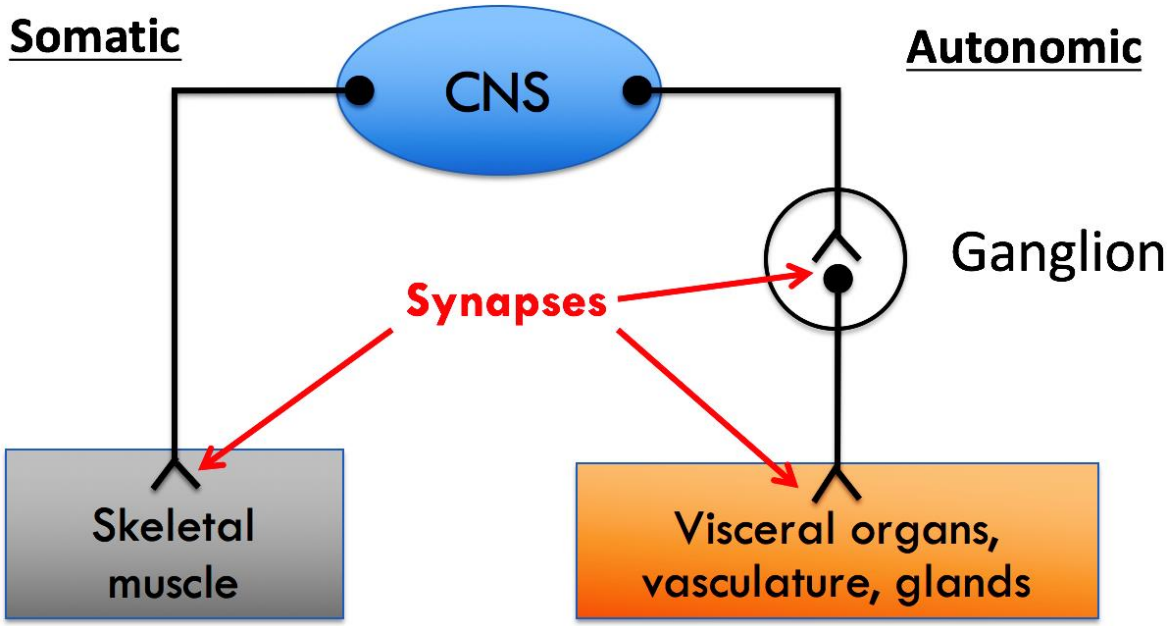
Autonomic Nervous System

Introduction 1

2020

The nervous system is divided into:
1- CNS; the brain and spinal cord
2- The peripheral nervous system
The motor (efferent) portion of CNS can be divided into: **Autonomic** and **Somatic**.
The **autonomic nervous system (ANS)** is largely independent (autonomous), its activities are not under direct conscious control.



The Autonomic nervous system has 3 subdivisions:

1. The sympathetic nervous system
2. The parasympathetic nervous system
3. The enteric nervous system.

The **enteric nervous system** (ENS) is one of the main divisions of the autonomic **nervous system** (ANS) and consists of a mesh-like **system** of neurons that governs the function of the gastrointestinal tract.

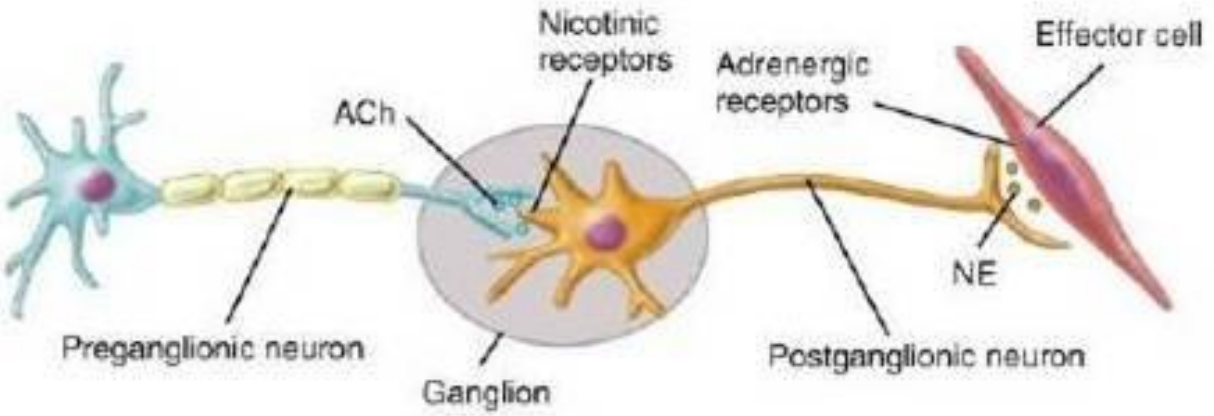
Many transmitter & neuromodulator substances have been identified in the ENS.

It is modulated by the sympathetic & parasympathetic systems

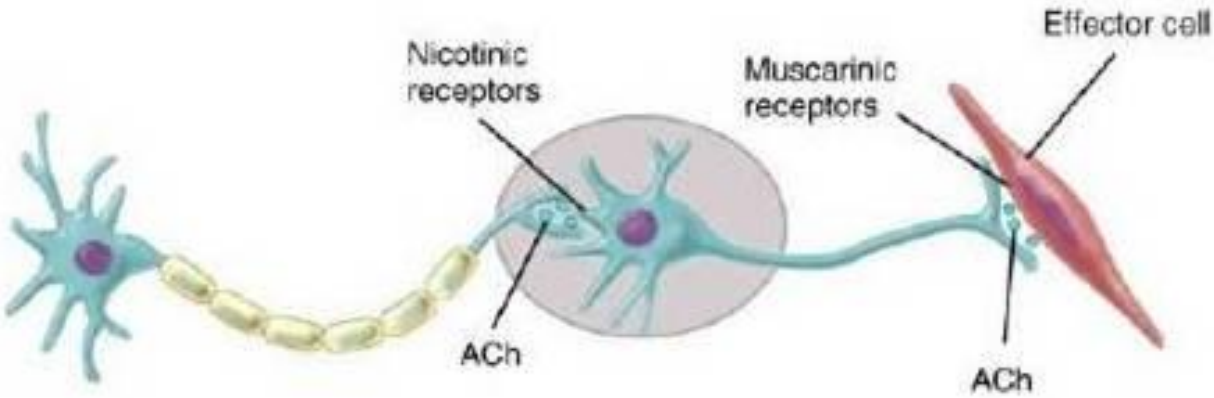
ANS Neurons

- Classified as either cholinergic or adrenergic neurons based upon the neurotransmitter released

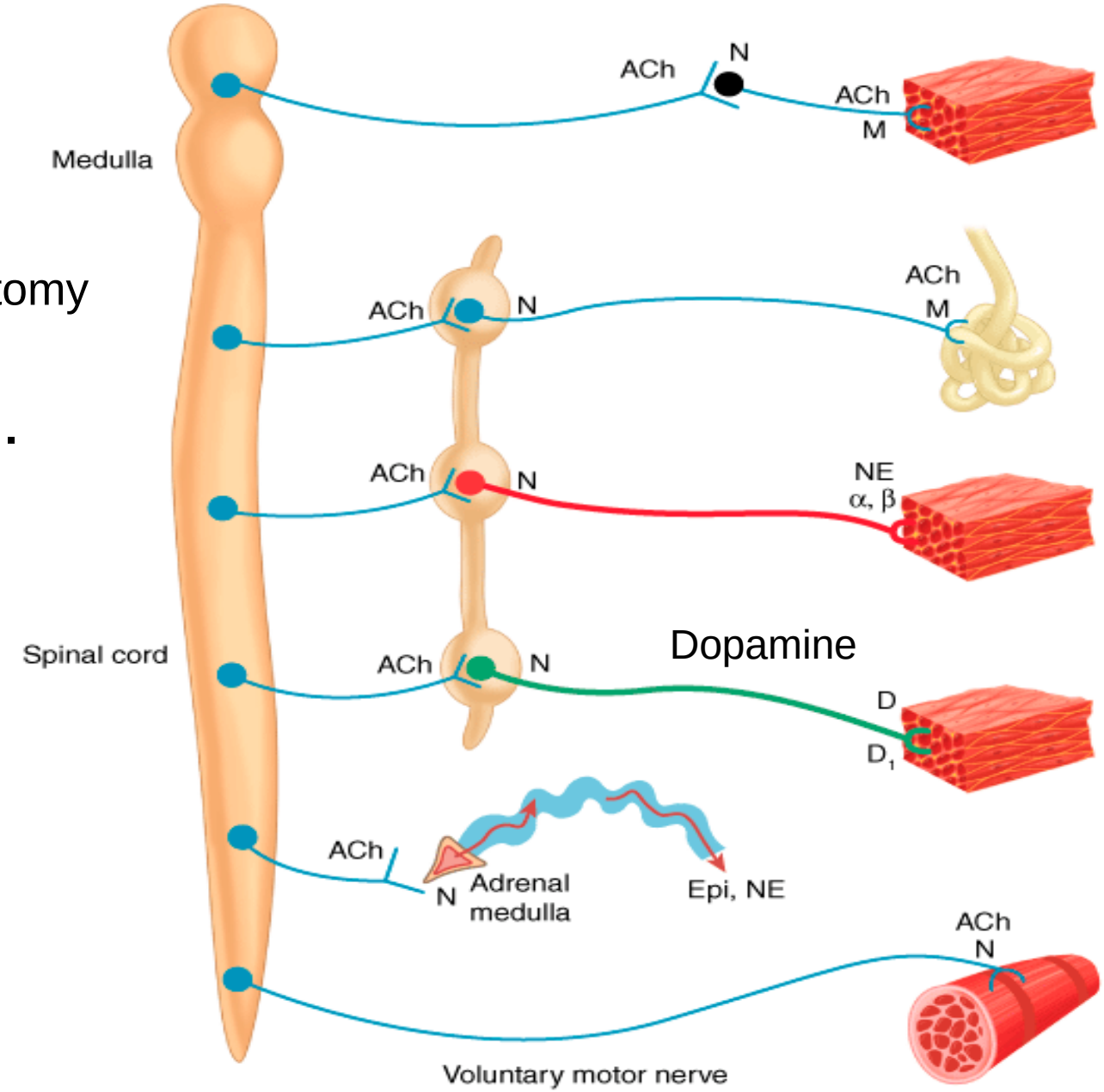
- Adrenergic



- Cholinergic

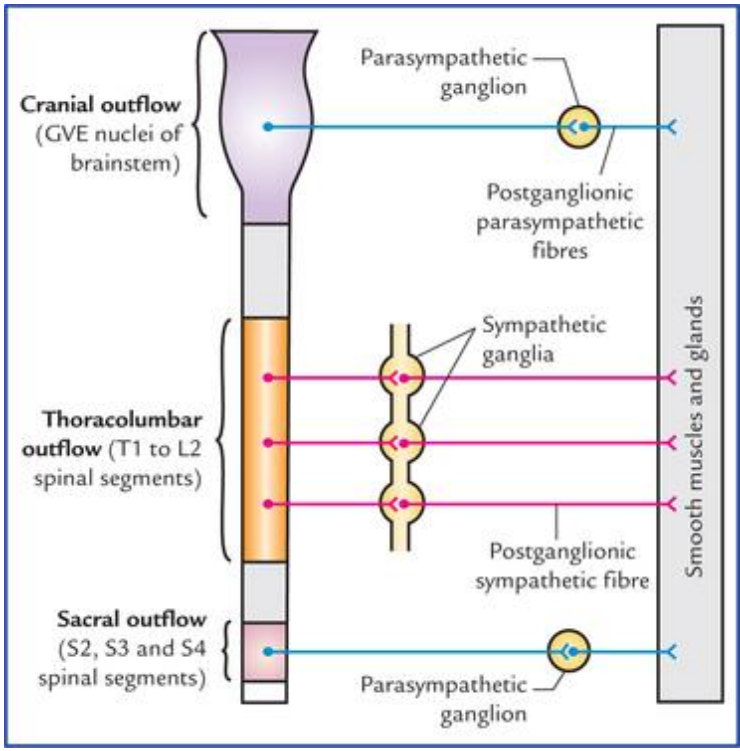


Anatomy of ANS.



Source: Katzung BG, Masters SB, Trevor AJ: *Basic & Clinical Pharmacology, 11th Edition:* http://www.accessmedicine.com

Parasympathetic cell bodies in brainstem & sacral spinal cord: ***craniosacral outflow.***



Parasympathetic : postganglionic neurons are short (ganglia located near effectors) stimulation involves only one visceral effector (organ)

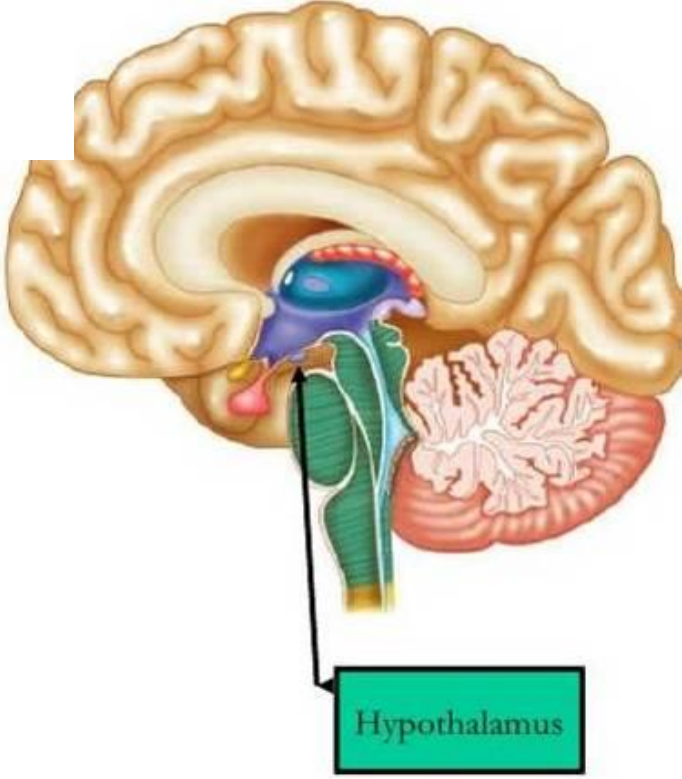
Sympathetic cell bodies located T1-L2 levels: ***thoracolumbar outflow.***

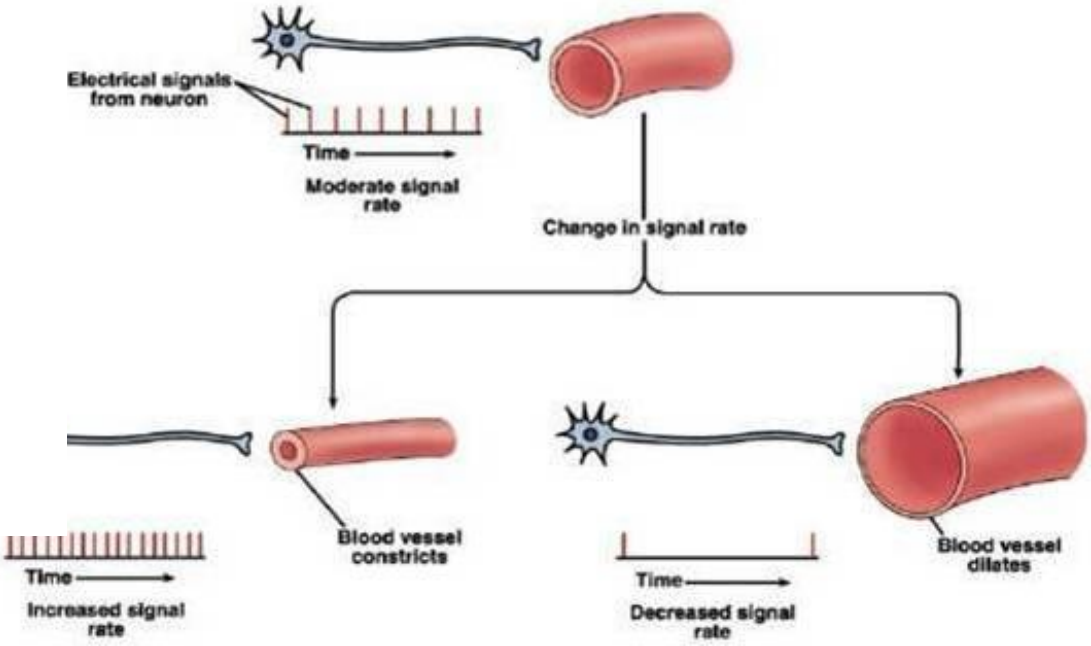
One sympathetic preganglionic neuron may have many branches and may synapse with 20+ postganglionic neurons.

Projection of divergence explains why sympathetic responses can affect many effectors at once

Physiological Effects of the ANS

- Some organs have only sympathetic innervation
  - sweat glands, adrenal medulla, arrector pili mm & many blood vessels
  - controlled by regulation of the "tone" of the sympathetic system
- Most body organs receive dual innervation
  - innervation by both sympathetic & parasympathetic
- Hypothalamus regulates balance (tone) between sympathetic and parasympathetic activity levels





- Parasympathetic
  - S(alivation) L(acrimation) U(rination) D(efecation)
  - metabolic “business as usual”
  - rest and digest - basic survival functions
- Sympathetic
  - fight or flight = “survival”
  - any increase in skeletal muscular activity

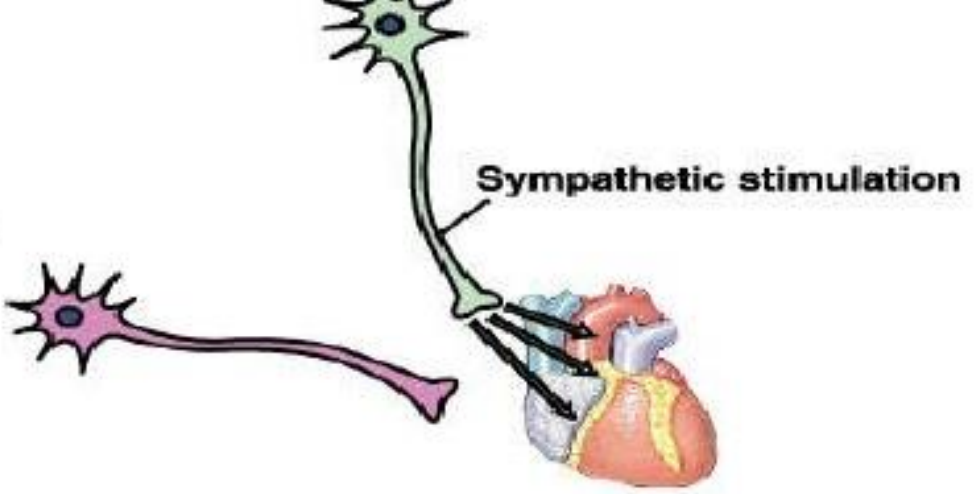
    for these activities - increase heart rate, blood flow, breathing

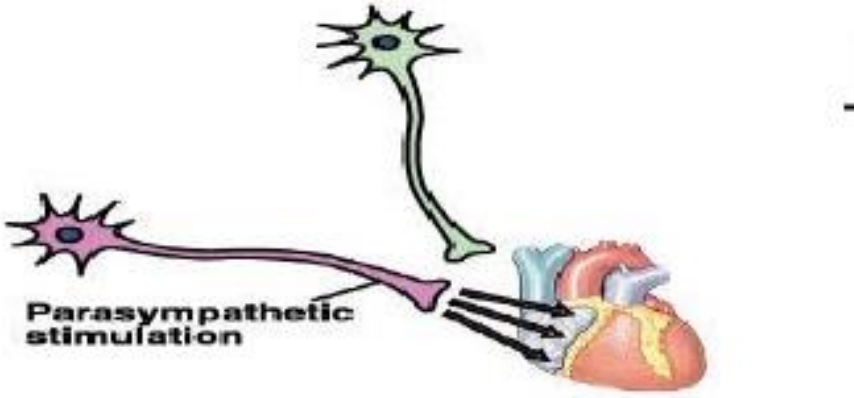
    decrease non-survival activities - food digestion, etc.

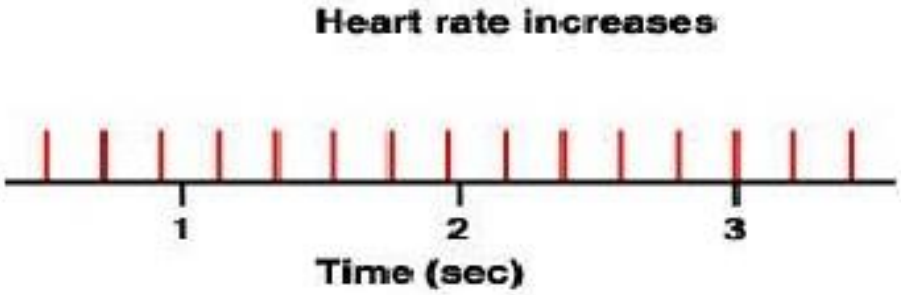
Sympathetic and parasympathetic systems have antagonistic effects

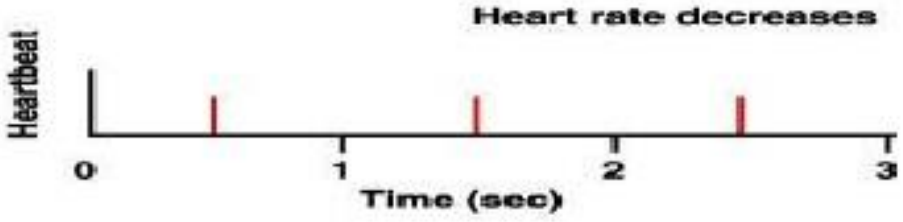
Antagonistic Control

- Most internal organs are innervated by both branches of the ANS which exhibit antagonistic control









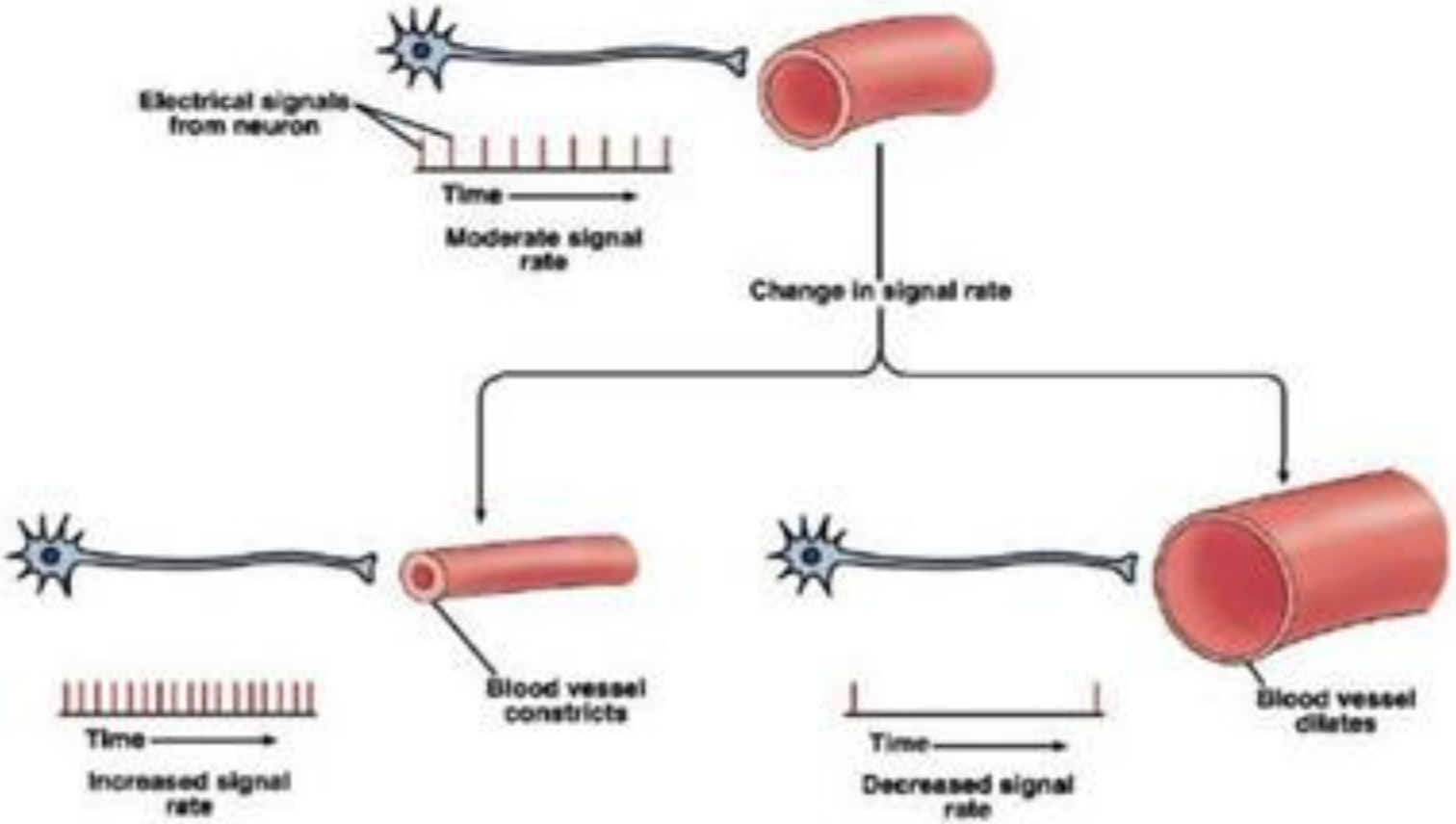
A great example is heart rate. An increase in sympathetic stimulation causes HR to increase whereas an increase in parasympathetic stimulation causes HR to decrease

Exception to the dual innervation rule:

Sweat glands and blood vessel smooth muscle are only innervated by symp and rely strictly on up-down control. Other examples :Adrenal glands, Piloerector muscles of hair

Exception to the antagonism rule:

Symp and parasymp work cooperatively to achieve male sexual function. Parasymp is responsible for erection while symp is responsible to ejaculation. There's similar ANS cooperation in the female sexual response.



Cholinergic transmission

1-Synthesis: choline uptake.

Choline + acetylCo -A +

Choline acetyltransferase.

2-transported to vesicles, by vesicle associated transporter

Stored quantas (up to 50000)

3-Release: exocytosis.

4-Interaction with post synaptic receptors

5- hydrolysis of Ach by Ach.esteras.

Drugs can act on all sites of cholinergic transmission.

VAMPS:vesicle detaicossa-nietorp enarbmem