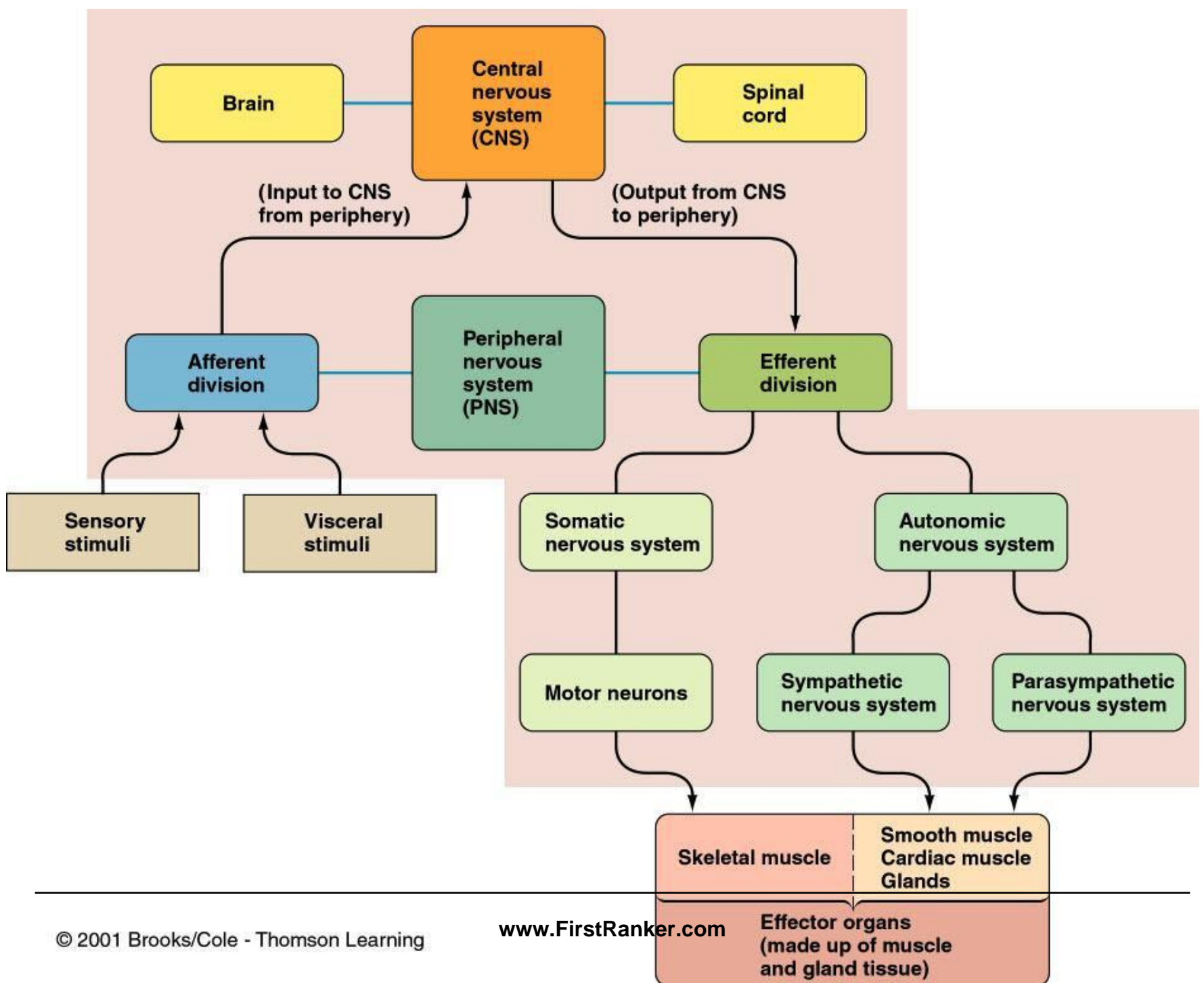


Functions

- 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

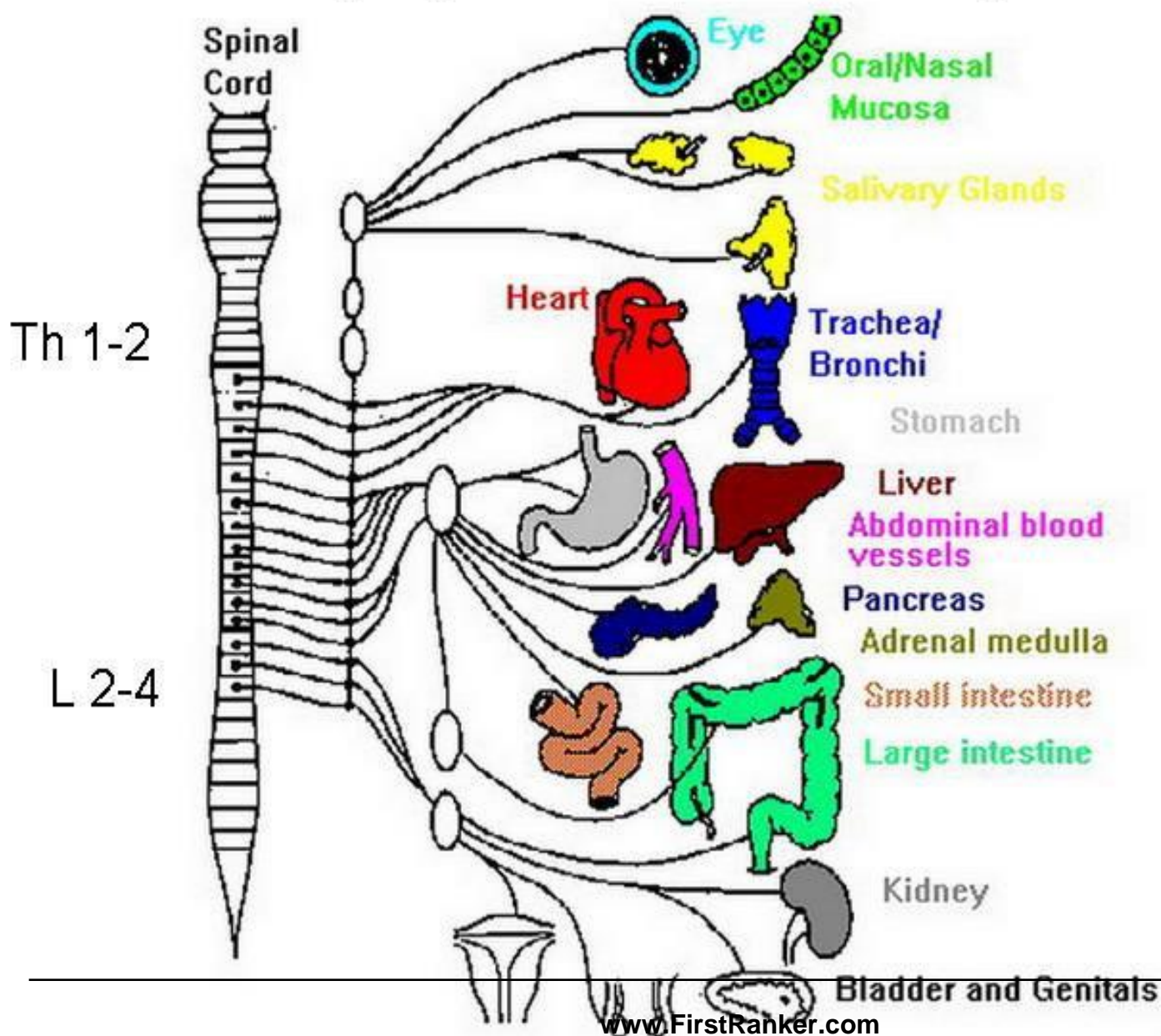


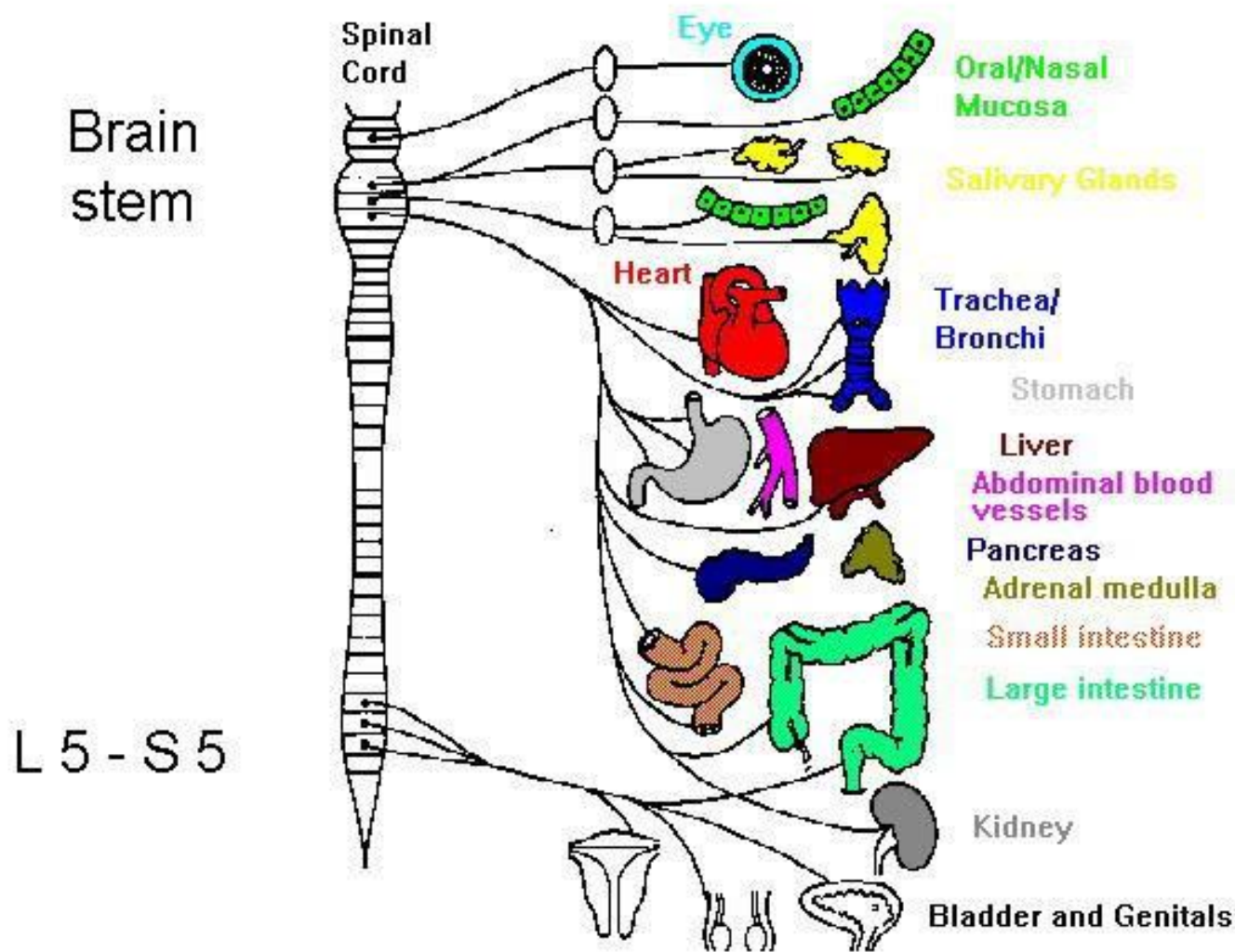
- **Parasympathetic**

- “Rest and digest”
- “D” division
- Digestion, Defecation, & Diuresis

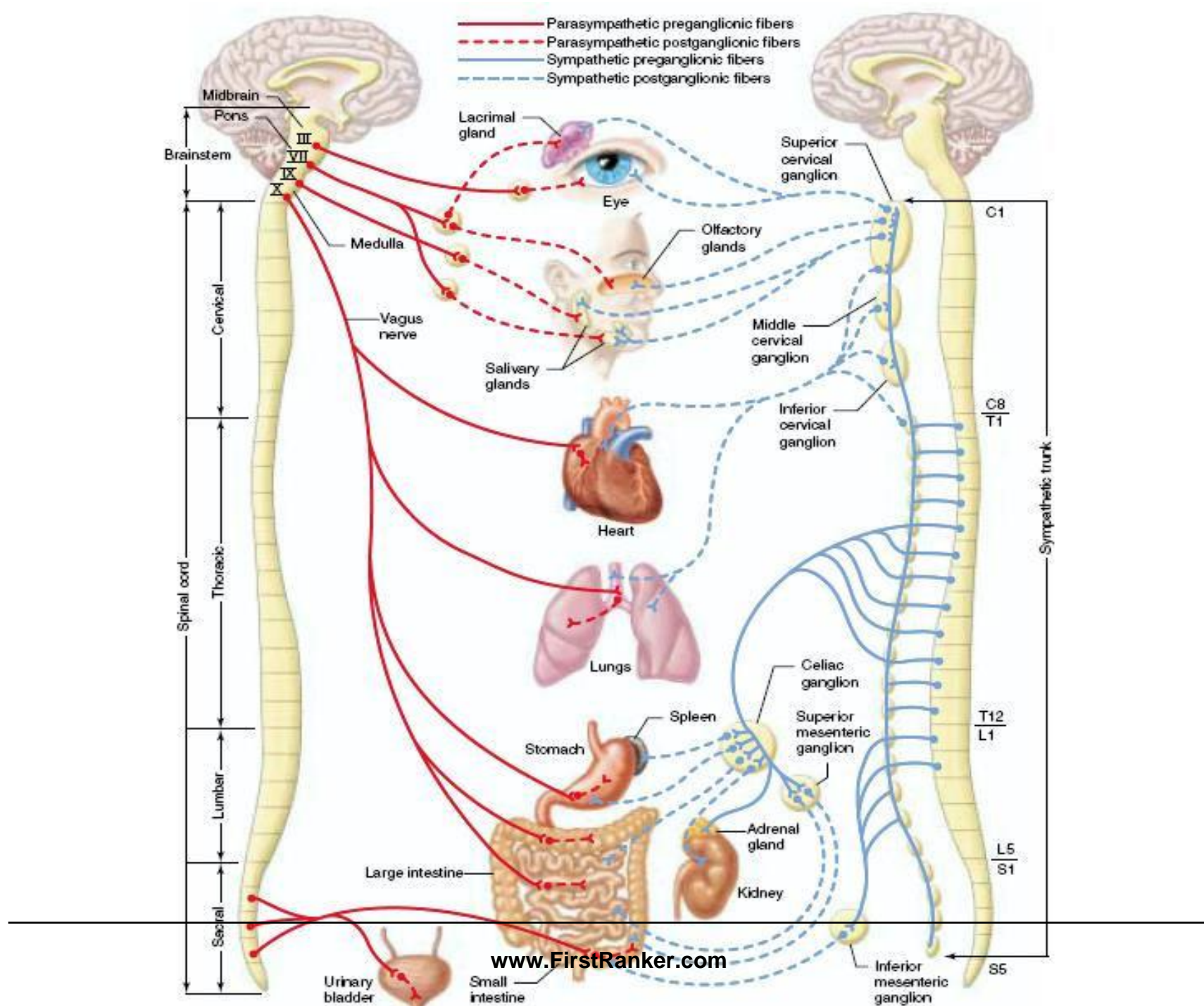


Sympathetic nervous system





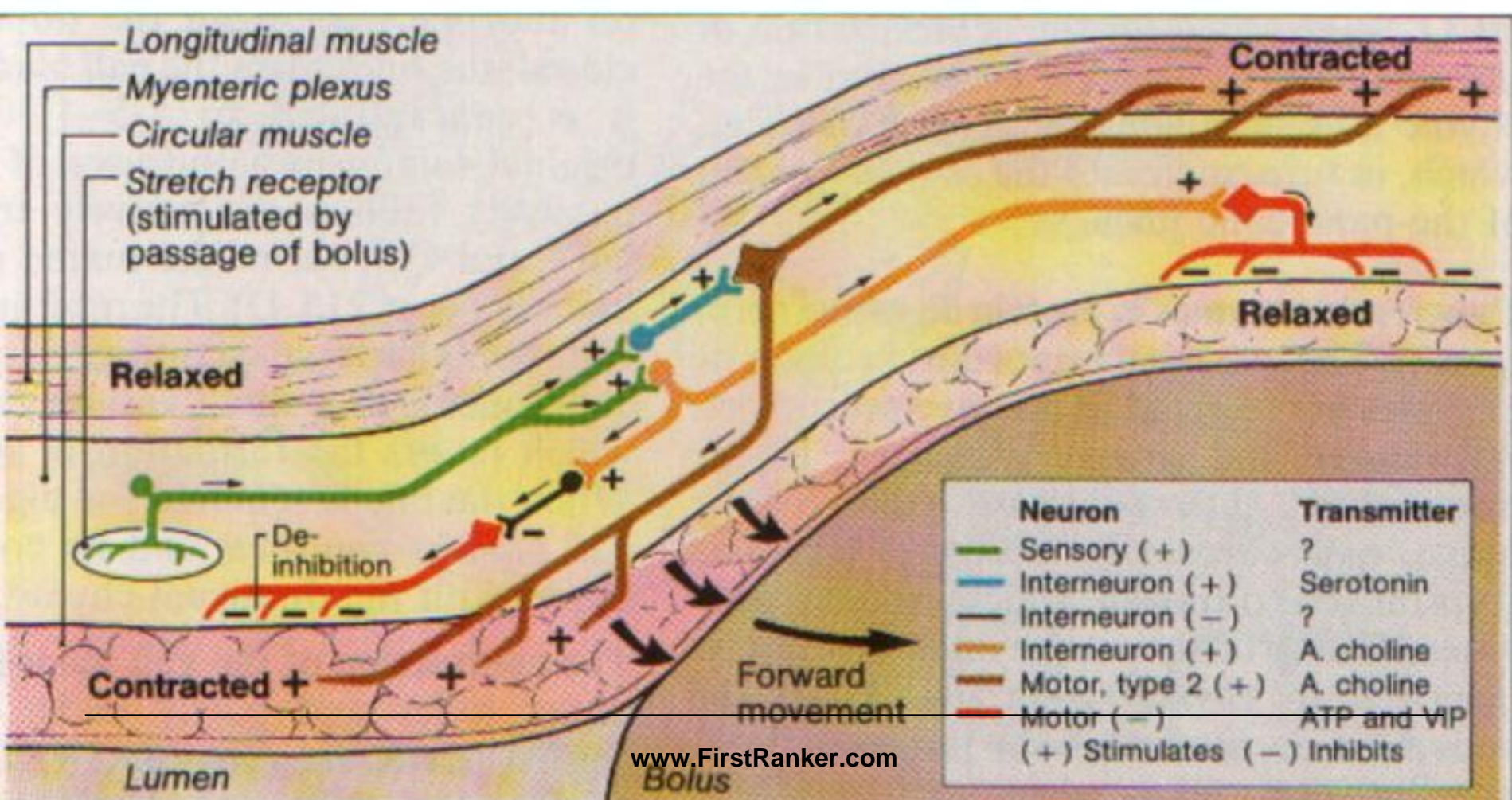
The Parasympathetic Nervous System

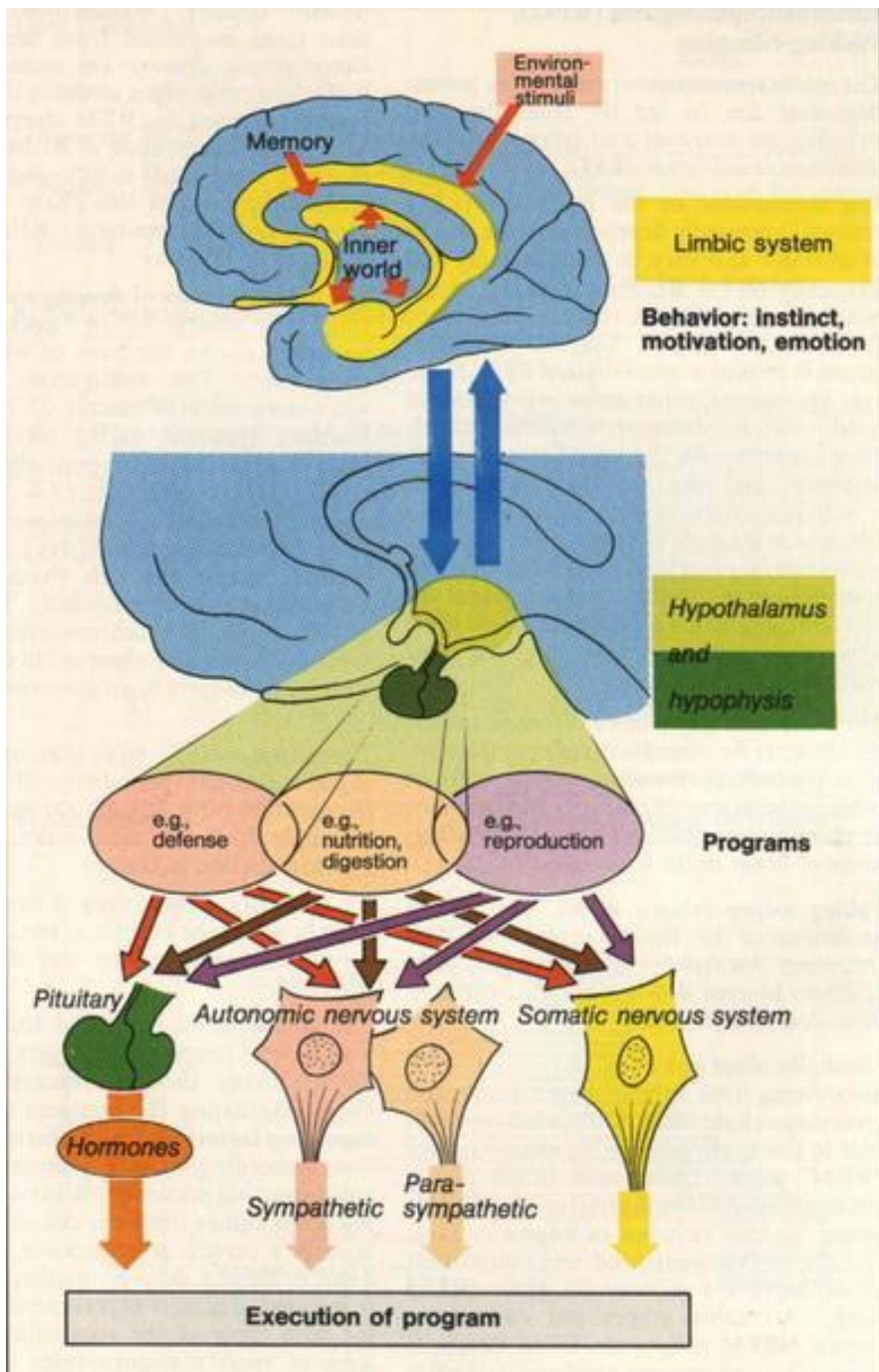


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Metasympathetic nerve plexus in stomach wall (scheme of interneuronal connection)





Role of hypothalamo-hypophyseal system in nerve and endocrine regulation

Hypothalamic area controls homeostasis, autonomic tone, trophotropic and ergotropic effects to adaptive behaviour. Ergotropic effects because of stimulation posterior hypothalamus lead to sympatonia. 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 behaviour 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 postsynaptic 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) β_1 , β_2 : increases
- cardiac muscle: contractility (inotropic) β_1 , β_2 : increases
- conduction at AV node β_1 : increases
- vascular smooth muscle M_3 : contracts; α = contracts & β_2 = relaxes
- smooth muscles of bronchioles β_2 : relaxes (major contribution); α_1 : contracts (minor contribution)
- pupil of eye α_1 : relaxes
- ciliary muscle β_2 : relaxes
- salivary glands: secretions β : stimulates viscous, amylase secretions; α_1 = stimulates potassium cation
- smooth muscles of GI tract - α , β_2 : relaxes
- sphincters of GI tract - α_1 : contracts
- glands of GI tract - inhibits

Parasympathetic (muscarinic)

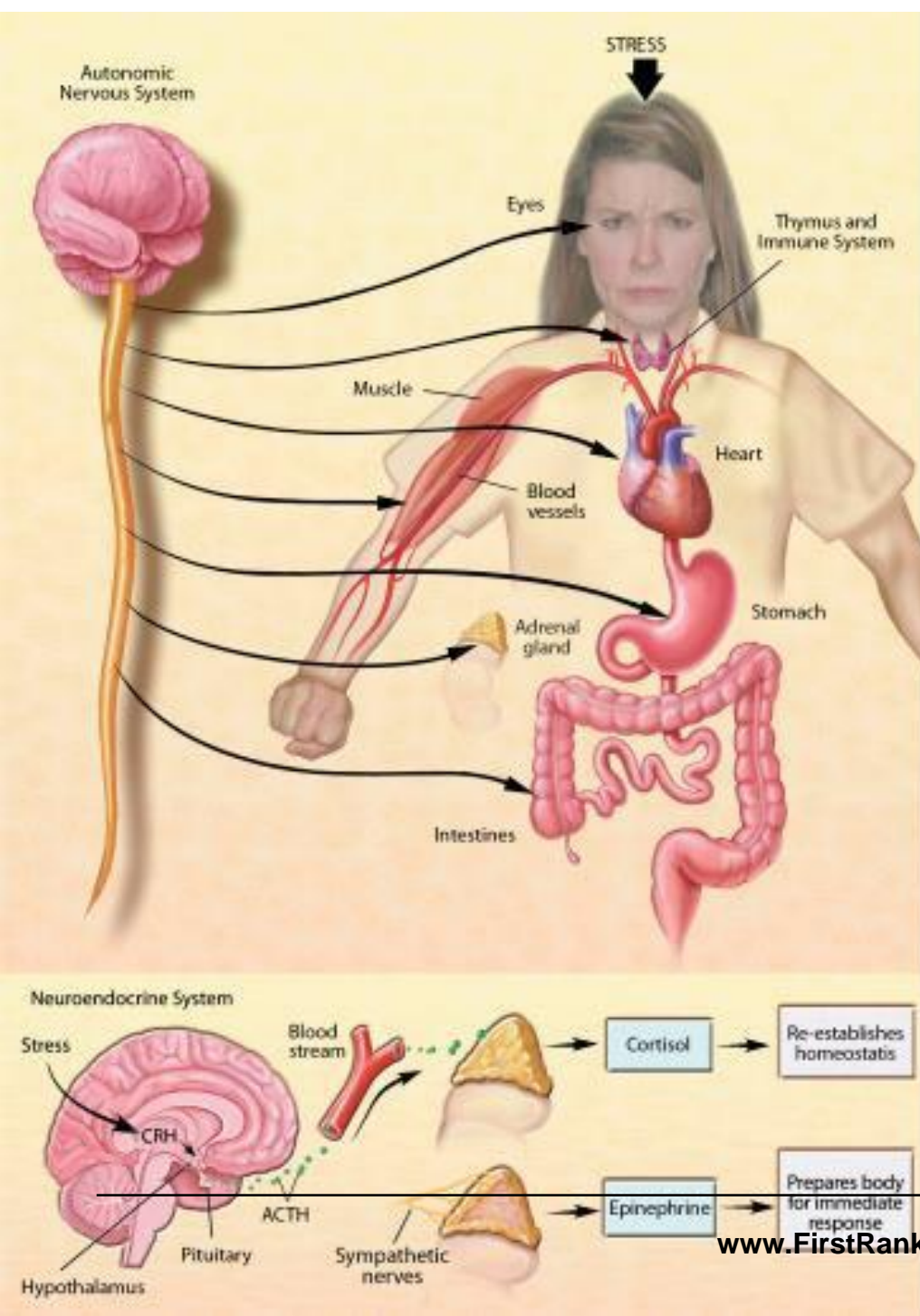
- cardiac output M2: decreases
- SA node: heart rate (chronotropic) M2: decreases
- cardiac muscle: contractility (inotropic) M2: decreases (atria only)
- conduction at AV node M2: decreases
- smooth muscles of bronchioles M3: contracts
- pupil of eye M3: contracts
- ciliary muscle M3: contracts
- salivary 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 traffic 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

Short Fuse
Irritability

Depression
Frustration
Emotional Irritability
Insecurity

Mental Illness
Anxiety

Behavioral

Drug/Use Abuse
Alcohol Use/Abuse

Smoking
Strained Relationships
Eating Problems
Suicide Attempts

Violence
Impulsive/

Psychosomatic

Ulcers
High Blood
Pressure

Insomnia
Indigestion
Headaches

Other
Cardiovascular
Body Infections
Irregular Pulse
rate

Irrational Behavior