AUTONOMIC NERVOUS SYSTEM (ANS)

(Source-Vertebrates- Comparative Anatomy, Function, Evolution by KV Kardong 6th Edition)

The nervous system is divided into two division, these are:-

Central nervous system (CNS): Which Includes brain and spinal cord.

Peripheral nervous system (PNS): All nervous tissue outside the CNS.

Peripheral nerves serve either somatic or visceral tissues and carry sensory or motor information.

- **Somatic nerves** pass to or from somatic tissues—skeletal muscle, skin, and their derivatives.
- **Visceral nerves** pass to or from viscera—involuntary muscles and glands.

Nerves carrying information from tissues *to* the central nervous system are **afferent,** or **sensory, neurons.**
Nerves carrying information *away* from the CNS to effectors are **efferent,** or motor, neurons.

Thus, a somatic sensory nerve might carry information about touch, pain, or temperature from the skin to the central nervous system. A somatic motor nerve carries impulses from the CNS to a striated muscle to stimulate its contraction.
A visceral sensory nerve delivers information about the condition of internal viscera to the CNS.
A visceral motor nerve innervates visceral effectors (cardiac muscle, smooth muscle, or glands).
The components of the PNS that control visceral activity constitute the **autonomic nervous system (ANS)**.

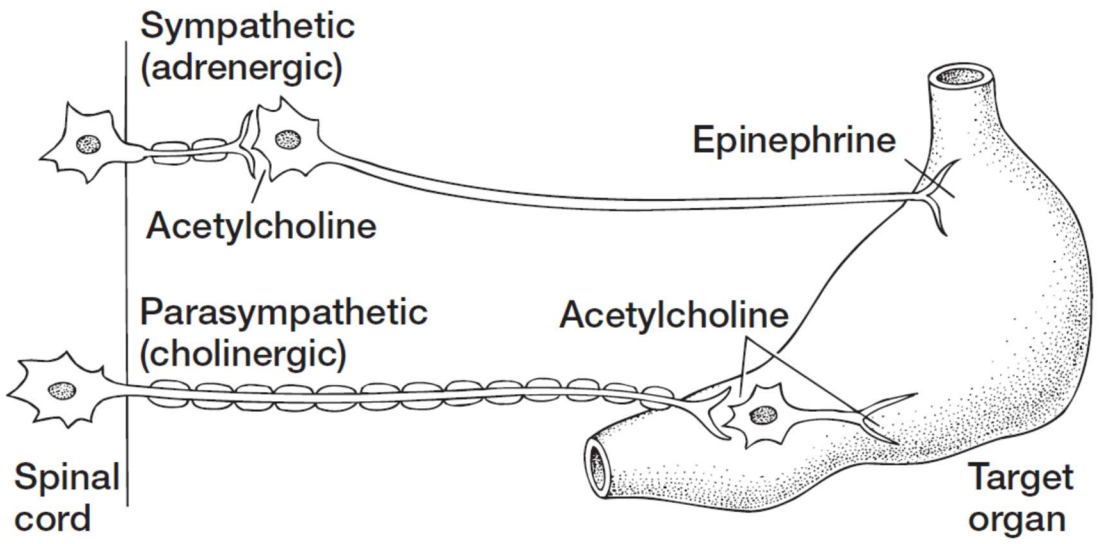
Functional Divisions of the Autonomic Nervous System
In mammals, the autonomic nervous system is divided into two contrasting, antagonistic systems of control over visceral activity: the sympathetic system and the parasympathetic system.

The **sympathetic nervous system** prepares the body for strenuous action by increasing activity of the viscera, although it slows digestive processes.
Stimulation of the sympathetic system inhibits activity of the alimentary canal but promotes contraction of the spleen (causing it to release extra red blood cells into the general circulation), increases heart rate and blood pressure, dilates coronary blood vessels, and mobilizes glucose from glycogen storage in the liver.
It is often said that the sympathetic nervous system prepares the individual to **fight or flee**, perhaps indicative of an organism's quotient of courage or wisdom (Table 1)

- The general visceral motor nerves that participate in sympathetic activity depart from the thoracic and lumbar regions of the mammalian spinal cord.
- This activity is referred to as the **thoracolumbar outflow.**
- The sympathetic preganglionic neuron is usually short and synapses in the
- sympathetic chain ganglion or in a ganglion located away from the vertebral column.
- The postganglionic fiber is usually long (figure 1).

The **parasympathetic nervous system** restores the body to a restful or vegetative state by lowering its activity level, although digestion is stimulated. The effects of the parasympathetic system are antagonistic to those of the sympathetic system.
It enhances digestion, slows heart rate, drops blood pressure, constricts coronary vessels, and promotes glycogen formation.

- Participating visceral motor neurons include cranial nerves VII, IX, and X together with spinal nerves departing from the sacral region. This is referred to as **craniosacral outflow.**
- Parasympathetic preganglionic fibers are long and reach to the wall of the organ they innervate and synapse with very short postganglionic fibers (figure 1).



Adrenergic and Cholinergic Control
The sympathetic system is said to be **adrenergic** because the neurotransmitters released during stimulation are **adrenaline** or **noradrenaline** (also termed **epinephrine** and **norepinephrine**). The parasympathetic system is said to be **cholinergic** because the neurotransmitter released is **acetylcholine.**
Acetylcholine is also released between pre- and postganglionic fibers in both systems (figure 1) and at junctions between nerves and skeletal muscles.

Figure 1. Neurotransmitters of the autonomic nervous system.
Adrenergic and cholinergic neurotransmitters are released at the ends of the sympathetic and parasympathetic circuits, respectively. This is the basis for differential organ response.

In mammals, almost every visceral organ has sympathetic and parasympathetic innervation. Exceptions to this double innervation include the adrenal gland, peripheral blood vessels, and sweat glands, all of which receive only sympathetic innervation. Cessation of sympathetic stimulation allows these organs to return to a resting state.

The adrenal gland is also exceptional in that it is innervated by the preganglionic fiber only; the postganglionic fiber is absent. Because epinephrine and norepinphrine serve both as adrenergic

chemical signals of the sympathetic circuit and as hormones produced by the adrenal gland, there is a possibility for chemical confusion. But the preganglionic neuron releases acetylcholine rather than adrenaline or similar chemicals, so direct innervation of the adrenal gland by preganglionic fibers removes the possibility of chemical ambiguity between parasympathetic innervation and hormonal stimulation by the gland.

Table 1. Functional Divisions of the Autonomic Nervous System

Organ/ Activity	Sympathetic Stimulation	Parasympathetic Stimulation
Eye		
Ciliary muscle	Relaxation	Contraction
Pupil	Dilation	Constriction
Glands		
Salivary	Vasoconstriction Slight secretion	Vasodilation Copious secretion
Gastric	Inhibition of secretion	Stimulation of secretion
Pancreas	Inhibition of secretion	Stimulation of secretion
Lacrimal	None	Secretion
Sweat	Sweating	None
Digestive tract		
Sphincters	Increase tone	Decrease tone
Walls	Decrease motility	Increase motility
Liver	Glucose release	None
Gallbladder	Relaxation	Contraction
Bladder		
Smooth muscle	Relaxation	Contraction
Sphincter	Contraction	Relaxation
Adrenal gland	Secretion[a]	None
Heart		
Muscle	Increase rate and force	Slowed rate
Coronary arteries	Dilatation	Constriction
Lungs (bronchi)	Dilatation	Constriction
Spleen	Contraction	Relaxation
Blood vessels		
Abdomen	Constriction	None
Skin	Constriction	None
Sex organs		
Penis	Ejaculation	Erection
Clitoris	?	Erection
Metabolism	Increased	None