system in nerve and endocrine regulation

Hypothalamic area controls homeostasis, autonomic tone, trophotropic and ergotropic effects to adaptive bechaviour. Ergotropic effects because of stimulation posterior hypothalamus lead to sympatotonia. Trophotropic effects, as a result of stimulation anterior hypothalamus, cause parasympathetic effects in the body. Functional connection of hypothalamus to limbic system helps to control bechaviour and emotions. Hypothalamus, pituitary gland and adrenal gland are functionally connected. These nerve centers play important role in nerve and endocrine regulation in the body.

Receptors

- Parasympathetic nervous system uses only acetylcholine (ACh) as its neurotransmitter.
- ACh acts on two types of receptors, muscarinic and nicotinic cholinergic receptors.
- Most transmissions occur in two stages:
- When stimulated, preganglionic nerve releases ACh at ganglion, which acts on nicotinic receptors of postganglionic nerve.
- Postganglionic nerve then releases ACh to stimulate muscarinic receptors of target organ.

Neurotransmitters

- At effector organs, **sympathetic ganglionic** neurons release noradrenaline (norepinephrine) to act on adrenergic receptors, with exception of sweat glands and adrenal medulla:
- At sweat glands, it is **acetylcholine** → muscarinic receptors.
- At adrenal cortex, there is **no postsynapic neuron**. Instead presynaptic neuron releases acetylcholine to act on nicotinic receptors.
- Stimulation of adrenal medulla releases adrenaline **(epinephrine)** into bloodstream which acts on adrenoceptors, producing a widespread increase in sympathetic activity.
- In parasympathetic system, ganglionic neurons use acetylcholine, to stimulate muscarinic receptors.

Sympathetic (adrenergic, with exceptions)

- cardiac output increases
- SA node: heart rate (chronotropic) β1, β2: increases
- cardiac muscle: contractility (inotropic)β1, β2: increases
- conduction at AV node β1: increases
- vascular smooth muscle M3: contracts; α = contracts & β2 = relaxes
- smooth muscles of bronchioles β2: relaxes (major contribution); α1: contracts (minor contribution)
- pupil of eye α1: relaxes
- ciliary muscle β2: relaxes
- salivary glands: secretionsβ: stimulates viscous, amylase secretions; α1 = stimulates potassium cation
- smooth muscles of GI tract - α, β2: relaxes
- sphincters of GI tract - α1: contracts
- glands of GI tract - inhibits

Parasympathetic (muscarinic)

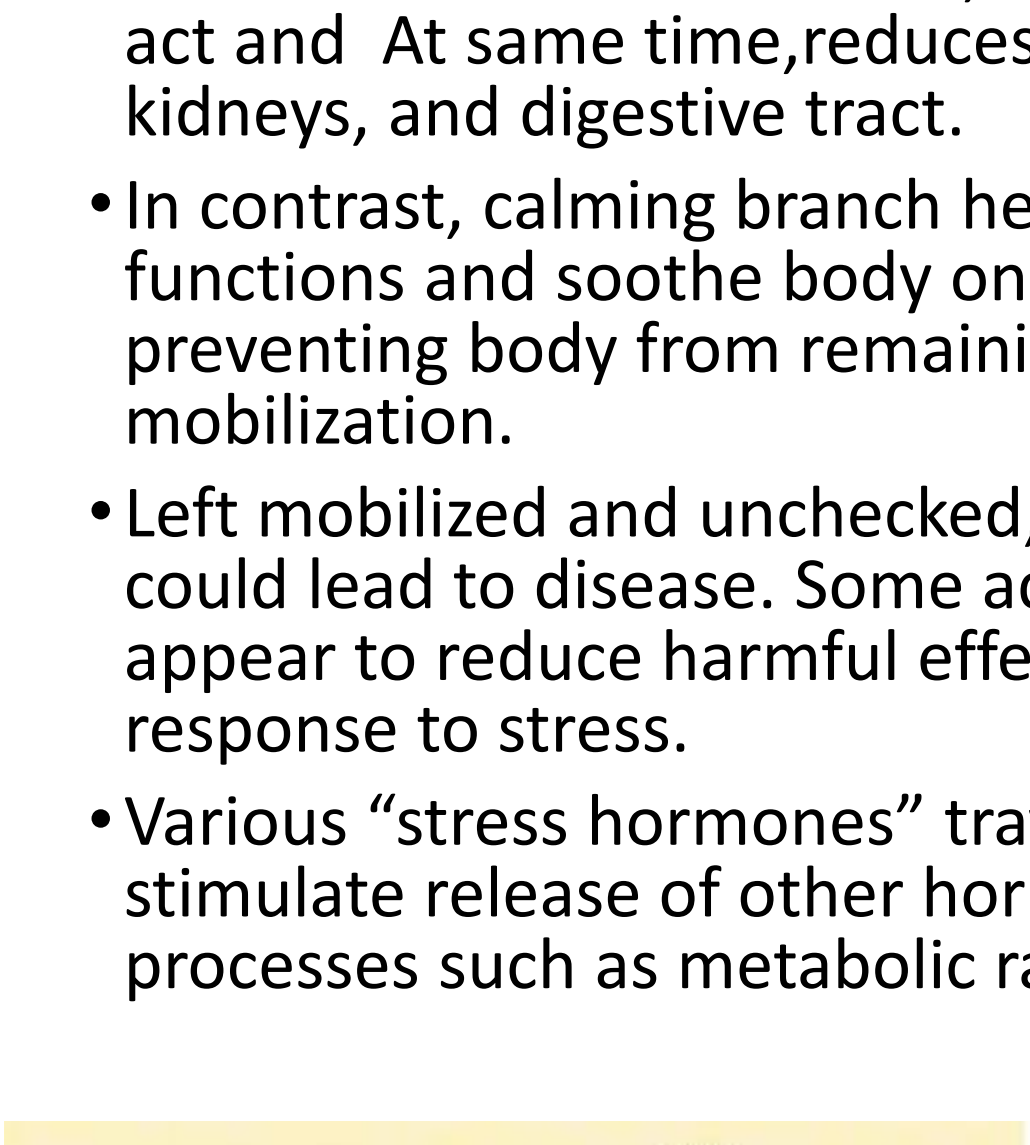
- cardiac output M2: decreases
- SA node: heart rate (chronotropic) M2: decreases
- cardiac muscle: contractility (inotropic) M2: decreases (atria only)
- conduction at AV node M2: decreases
- smooth muscles of bronchioles M3: contracts
- pupil of eye M3: contracts
- ciliary muscle M3: contracts
- salivary glands: secretions stimulates watery secretions
- GI tract motility M1, M3: increases
- smooth muscles of GI tract M3: contracts
- sphincters of GI tract M3: relaxes
- glands of GI tract M3: secretes

Autonomic regulation & stress

- A stressful situation activates three major communication systems in brain that regulate bodily functions.
- First of these systems is ***voluntary nervous system***, which sends messages to muscles so that we may respond to sensory information.
- Second communication system is ***autonomic nervous system***. It combines ***sympathetic* or emergency branch**, which gets us going in emergencies, and ***parasympathetic* or calming branch**, which keeps body's maintenance systems, such as digestion, in order and calms body's responses to the emergency branch.
- Third major communication process is ***neuroendocrine system*,** which also maintains body's internal functioning.

Specific task

- Emergency branch causes arteries to muscles to relax in order to deliver more blood, allowing greater capacity to act and At same time,reduces blood flow to skin, kidneys, and digestive tract.
- In contrast, calming branch helps to regulate bodily functions and soothe body once stressor has passed, preventing body from remaining too long in a state of mobilization.
- Left mobilized and unchecked, these body functions could lead to disease. Some actions of calming branch appear to reduce harmful effects of emergency branch's response to stress.
- Various "stress hormones" travel through blood and stimulate release of other hormones, which affect bodily processes such as metabolic rate and sexual functions.



Stress reaction

- When stress occurs, sympathetic nervous system is triggered.
- Norepinephrine is released by nerves, and epinephrine is secreted by adrenal glands. By activating receptors in blood vessels and other structures, these substances ready heart and working muscles for action.
- Acetylcholine is released in parasympathetic nervous system, producing calming effects.
- Digestive tract is stimulated to digest a meal, heart rate slows, and pupils of eyes become smaller.
- Neuroendocrine system also maintains the body's normal internal functioning.

Chronic stress

- When glucocorticoids or adrenaline are secreted in response to prolonged psychological stress commonly encountered by humans, results are not ideal.
- Normally, bodily systems gear up under stress and release hormones to improve memory, increase immune function, enhance muscular activity and restore homeostasis.
- If you are not fighting or fleeing, but standing frustrated in a supermarket checkout line or sitting in a traffc jam, you are not engaging in muscular exercise.
- When stimulated chronically, there are consequences:
- Memory is impaired,
- Immune function is suppressed, and
- Energy is stored as fat.

Response to stress

Psychological	Behavioral	Psychosomatic
Short Fuse	Drug/Use Abuse	Ulcers
Irritability	Alcohol Use/Abuse	High Blood Pressure
Depression	Smoking	Insomnia
Frustration	Strained Relationships	Indigestion
Emotional Irritability	Eating Problems	Headaches
Insecurity	Suicide Attempts	Other Cardiovascular
Mental Illness	Violence	Body Infections
Anxiety	Impulsive/ Irrational Behavior	Irregular Pulse rate