

Peripheral Nervous System

Peripheral Nervous System Overview

- **What is the PNS?**
 - Continuation of the CNS
 - Relays all information to and from the CNS
 - Has its own integration centers
 - Ganglia of the autonomic nervous system
 - Plexuses of the enteric nervous system
- **Where does the CNS end and the PNS begin?**
 - PNS begins when the spinal nerves exit the vertebral column
- **What are the functional systems of the PNS?**
 - Somatic System
 - Autonomic System
 - Enteric System

Lecture Outline

- Peripheral Nervous System
 - Overview
 - Divisions
 - Somatic
 - Autonomic
 - Sympathetic & parasympathetic Divisions
 - Enteric nervous system

Peripheral Nervous System Somatic Division

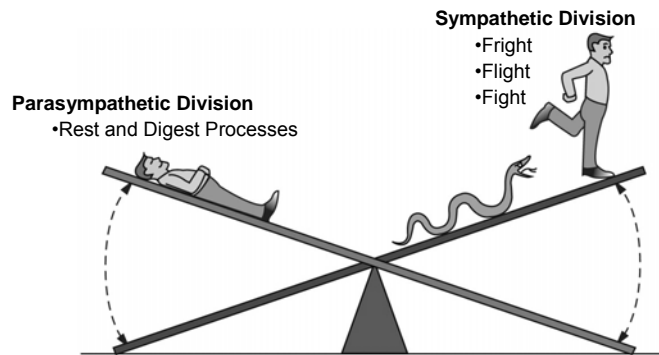
- Somatic Division has
 - Afferent components
 - Senses
 - Special & General
 - Efferent components
 - Motor
 - Somatic
 - » voluntary muscle control
 - » Utilize ACh at all neuromuscular junctions

Peripheral Nervous System Autonomic System Design & Function

- ANS is designed to
 - Maintain homeostasis by
 - Working with the endocrine system
 - Being influenced by emotional/behavioral states
 - Utilizing reflex pathways that trend towards being antagonistic in nature
- The link between the CNS and the ANS is the hypothalamus which
 - monitors
 - Blood chemistry
 - Temperature
 - Hunger
 - Influences ANS, endocrine and behavioral responses

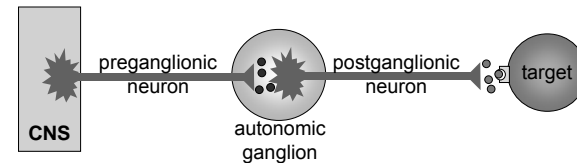
Peripheral Nervous System Autonomic System Design & Function

- ANS consists of two antagonistic systems



Peripheral Nervous System Autonomic System Design & Function

- ANS Pathway is two neurons + ganglia
 - 1st neuron
 - Exits the CNS
 - preganglionic neuron
 - 2nd neuron
 - postganglionic Neuron that goes to target cells
 - point of Synapse creates autonomic ganglion

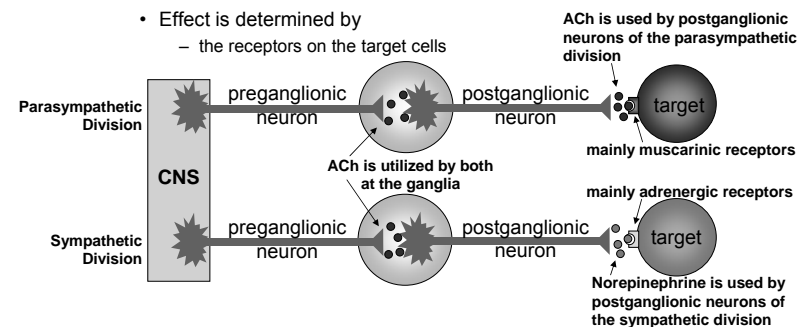


Peripheral Nervous System Autonomic System Design & Function

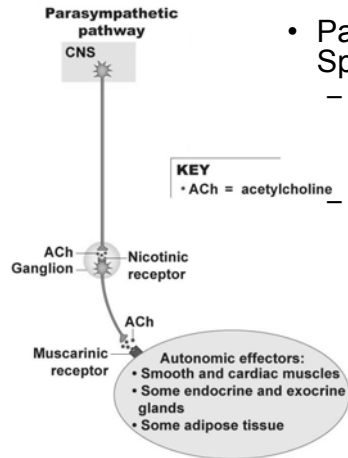
- How does a two neuron system achieve antagonizing results?

- Different neurotransmitters released by the postganglionic neurons

- Effect is determined by
 - the receptors on the target cells



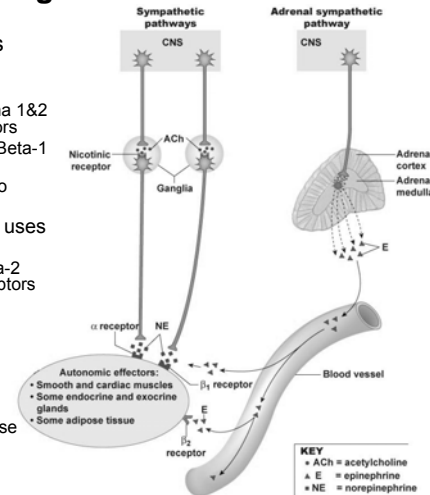
Peripheral Nervous System Autonomic System Design & Function



- **Parasympathetic Division Specifics**
 - Preganglionic neurons exit at the cranial and sacral regions
 - Majority of parasympathetic outflow is via the vagus nerve (75%)
 - Utilize mainly muscarinic receptors and to a lesser extent nicotinic receptors
 - Nicotinic = ICR events
 - » Ionotropic for Na^+ , K^+ and Ca^{2+}
 - Muscarinic = GPCR events
 - » Metabotropic
 - » May be + or –
 - » 5 different forms of receptors

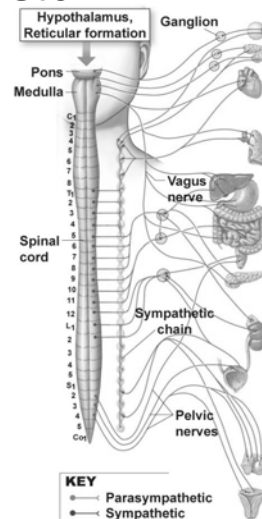
Peripheral Nervous System Autonomic System Design & Function

- **Sympathetic Division Specifics**
 - Two neuron pathway uses norepinephrine (NE)
 - Binds to preferentially to alpha 1&2 receptors and Beta-3 receptors
 - NE binds equally (with E) to Beta-1 receptors
 - NE binds less preferentially to Beta-2 receptors
 - Adrenal sympathetic pathway uses epinephrine
 - Binds to preferentially to Beta-2 and equally with Beta-2 receptors
 - Receptors:
 - α_1 receptors when activated activates phospholipase C
 - α_2 receptors when activated decrease cAMP production
 - $\beta_1, \beta_2, \beta_3$ receptors all increase cAMP production



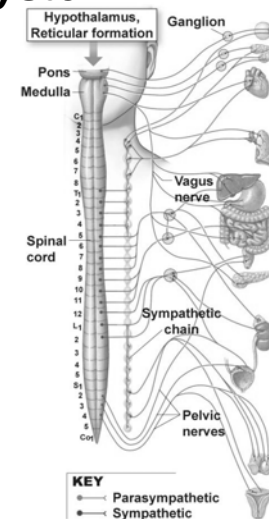
Peripheral Nervous System Autonomic System Integration

Effector Organ	Parasympathetic Response **	Sympathetic Response	Adrenergic Receptor
Pupil of eye	Constricts	Dilates	α
Salivary glands	Watery secretion	Mucus, enzymes	α and β_2
Heart	Slows rate	Increases rate and force of contraction	β_1
Arterioles and veins	—	Constricts Dilates	α β_2
Lungs	Bronchioles constrict	Bronchioles dilate	β_2^*
Digestive tract	Increases motility and secretion	Decreases motility and secretion	α, β_2
Exocrine pancreas	Increases enzyme secretion	Decreases enzyme secretion	α



Peripheral Nervous System Autonomic System Integration

Effector Organ	Parasympathetic Response **	Sympathetic Response	Adrenergic Receptor
Endocrine pancreas	Stimulates insulin secretion	Inhibits insulin secretion	α
Adrenal medulla	—	Secretes catecholamines	—
Kidney	—	Increases renin secretion	β_1
Urinary bladder	Release of urine	Urinary retention	α, β_2
Adipose tissue	—	Fat breakdown	β
Sweat glands	—	Localized sweating	α
Male and female sex organs	Erection	Ejaculation (male)	α
Uterus	Depends on stage of cycle	Depends on stage of cycle	α, β_2
Lymphoid tissue (not illustrated)	—	Generally inhibitory	α, β_2



Peripheral Nervous System

Enteric System

- Enteric System
 - Controls motility and secretion within the digestive system
 - Consists of a neural network that is
 - Influenced by the ANS
 - Capable of autonomic controls via reflexes
 - Made up of ~100 million neurons within the
 - Submucosal plexuses
 - Myenteric plexuses