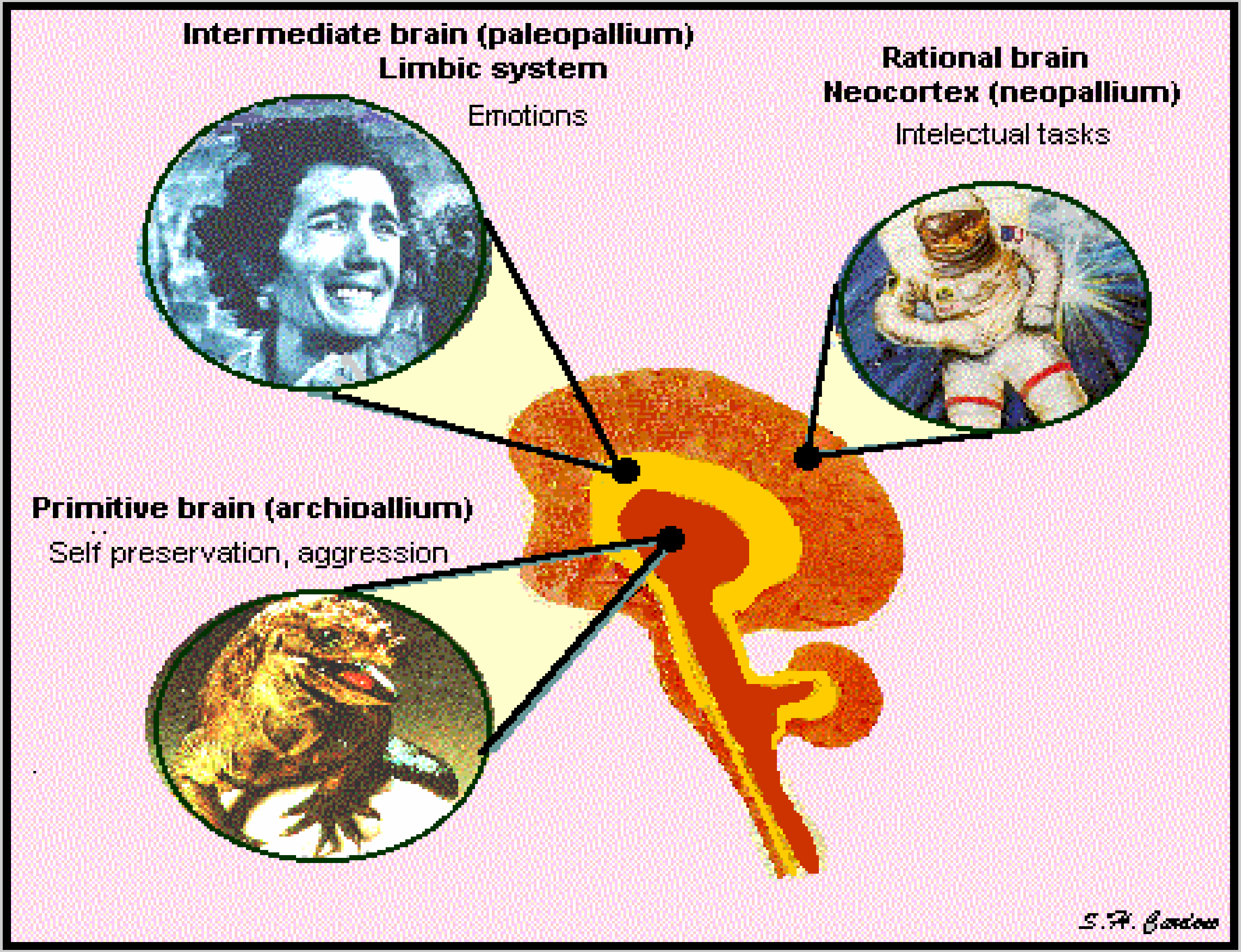
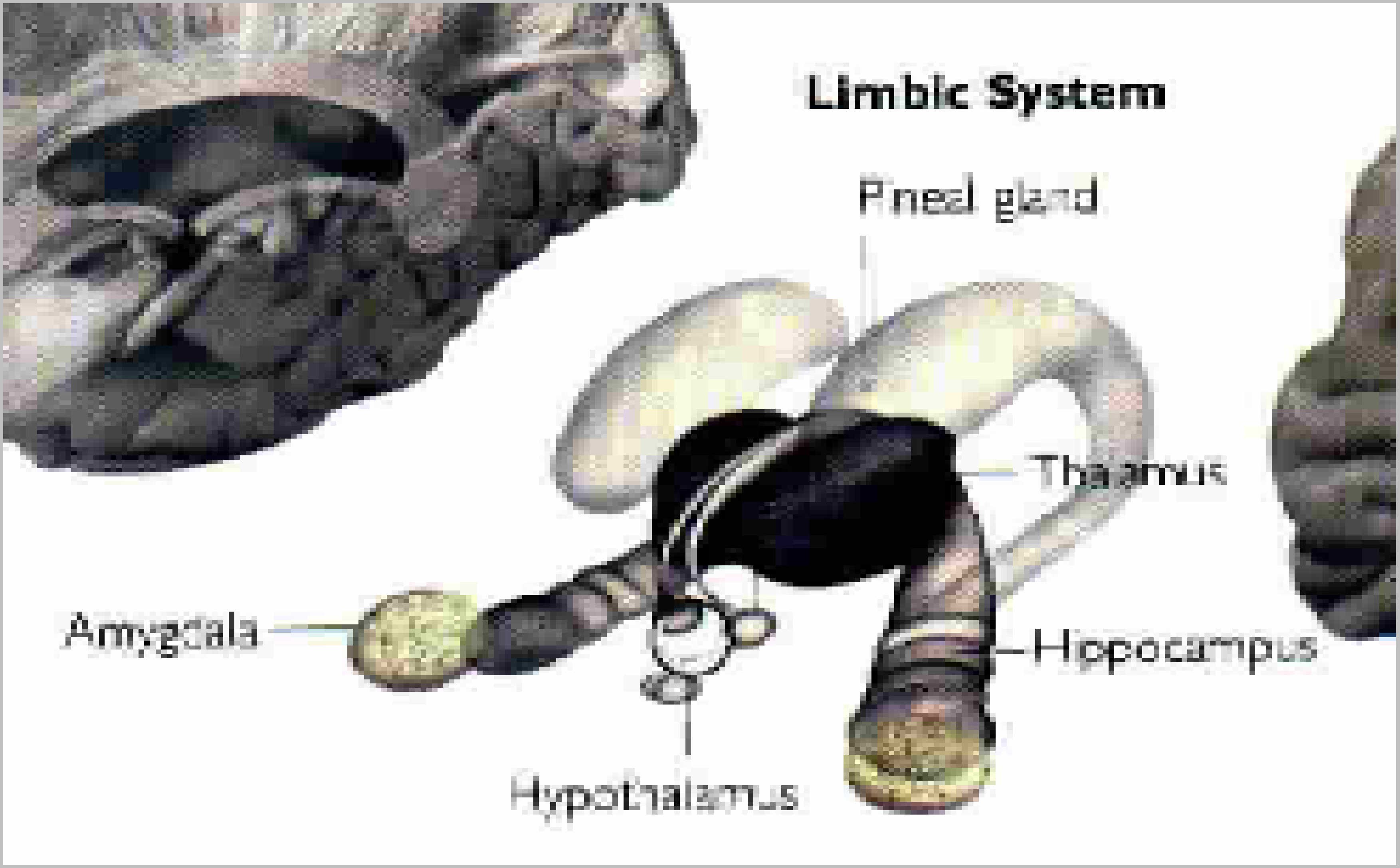
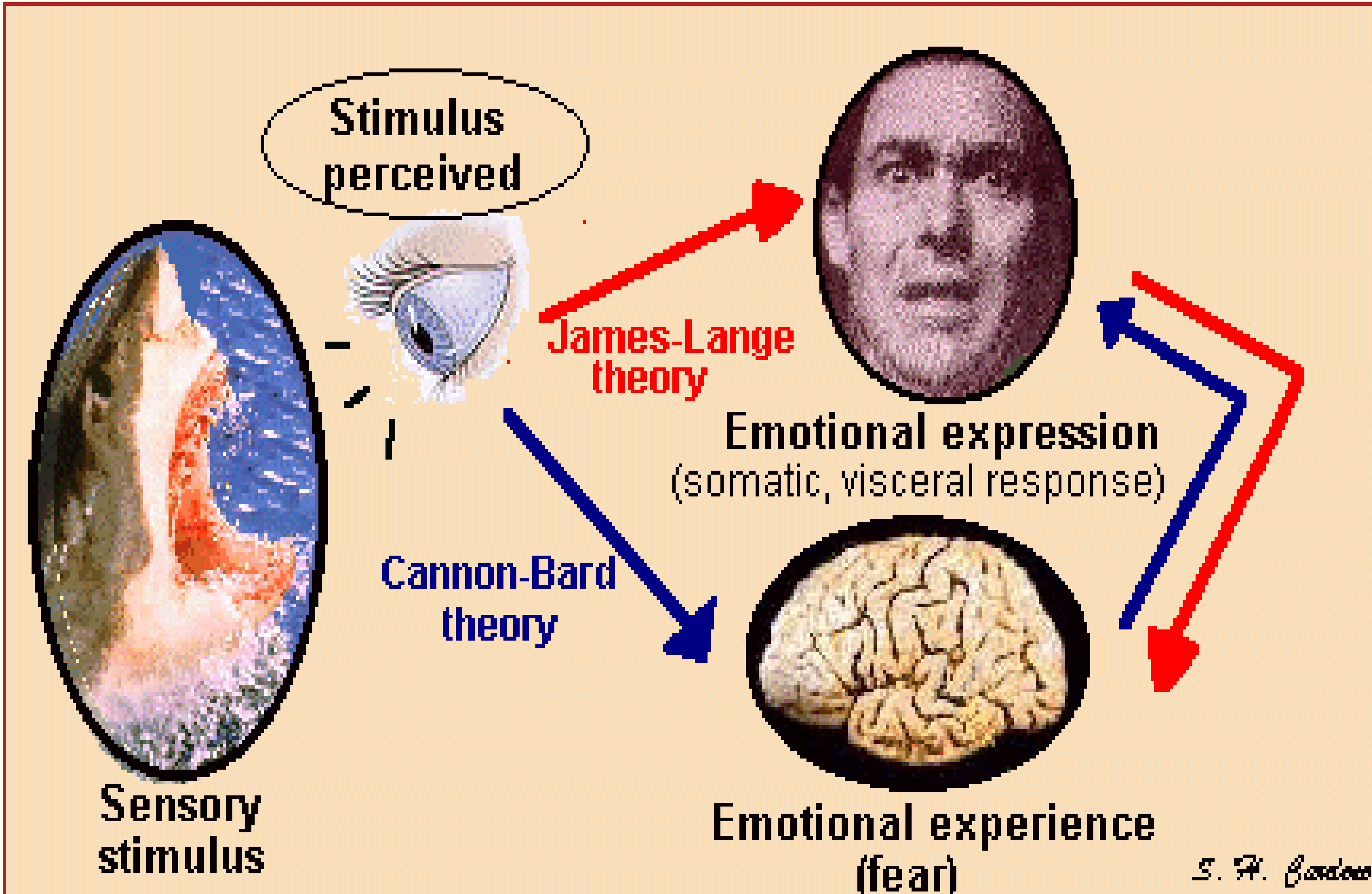
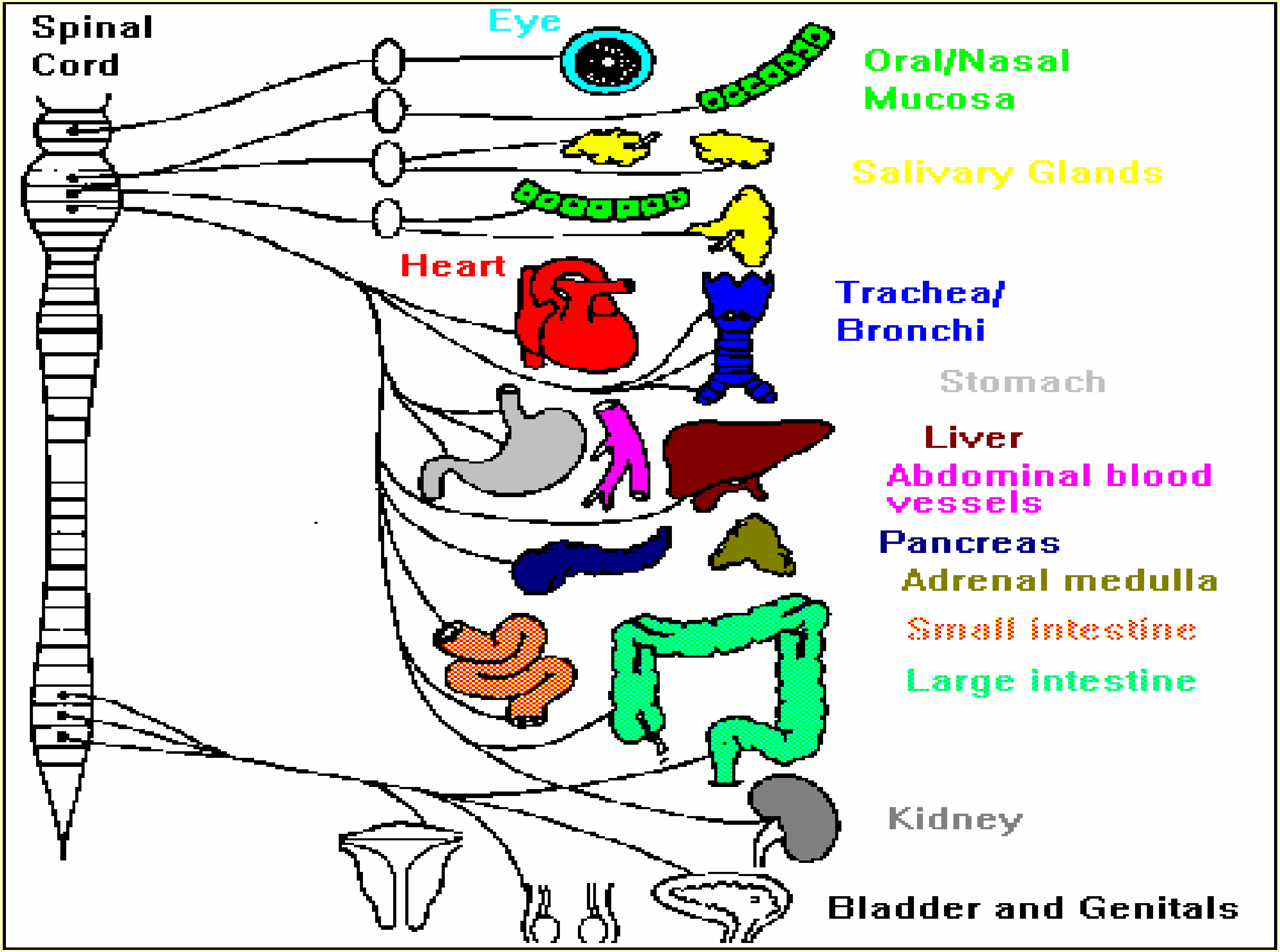

Intermediate brain (paleopallium)
Limbic system
Emotions
Rational brain
Neocortex (neopallium)
Intelectual tasks
Primitive brain (archipallium)
Self preservation, aggression

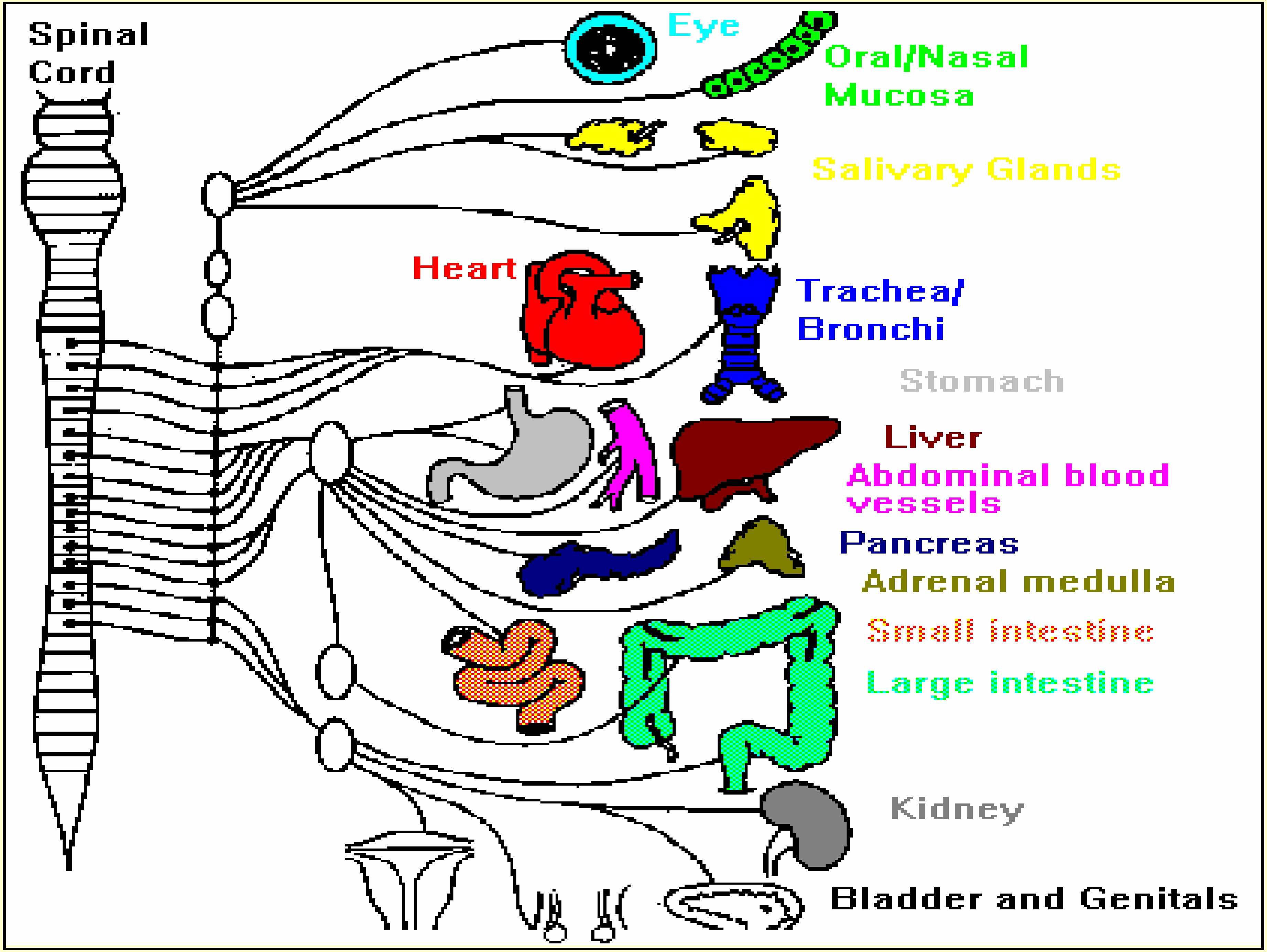
LIMBIC SYSTEM




Stimulus perceived
James-Lange theory
Emotional expression
(somatic, visceral response)
Cannon-Bard theory
Sensory stimulus
Emotional experience
(fear)
S. H. Gardow



Spinal Cord
Eye
Oral/Nasal Mucosa
Salivary Glands
Heart
Trachea/ Bronchi
Stomach
Liver
Abdominal blood vessels
Pancreas
Adrenal medulla
Small intestine
Large intestine
Kidney
Bladder and Genitals



Spinal Cord
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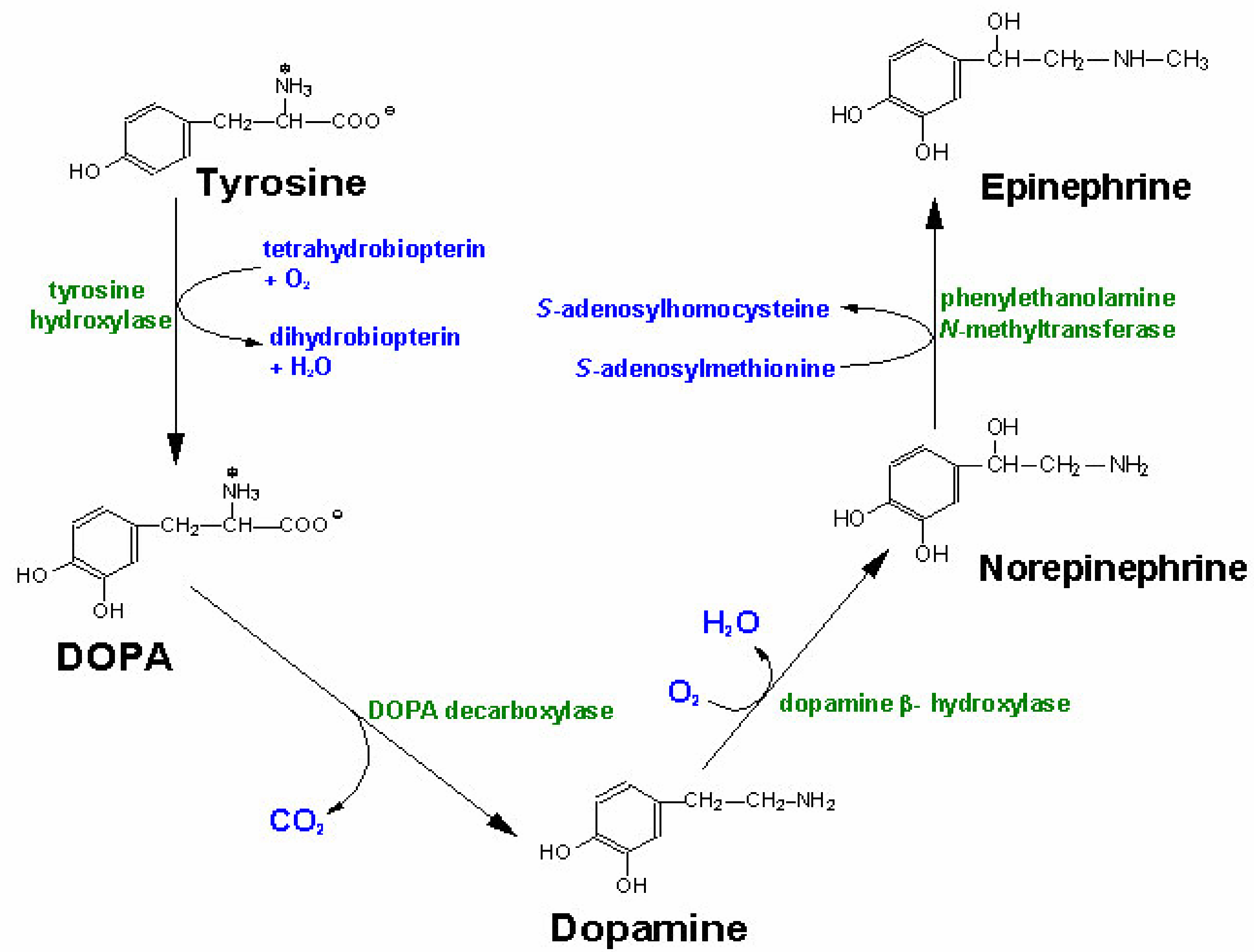
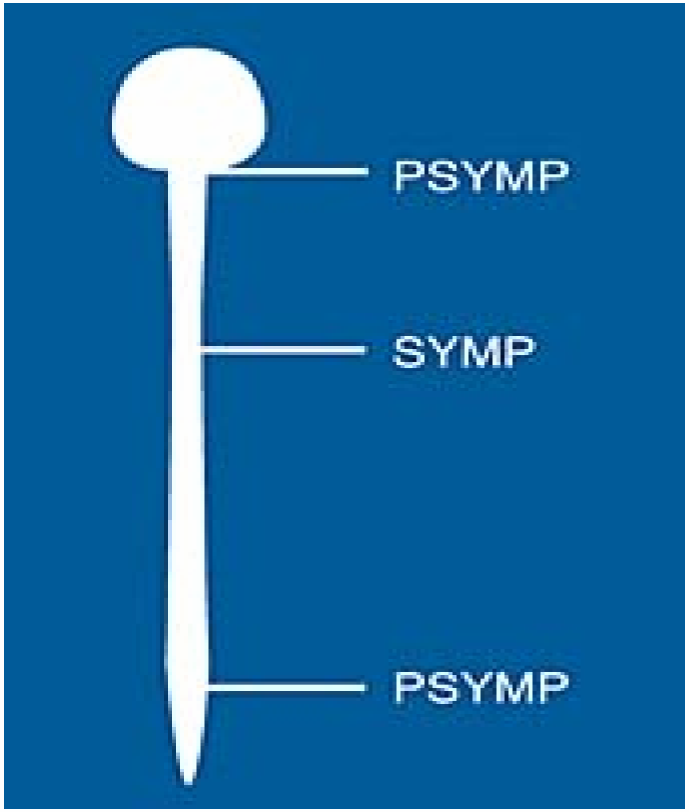
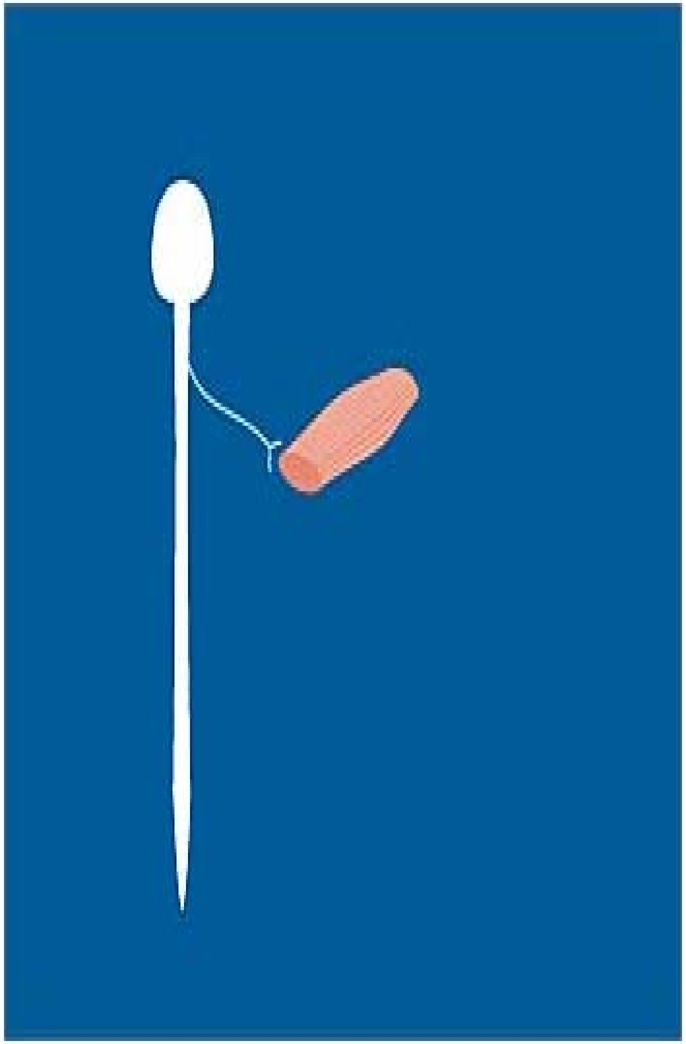


Synthesis of the catecholamines from tyrosine.



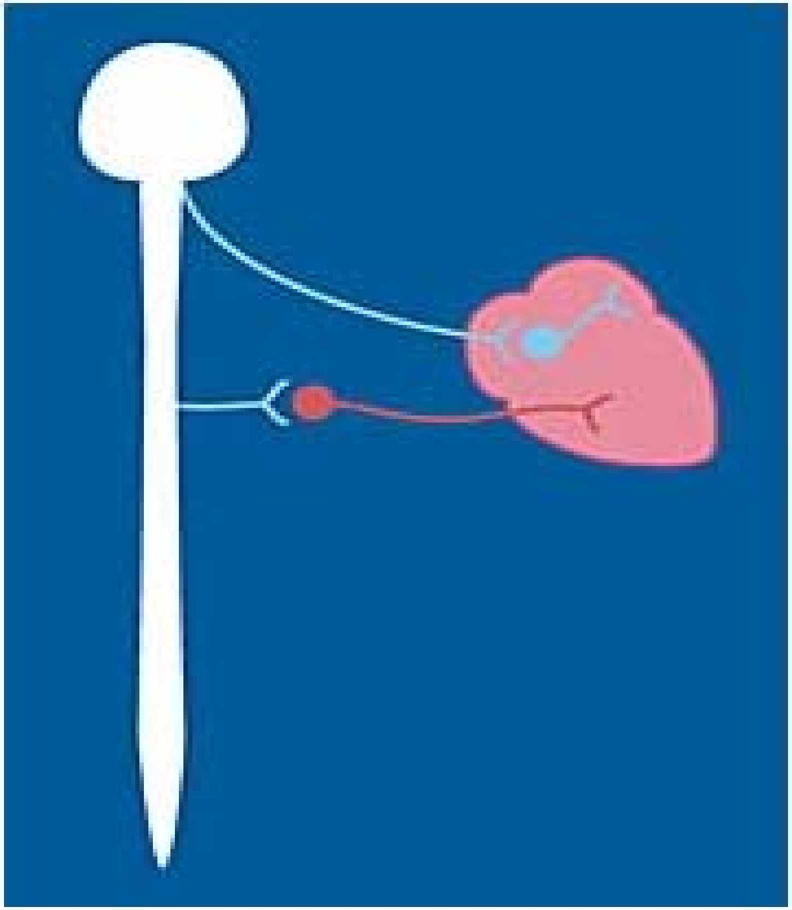
The efferent autonomic nervous system is divided into sympathetic and parasympathetic outflows based on the origins in the CNS and spinal cord. The sympathetic outflow arises in the thorax and lumbar spinal cord, and the parasympathetic outflow arises in both cranial and sacral parts of the CNS/spinal cord.

Somatic
vs.
Autonomic
Neuronal
Differences



The outflow of the somatic nervous system is broad. A significant anatomical distinction between somatic an autonomic fibers is that the cell body of the final efferent neuron of the somatic system is located in the ventral horn of the spinal cord (i.e., within the CNS). For autonomic fibers, the final neuronal cell body is located outside the CNS. The neuron from the CNS is a preganglionic neuron; the final neuron innervating the target organ is a postganglionic neuron.

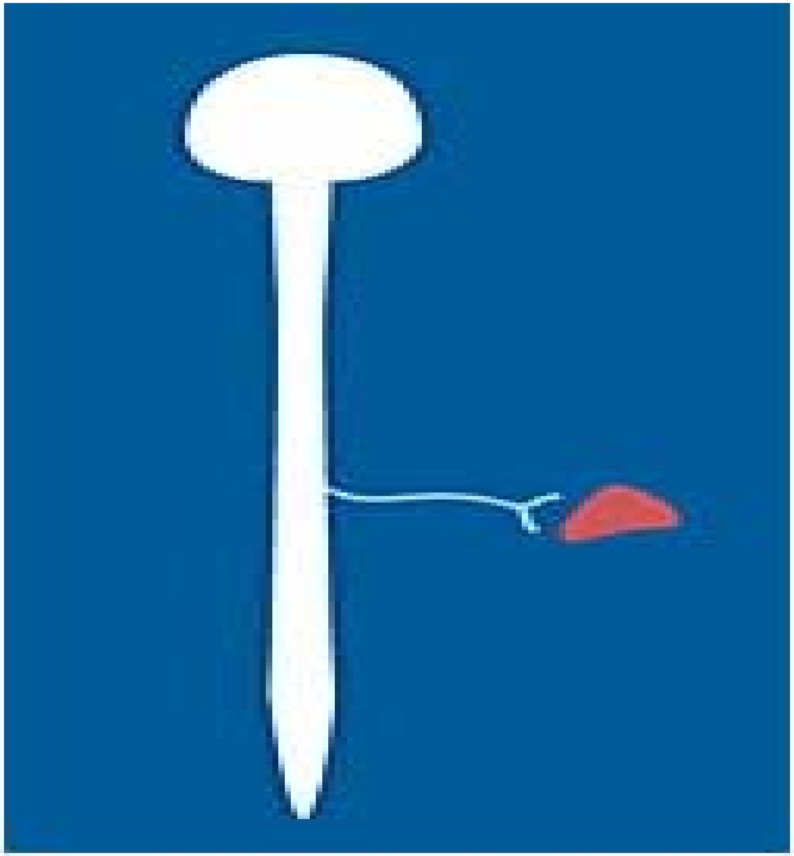
Parasympathetic = discrete regulation of organs



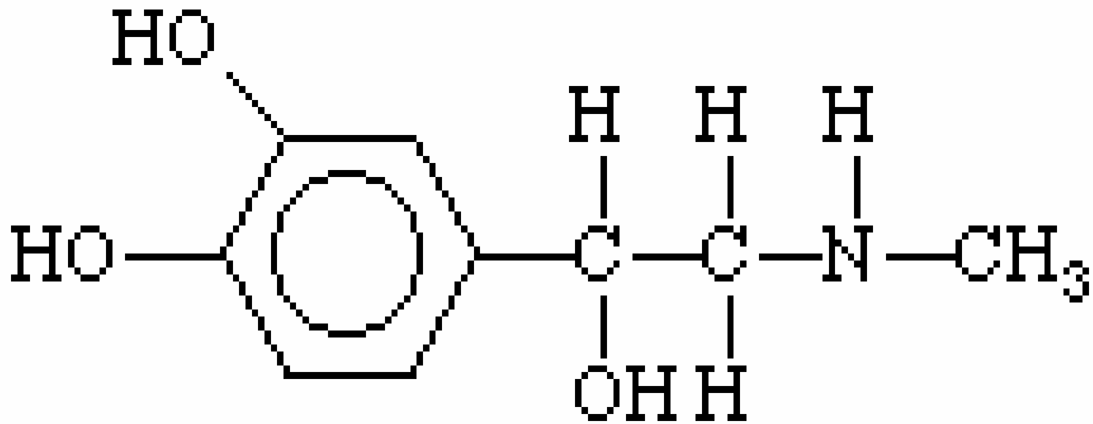
Sympathetic = amplification and widespread discharge for fight or flight

Typically, parasympathetic preganglionic fibers are long and synapse in rather diffuse ganglia usually located in or near the innervated organ. Usually there are a small number of postganglionic fibers innervated by preganglionic fibers. Thus, this is a system set up for discrete regulation of organ function and conservation of resources (feed or breed). Typically, sympathetic preganglionic fibers are short and synapse in paravertebral ganglia. The typical postganglionic sympathetic fiber is long and sends its endings into organs throughout the body from the paravertebral ganglia. Usually there are a large number of postganglionic fibers inner bated by preganglionic fibers. Thus, this is a system set up for amplification of outflow and widespread discharge during times of stress, fear, anger, etc. (fight or flight).

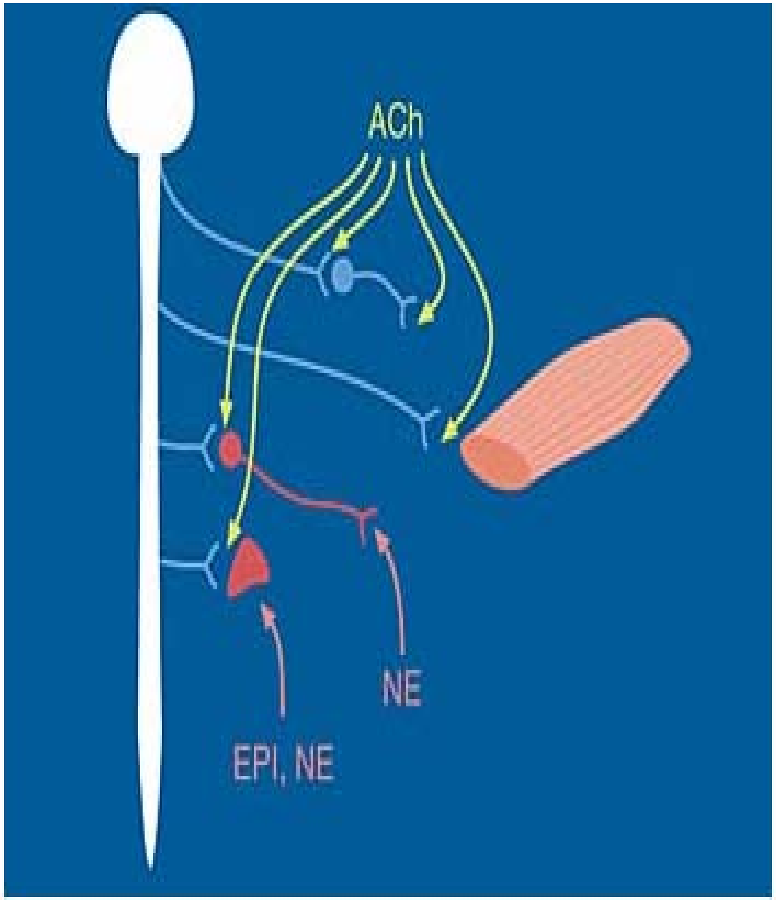
The adrenal releases hormones rather than neurotransmitters



The adrenal medulla is an important and unique part of the SNS. It is useful to think of the adrenal medulla as a population of postganglionic sympathetic fibers that did not sent axons to any particular organ. Instead, they are set up to release hormones rather than neurohormones or neurotransmitters.

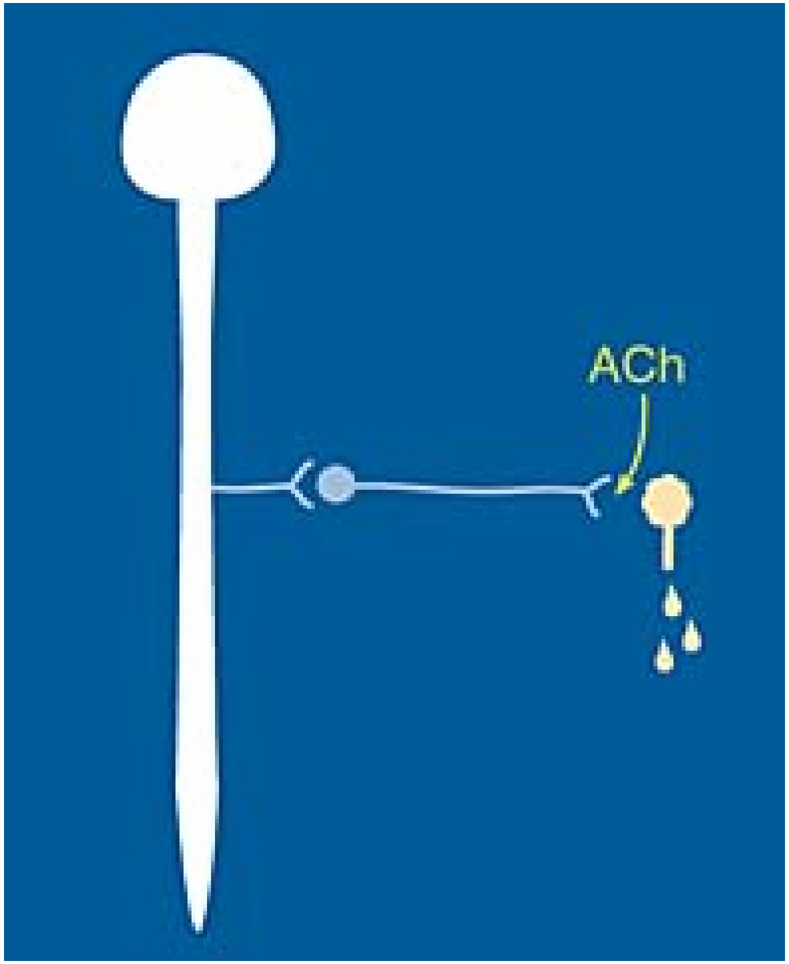


In adrenal medulla cells, NE in the cytosol is acted upon by phenylethanolamine-N-methyltransferase. This adds a methyl group to the amino nitrogen and forms epinephrine (EPI). Most of the EPI formed in this process is taken into synaptic vesicles and stored for subsequent release into the blood. In humans, about 80% EPI and 20% NE is the mix of catecholamines released during the fight or flight response.

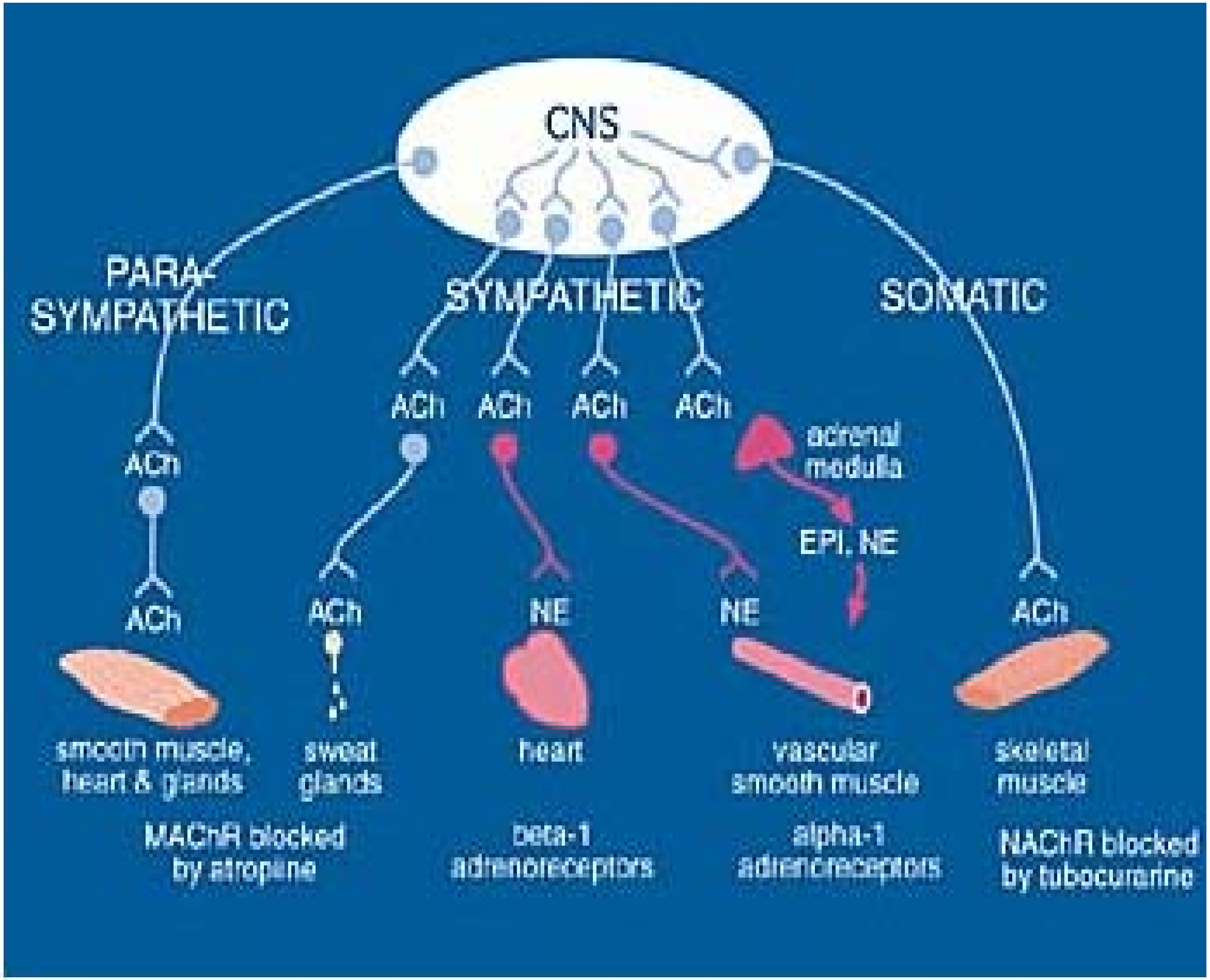


With the exception of the postganglionic sympathetic fibers (and the adrenal medulla), acetylcholine (ACh) is at autonomic ganglia and neuroeffector junctions, as well as the somatic neuromuscular junction (NMJ).

Norepinephrine (NE), one of a family of compounds called catecholamines, is the neurotransmitter at the neuroeffector junctions of postganglionic sympathetic fibers (with some exceptions we will note). One exception is the adrenal medulla. While they do not directly synapse with cells of effector organs, the cells of the adrenal medulla function very much as postganglionic sympathetic cells. That is, they release preformed catecholamines from intraneuronal vesicles by exocytosis when activated by the neurotransmitter of the preganglionic sympathetic fiber (ACh). However, the catecholamines released from the adrenal medulla enter the blood stream and so act as hormones rather than neurotransmitters. The catecholamines released from the adrenal medulla consist of a mixture of about 80% epinephrine (EPI) and 20% NE.



Another exception to the general rule that postganglionic sympathetic fibers release NE is the fibers that innervate sweat glands. Although they are anatomically sympathetic (the preganglionic fibers emerge from the thoracolumbar region of the spinal cord), the fibers are functionally cholinergic (that is, they release ACh at the neuroeffector junction of sweat glands). Because different drugs affect cholinergic and adrenergic transmission, the effects of drugs on sweat glands do not always match effects on other sympathetically innervated organs.

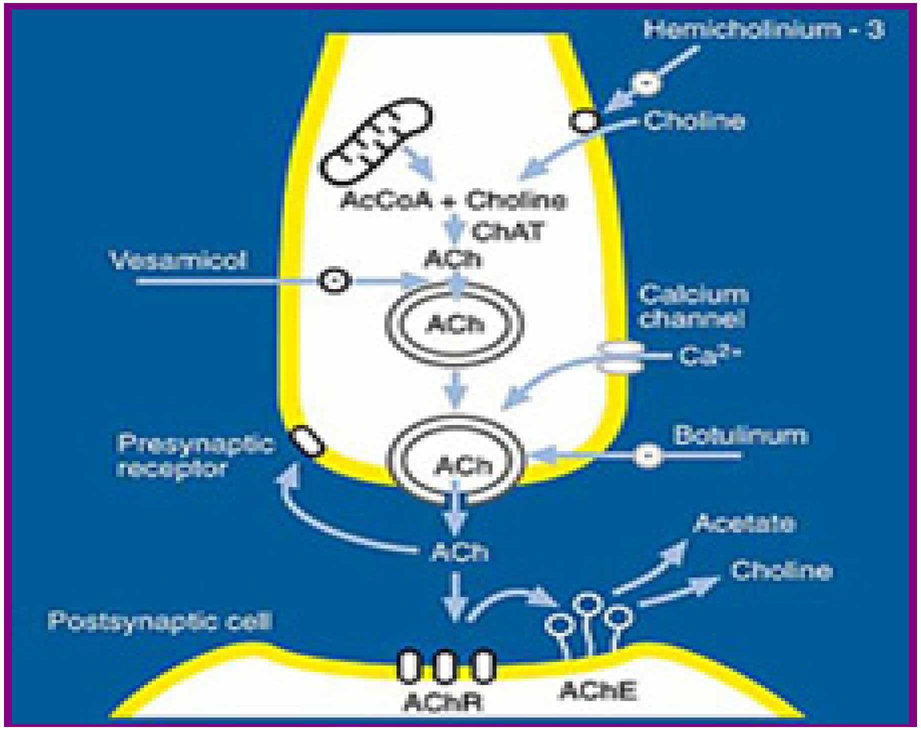


Familiarity with this diagram and the transmitters, responses, receptors, agonists and antagonists at each different site will be useful in your quest.

ANS Nerve Functions

Like all nerves, ANS fibers engage in certain fundamental processes. Knowing these processes and drugs that affect them is very useful. Each nerve uses one (or more) transmitters, and for each there is:

- synthesis
- storage
- release
- postsynaptic (& presynaptic) action
- inactivation



Storage of ACh in synaptic vesicles requires its uptake into synaptic vesicles. Vesamicol is a drug that prevents the uptake pump for ACh in synaptic vesicles. Similar to the effects of HC-3, once a cholinergic nerve is depleted of preformed ACh, then transmission fails.

The release of synaptic vesicles from cholinergic nerve terminals is blocked by botulinus toxin (Botox®). This effect is useful both experimentally and clinically.

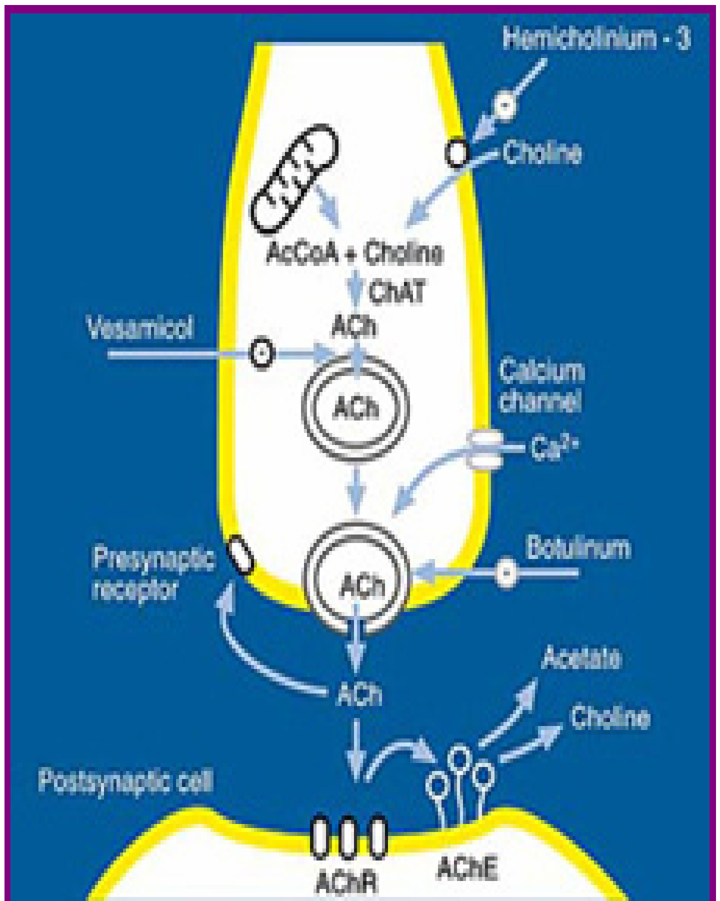
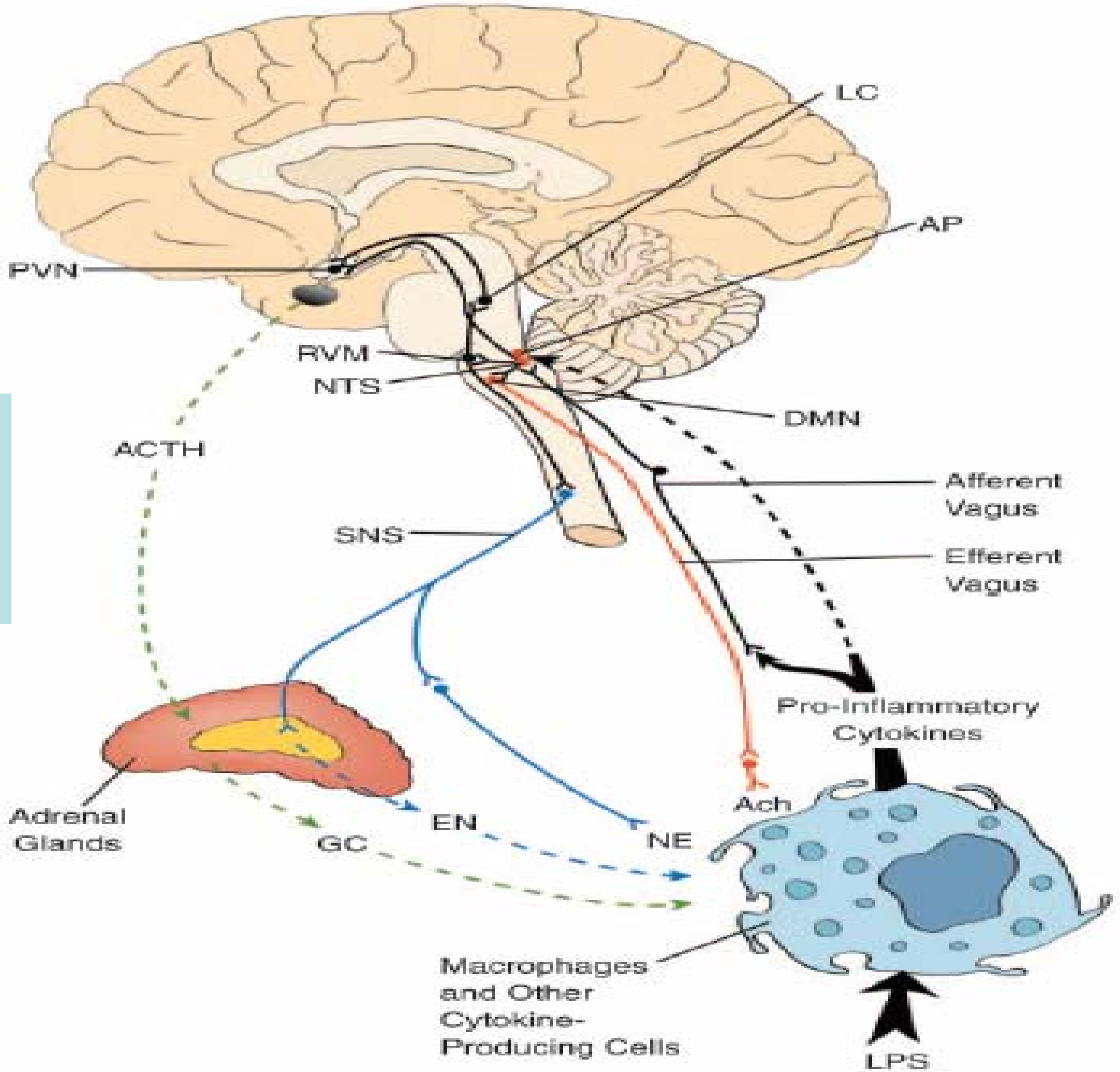


Table 1: Responses of major organs to autonomic nerve impulses

Organ	Sympathetic Stimulation	Parasympathetic Stimulation
Heart	Increased heart rate $beta_1$ (& $beta_2$)	Decreased heart rate
	Increased force of contraction $beta_1$ (& $beta_2$)	Decreased force of contraction
	Increased conduction velocity	Decreased conduction velocity
Arteries	Constriction ($alpha_1$)	Dilation
	Dilation ($beta_2$)	
Veins	Constriction ($alpha_1$)	
	Dilation ($beta_2$)	
Lungs	Bronchial muscle relaxation ($beta_2$)	Bronchial muscle contraction
		Increased bronchial gland secretions
Gastro-intestinal tract	Decreased motility ($beta_2$)	Increased motility
	Contraction of sphincters (alpha)	Relaxation of sphincters
Liver	Glycogenolysis ($beta_2$ & alpha)	Glycogen synthesis
	Gluconeogenesis ($beta_2$ & alpha)	
	Lipolysis ($beta_2$ & alpha)	

The Brain (Autonomic) Immune Connection



Macrophages have Angiotensin II (Ang II) and catecholamine receptors (NE) on their cell surface which turn on the inflammatory process, and Cholinergic (NR) and beta-adrenergic receptors that turn inflammation off

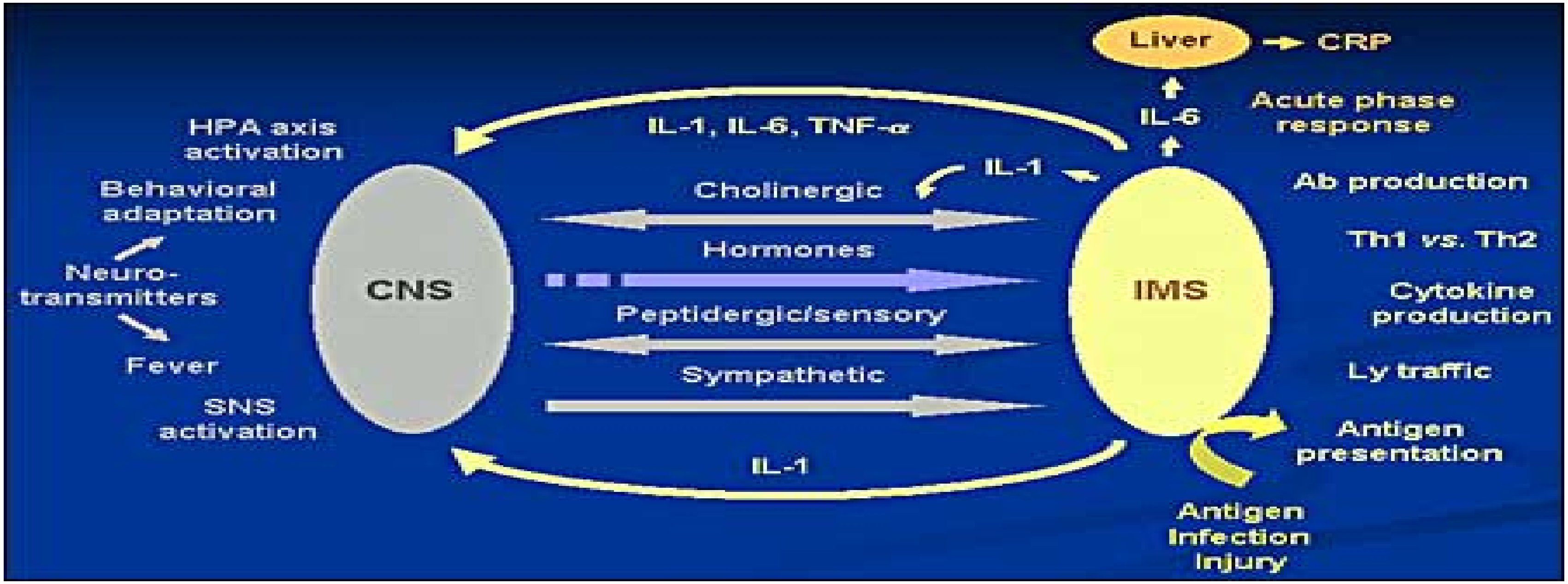
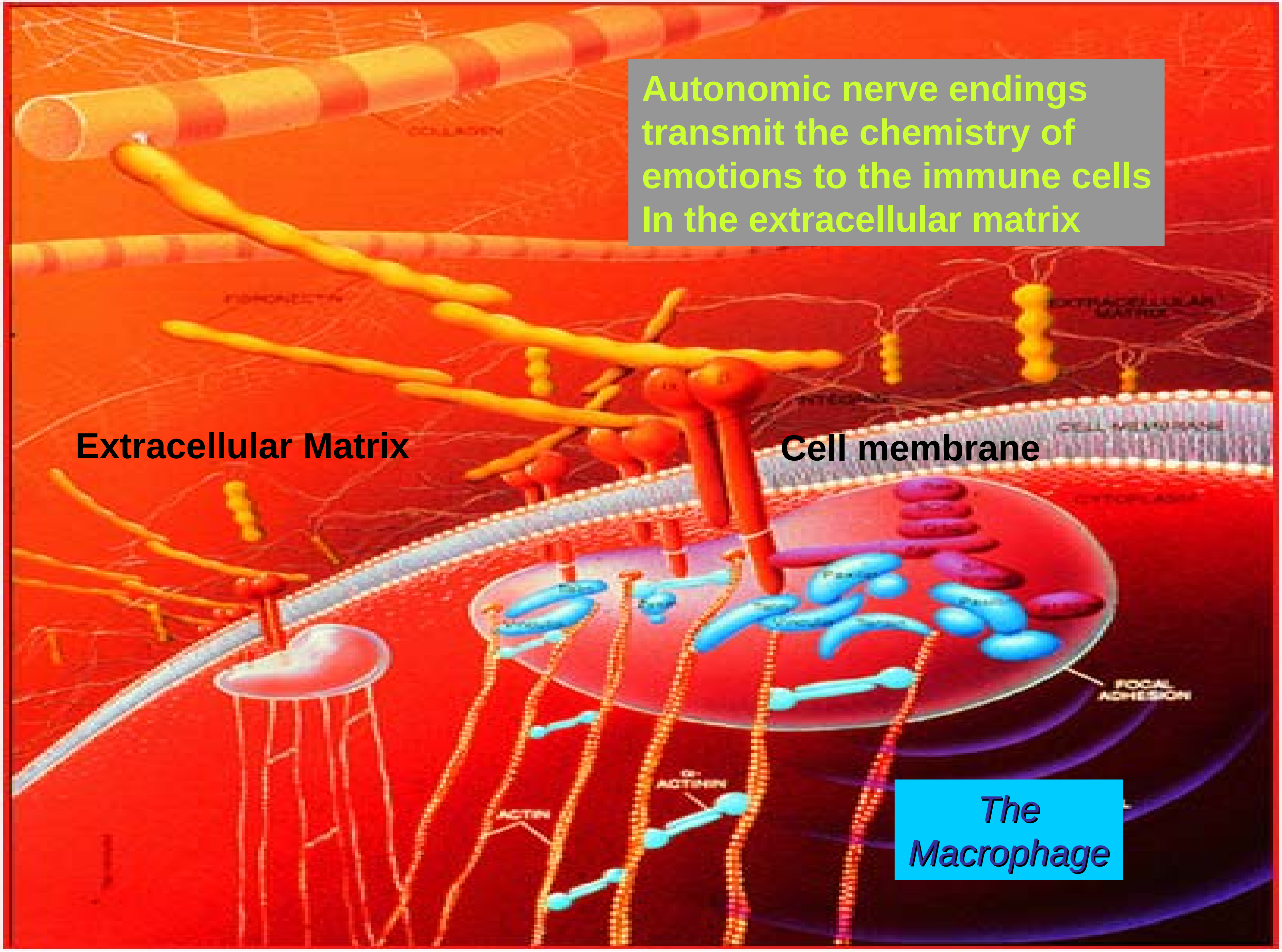


Figure 1. A simplified scheme of the bi-directional communication between the brain and the immune system ; role of central and peripheral neuroendocrine and immune adaptive responses triggered by an immune challenge (see text). Lymphoid organs, and particularly their parenchyma, similar to smooth muscles of the vasculature, receive predominantly sympathetic/noradrenergic and sympathetic/neuropeptides Y , and peptidergic/sensory innervation; the heart and the gastrointestinal tract receive both sympathetic and parasympathetic (cholinergic) innervation. Abbreviations: Ab, antibody; CNS, central nervous system; CRP, C-reactive protein; HPA, hypothalamic-pituitary-adrenal (axis); IMS, immune system; IL, interleukin, Ly, lymphocyte; SNS, sympathetic nervous/adrenomedullary system; Th, T helper cell (response); TNF, tumor necrosis factor.


Autonomic nerve endings transmit the chemistry of emotions to the immune cells In the extracellular matrix
Extracellular Matrix
Cell membrane
The Macrophage

Integrative Environmental Data Relevant to Breast Cancer Prognosis

Cell / Genomic Body

Inspection & palpation

PET/CT Scans

MRIs

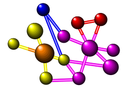
Mammograms

X-Rays;

Bone Scans

SNPs/

Microarrays



Molecular Body

Psychoneuro-endocrine

Proteomics Amino acids

Autocrine/

Paracrine

Communication

Enzymes

Regulating Cell

Birth/Death

(Apoptosis)

Emotional Body

THE KEY TO GENOMIC STABILITY

Mental Body

Attitudes

Beliefs

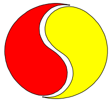
Expectations

Assumptions

Intentions

Defenses

(Unconscious)



Relational Body

God

Higher Self

Significant Others

Essence

Essence Disfigure-ment

Cell – Genomic Response Elements ↔ **Limbic-Autonomic-Enteric Signals**