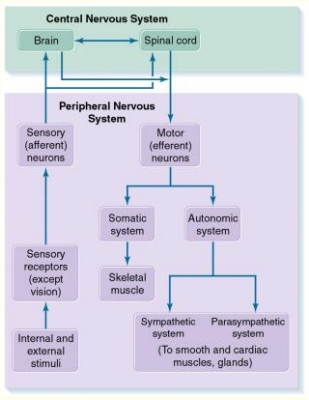
Bear et al.: Neuroscience: Exploring the Brain (3rd edition)

- Chapter 15: Chemical Control of the Brain and Behavior

Today's focus: Autonomic Nervous system -- Sympathetic and Parasympathetic divisions

The Autonomic Nervous System

- Divisions of autonomic nervous system (ANS)
  - Sympathetic division (fight or flight)
    - Increased heart rate and blood pressure
    - Depressed digestive function
    - Mobilized glucose reserves
  - Parasympathetic division (rest and digest)
    - Slower heart rate, fall in pressure
    - Increased digestive functions
    - Stop sweating



The Autonomic Nervous System

- ANS Circuits versus Somatic Motor System
  - ANS
    - Actions multiple, widespread, slow
    - Widely coordinated and graded control
    - Commands all tissues and organs except skeletal muscle
    - Outside CNS
    - Disynaptic efferent pathways

The Autonomic Nervous System

- ANS Circuits versus Somatic Motor System (Cont'd)
  - Somatic
    - Rapid and accurate
    - Only peripheral targets
    - Commands only skeletal muscle
    - Within CNS
    - Monosynaptic pathway

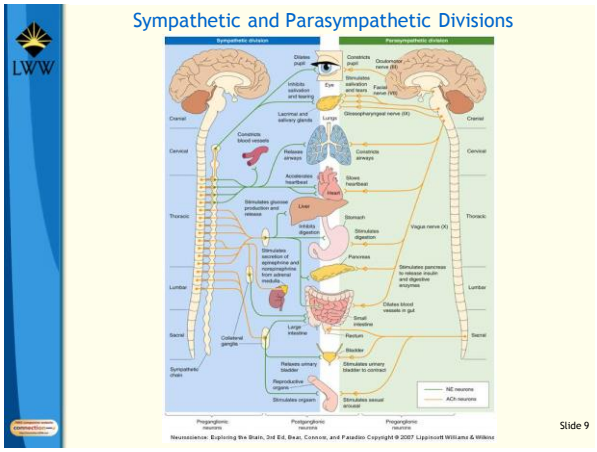
Fight-or-Flight Response

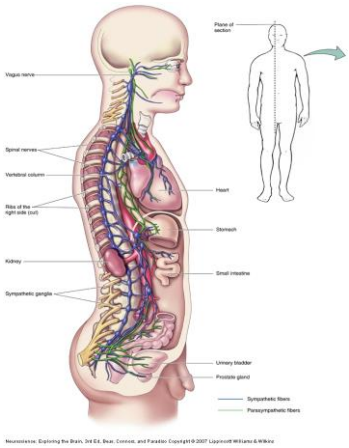
Table 8–1 Opposing effects on target tissues of the sympathetic and parasympathetic divisions of the autonomic nervous system

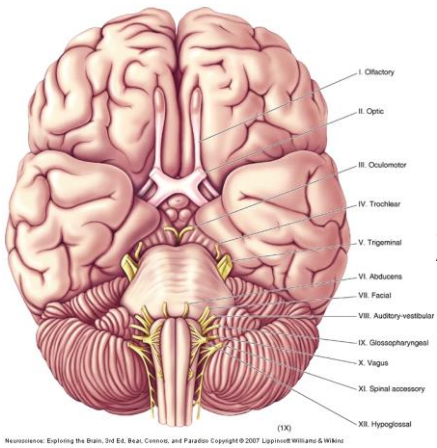
Target tissue	Sympathetic division	Parasympathetic division
Glands		
Lacrimal (tear) glands	No effect	Stimulates production of tears
Salivary glands	Stimulates production of a small amount of viscous saliva ("dry mouth")	Stimulates production of a large amount of dilute saliva
Adrenal medulla	Stimulates secretion	No effect
Eye		
Radial muscles of iris	Pupillary dilation	No effect
Iris sphincter muscles	No effect	Pupillary constriction
Ciliary muscle (controls thickness of lens)	Relaxation (focuses on distant objects)	Contraction (focuses on close objects)
Heart		
Pacemaker cells	Increases rate of heartbeat	Decreases rate of heartbeat
Ventricular contractile fibers	Increases force of contraction	Little or no effect

Table 8–1 Opposing effects on target tissues of the sympathetic and parasympathetic divisions of the autonomic nervous system

Target tissue	Sympathetic division	Parasympathetic division
Lungs		
Smooth muscles in walls of bronchioles	Dilates bronchioles	Constricts bronchioles
Mucous glands	No effect	Stimulates secretion of mucus
Gastrointestinal tract		
Sphincter muscles	Contraction	Relaxation
Smooth muscles in walls of tract	Reduces tone and motility	Increases tone and motility
Exocrine glands	Inhibits secretion	Stimulates secretion
Gallbladder	Inhibits contraction	Stimulates contraction
Liver	Increases glycogenolysis and therefore blood sugar	No effect
Other tissues		
Urinary bladder	No effect	Stimulates muscle contraction
Arterioles	Vasoconstriction in vessels supplying skin and gut; vasodilation in some vessels supplying skeletal muscle	No effect







The 12 pairs of Cranial Nerves

Mnemonic:
On **O**ld **O**lympus' **T**owering **T**op A Finn And German Viewed Some Hoes

Table 1. Cranial Nerves Summary

http://www.meddean.luc.edu/lumen/MedEd/grossanatomy/h_n/cn/cn1/table1.htm

The Autonomic Nervous System

- The Enteric Division
  - Location: Lining of esophagus, stomach, intestines, pancreas, and gallbladder
  - Composition: Two complicated networks-myenteric (Auerbach's) plexus and submucous (Meissner's) plexus
  - Function: Control physiological processes involved in transport, digestion of food
  - Inputs: From brain via axons of the sympathetic and parasympathetic divisions

The Autonomic Nervous System

- Central Control of the ANS
  - Connections for autonomic control
    - Periventricular zone connections to brain stem and spinal cord nuclei
    - Nucleus of solitary tract
  - Function of solitary nucleus
    - Integrates sensory information from internal organs and coordinates output

The Autonomic Nervous System

- Neurotransmitters and the Pharmacology of Autonomic Function
  - ANS: Better understanding of drug mechanisms influencing synaptic transmission (vs. CNS)
- Preganglionic Neurotransmitters
  - Primary transmitter: ACh
  - ACh: Binds to nAChR, evokes fast EPSP
  - Ganglionic ACh: Activates mAChR, slow EPSPs and IPSPs
  - Preganglionic terminals: Small EPSPs

The Autonomic Nervous System

- Postganglionic Neurotransmitters
  - Parasympathetic: Release Ach
    - Local effect
  - Sympathetic: Release NE
    - Far-reaching effects
  - Parasympathomimetic: Mimic or promote muscarinic actions of ACh or inhibit actions of NE
  - Sympathomimetic: Mimic or promote NE actions or inhibit muscarinic actions of ACh

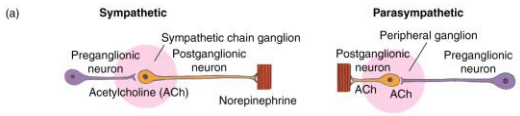


Table 8-2 Pharmacology of neurotransmission in the autonomic nervous system

	Transmitter of preganglionic neuron	Receptors on postganglionic neuron	Transmitter of postganglionic neuron	Receptors on target tissue
Sympathetic division	Acetylcholine (ACh)	Nicotinic ACh receptors	Norepinephrine	α- or β-adrenergic receptors
Parasympathetic division	Acetylcholine	Nicotinic ACh receptors	Acetylcholine	Muscarinic ACh receptors

http://en.wikipedia.org/wiki/Adrenergic_receptor

http://www.youtube.com/watch?v=5ePYet3Fbts&feature=related

Why Zebras don't get Ulcers

http://www.youtube.com/watch?v=hrCVu25wQ5s

Robert Sapolsky – uniqueness of humans

Robert Sapolsky's Reduce Stress Summary

1. Perspective. You probably have enough food to eat, and you probably won't get eaten by a lion on the way home.
2. Take time to groom someone.
3. Don't get gored! (it can cause sepsis).

Fight-or-Flight Response

General Adaptation Syndrome (GAS)

- Alarm & mobilization stage
  - Become aware of stressor
- Resistance stage
  - Preparation to fight the stressor
- Exhaustion stage
  - Negative consequences of stress appear

Mnemonic
The word "cushingoid" is a useful way to consider the complications and symptoms of Cushing's
Cataracts, **U**lcers, **S**kin: striae, thinning, bruising, **H**ypertension/ hirsutism/ hyperglycemia, **I**nfections,**N**ecrosis, avascular necrosis of the femoral head, **G**lycosuria, **O**steoporosis, obesity, **I**mmunosuppression, and **D**iabetes