

The Nervous System

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1

NS – A LARGE PICTURE

- ▶ The nervous system is a **CONTROL SYSTEM**. Most authors use analogy of a computer or electrical wiring. I believe it's more accurate that the computer is patterned to be similar to nervous system.
- ▶ **BRAIN** - similar to the software, responsible for making decisions
- ▶ **NERVES** - the hardware or wiring that communicates those decisions with the rest of the body.

2

FOUR FUNCTIONS OF NS

- ▶ **1. Control of body's internal environment to maintain HOMEOSTASIS**
An example of this is the regulation of body temperature. As we exercise we create heat, in order to maintain a relatively constant core temperature the nervous system sends messages to the blood vessels to dilate (expand), increasing blood flow to the skin, and increasing sweating to help disperse the accumulating heat.
- ▶ **2. Programming of spinal cord REFLEXES**
An example of this is the stretch reflex. This reflex functions to protect us from injury. If we were out jogging and accidentally ran into a pot-hole and rolled our ankle, the stretch reflex would instantly sense the stretch in the muscles around the ankle and send messages to those muscles telling them to contract and resist the stretch. This reflex serves to protect the ankle from breaking and results in a minor sprain rather than a severe break.

3

FOUR FUNCTIONS OF NS

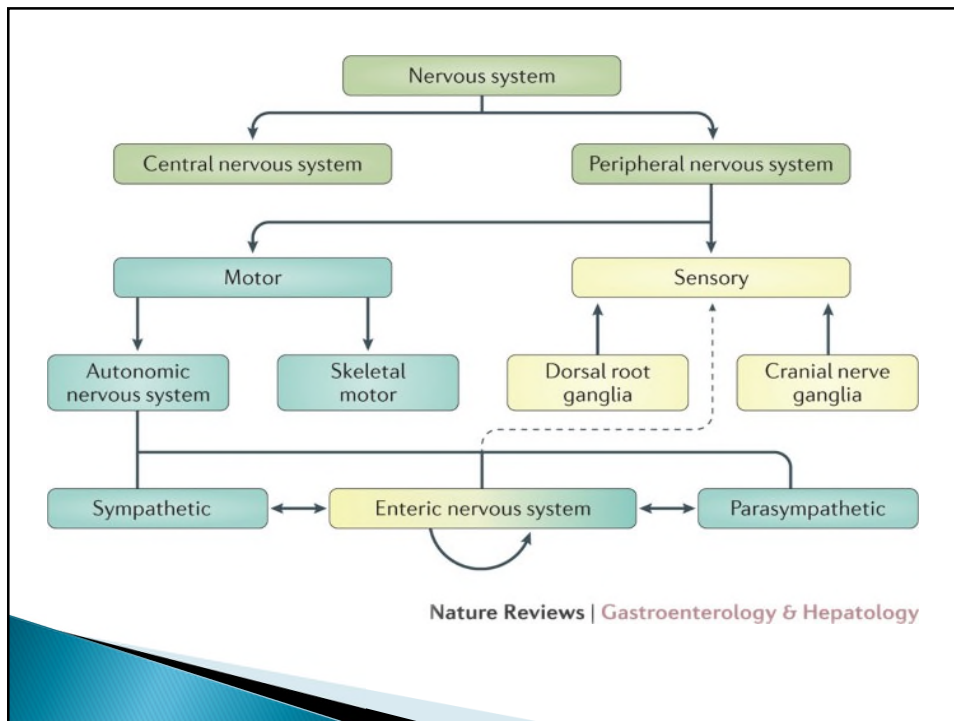
- ▶ **3. MEMORY and learning**
You didn't learn to read or write overnight did you? A certain amount of repetition was required to learn and memorize these key functions. The same applies with exercise. New movements, especially complex ones, take time for the nervous system to learn. Remember this when teaching new exercises to people – a certain amount of repetition will need to occur before their nervous system gets it right!
- ▶ **4. VOLUNTARY CONTROL of movement**
Every voluntary movement that a person performs is under the direct control of the nervous system as the nervous system sends the messages to the particular body parts to move. If the movement has been repeated numerous times (walking for most of us...) the movement will be very efficient. If however the movement is new and still requires some repetition then we would expect the movement to be less efficient and in some cases look awkward and ungainly (such as a person learning the squat for the first time).

4

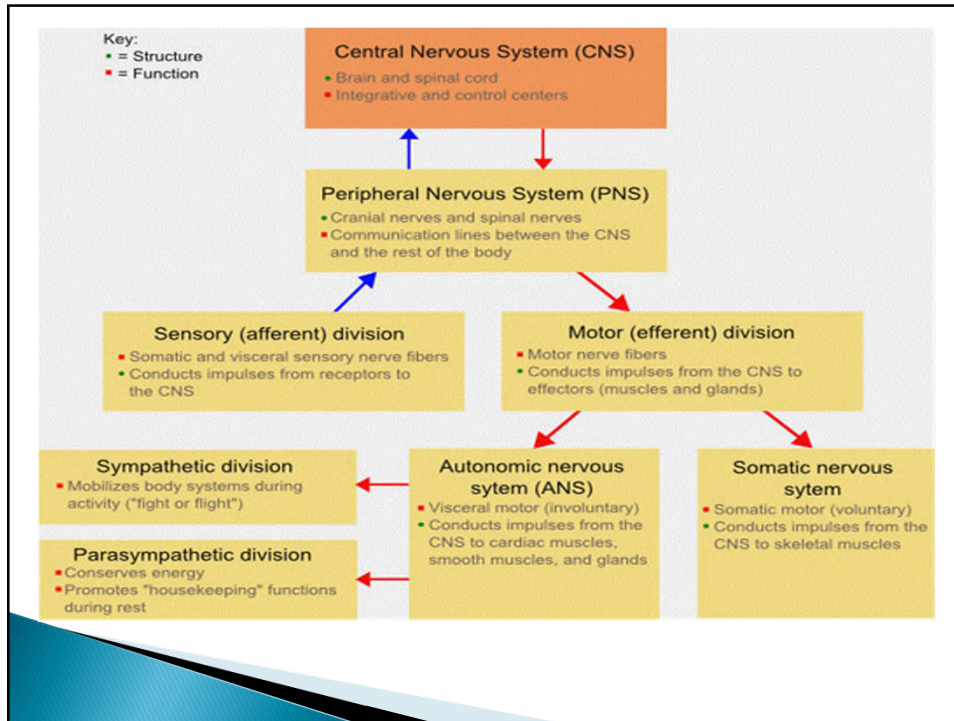
FUNCTION OVERALL

- ▶ NS – ability to function in everyway.
- ▶ Muscle creates movement by contracting and pulling. NS responsible for **stimulating** the muscles and causing them to contract. Without the neural impulses of the NS, muscle would not work.
- ▶ Fitness: a new exercise..., the movement is awkward and difficult. NS is trying to learn something new. With repetition, it becomes second nature.
- ▶ Not just muscle; it stimulates **every tissue and organ** within the body.

5



6



7

SECTION I CENTRAL NERVOUS SYSTEM (CNS)

COMPONENTS

1. **BRAIN** (brain stem, cerebrum, cerebellum, diencephalon)
2. **SPINAL CORD** - 31 segments. A pair of spinal nerves come out of each segment. Both motor and sensory nerves are located in the spinal cord.

They **INTEGRATE INFORMATION** from the peripheral nervous system and respond automatically or make **decisions on actions** that should be taken. CNS acts as the 'head office' of the body, it works consciously and subconsciously to control all activities within the body.

8

GUT – BRAIN relationship

- ▶ Microbiome is intricately and powerfully connected to the function of the brain.
- ▶ Where is actually a decision made? Who is the boss?
- ▶ Mystery about this connection.
- ▶ Gut often referred as the SECOND BRAIN

9

CNS COMPONENTS

3. THE MENINGES: three layers of **membranes** that cover the brain and the spinal cord. The outermost layer is the **dura mater**. The middle layer is the **arachnoid**, and the innermost layer is the **pia mater**. The meninges offer protection to the brain and the spinal cord by acting as a barrier against bacteria and other microorganisms.

4. The cerebrospinal fluid (CSF) circulates around the brain and spinal cord. It protects and nourishes the brain and spinal cord.

10

CNS COMPONENTS

5. MYELIN: The fatty layer of extracellular connective tissue which covers nerve axons. It provides insulation and promotes nerve transmission along the nerve axon in the brain and in the periphery. The brain is reliant on healthy fatty acid balance for myelin and for nerve membrane function.

Nutrients: EFA, antioxidants (esp. fat soluble)

11

CNS COMPONENTS

6. GLIALS:

- ❖ The connective tissue cells of the brain.
- ❖ Do not produce electrical impulses
- ❖ 10 times more glials than nerve cells.
- ❖ Types: Astrocytes, Microglia, Oligodendrocytes.

Function:

- ❑ Structural support for the nerve cells
- ❑ Regulatory control
- ❑ Nutrient delivery
- ❑ Waste removal
- ❑ Myelin production and distribution
- ❑ Immunity
- ❑ Neurodegenerative disorders are often diseases of the glial cells

12

NEURONS

- ▶ The neuron is the basic unit in the nervous system, found in the brain, spinal cord and the peripheral nerves. It acts as a **conductor** responsible for the transport and uptake of neurotransmitters - chemicals that relay information between brain cells.
- ▶ Depending on its location, a neuron can perform the job of a sensory neuron, a motor neuron, or an interneuron, sending and receiving specific neurotransmitters.
- ▶ 3 parts of the neuron:
 - Cell body
 - Dendrites (carry a nerve impulse into the cell body)
 - Axon (carries impulses away from the cell body to another neuron or tissue)

13

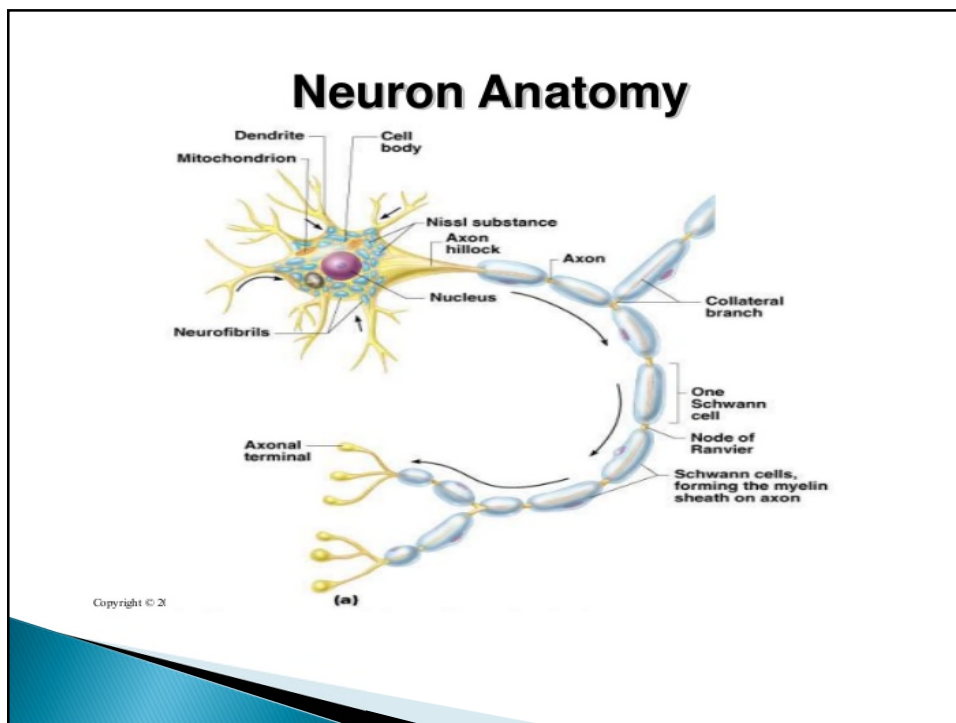
NERVE vs NEURON

- ▶ They sound similar but are different. Nerves are actual projections of neurons.
- ▶ Neuron is an individual specialized cell which are primarily involved in transmitting information through electrical and chemical signals. Neuron is also known as the nerve cell. There are two types of neurons – sensory neurons and motor neurons. [A group of neurons form a nerve.](#)
- ▶ Nerve is an enclosed, cable-like bundle of axons and nerve fibers found in the peripheral nervous system. There are three types of nerves **autonomic nerves, motor nerves, and sensory nerves.**

14

NERVE VERSUS NEURON	
<p>A nerve is a whitish fiber of neuron cells which carry impulses to the central nervous system and from the central nervous system to the effector organs</p>	<p>A neuron is a specialized cell involved in transmitting nerve impulses</p>
<p>Found only in the peripheral nervous system</p>	<p>Found in both peripheral and central nervous systems</p>
<p>Composed of many nerve fibers, blood vessels, and lymphatics</p>	<p>Composed of an axon, cell body, and dendrites</p>
<p>Acts a conducting zone for transporting signals</p>	<p>Chemical and electronic signals are generated here</p>
<p>Cranial nerves, spinal nerves, sensory nerves, and motor nerves are the main four types</p>	<p>Types include sensory neurons, motor neurons, and interneurons</p>
	<p>Visit www.pediaa.com</p>

15



16

NEURAL CONNECTIONS

- ▶ **Neurons** send signals to other cells through axons
- ▶ Causes neurotransmitters to be released at synapses'
- ▶ Over 100 trillion neural connections in the average brain; the number and location can vary. Proceedings of the National Academy of Sciences, Jan 2018: out of the 160 participants studied, the brains of **highly creative people have more connections among three specific regions of the brain than less creative thinkers.**
- ▶ <https://www.livescience.com/61428-brain-connections-creativity.html>

17

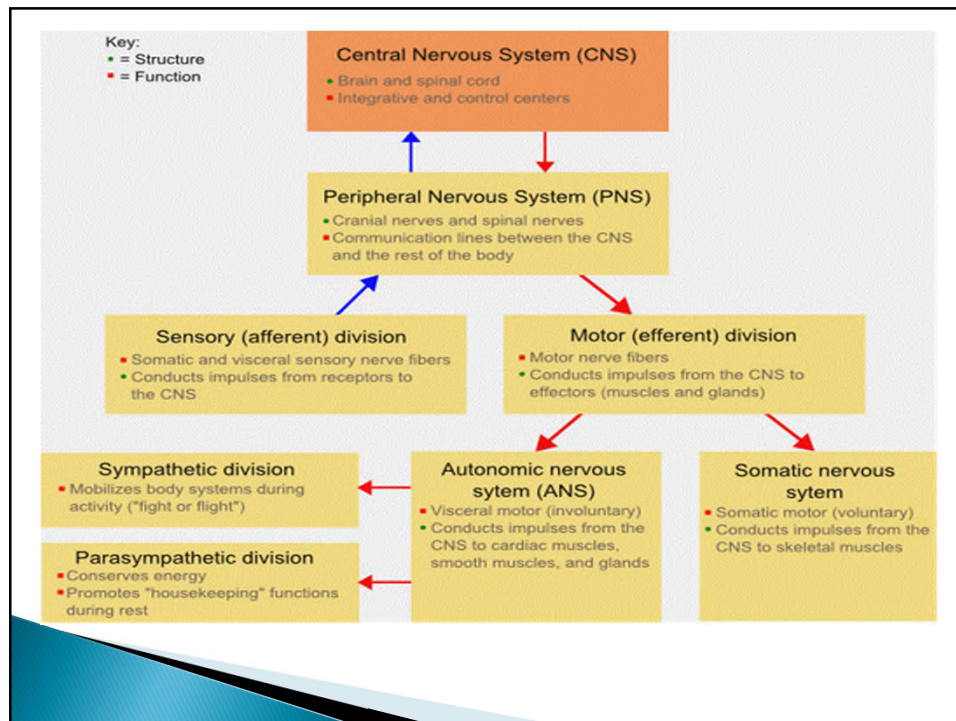
- ▶ "You have these three different systems that are all located in different parts of the brain, but they are all co-activated at once," said lead study author Roger Beaty, a postdoctoral fellow studying cognitive neuroscience at Harvard University. "People who are **better able to co-activate them [came] up with more-creative responses.**"
- ▶ A synapse gives a command to the cell and the entire communication process typically takes only a fraction of a millisecond. Signals travel along an alpha motor neuron in the spinal cord **268 mph** (431 km/h); the fastest transmission in the human body, according to [Discover magazine](#).

18

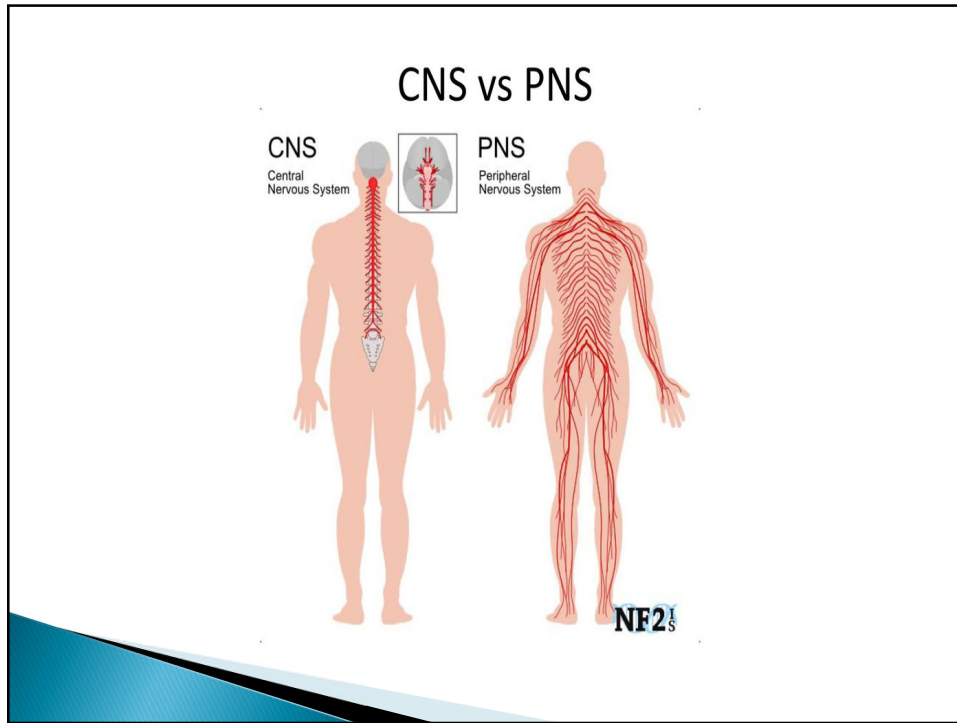
Diagnosing nervous system conditions

- ▶ Traditional X-ray
- ▶ A specialized X-ray - fluoroscopy examines the body in motion, such as blood flowing through arteries.
- ▶ MRI
- ▶ CT scan
- ▶ (EEG), an electroencephalogram which records the brain's continuous electrical activity. Positron emission tomography (PET) is a procedure that measures cell or tissue metabolism and brain activity to detect tumors or diseased tissue or tumors, the NIH noted.
- ▶ A spinal tap places a needle into the spinal canal to drain a small amount of cerebral spinal fluid that is tested for infection or other abnormalities, according to the NIH.

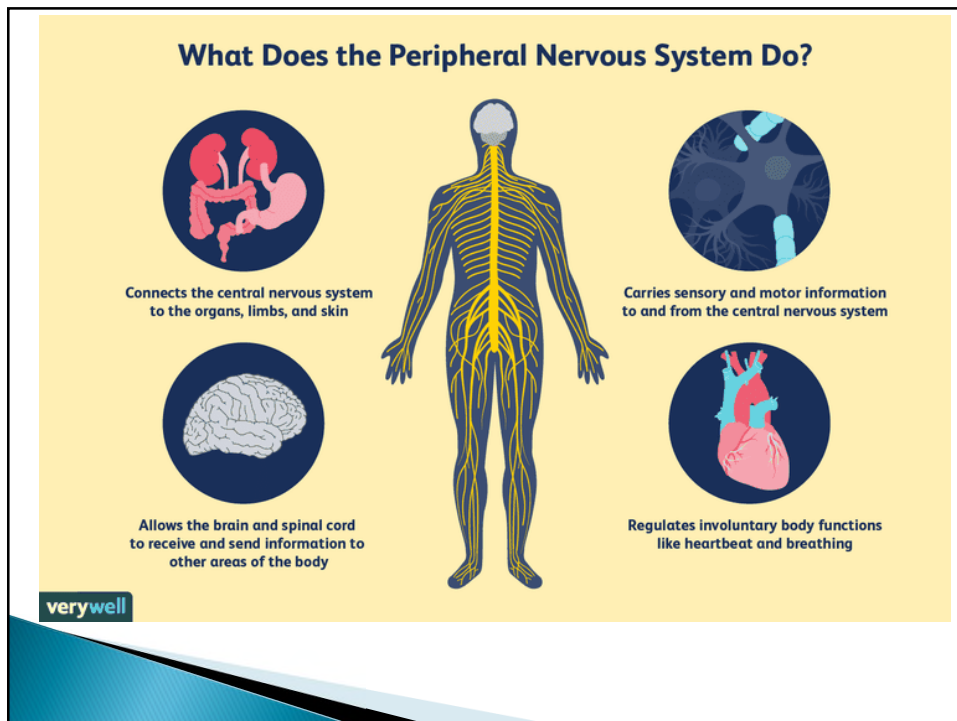
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20



21



22

SECTION II

PERIPHERAL NERVOUS SYSTEM (PNS)

1. SENSORY-SOMATIC NS

2. AUTONOMIC NS

23

SENSORY-SOMATIC NS

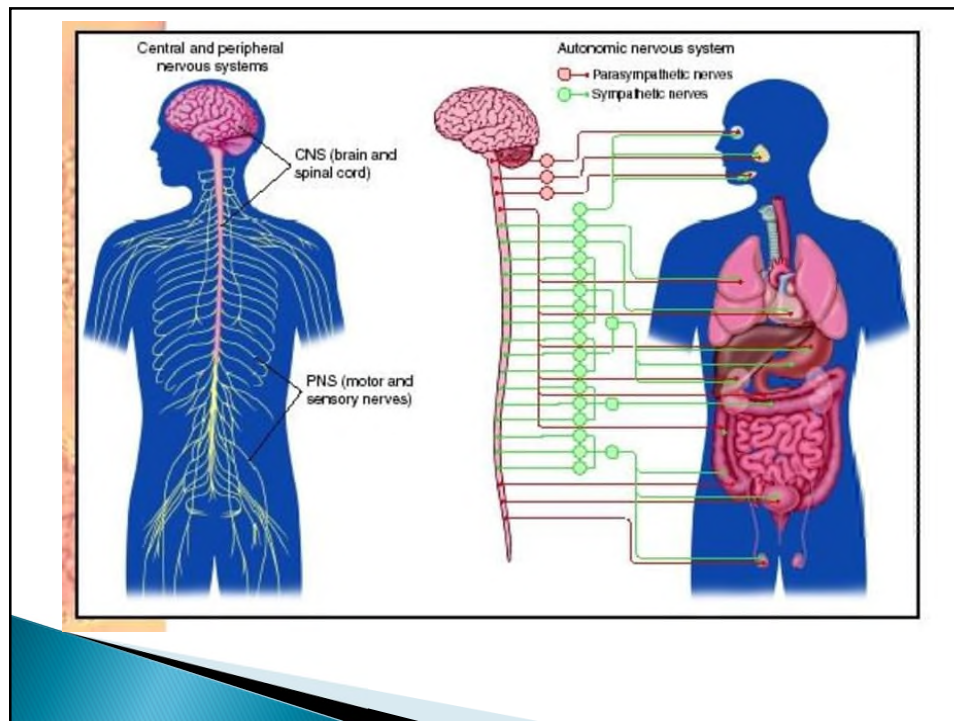
- ▶ The sensory-somatic nervous system is made up of **cranial and spinal nerves** and contains both **sensory** and **motor** neurons.
- ▶ **Sensory neurons** transmit sensory information from the skin, skeletal muscle, and sensory organs to the CNS.
- ▶ **Motor neurons** transmit messages about desired movement from the CNS to the muscles to make them contract. Without its sensory-somatic nervous system, an organism would be unable to process any information about its environment (what it sees, feels, hears, and so on) and could not control motor movements.
- ▶ Unlike the autonomic nervous system, which has two synapses between the CNS and the target organ, sensory and motor neurons have only one synapse—one ending of the neuron is at the organ and the other directly contacts a CNS neuron. **Acetylcholine** is the main neurotransmitter released at these synapses.
- ▶ Humans have **12 cranial nerves**, nerves that emerge from or enter the skull (cranium), as opposed to the **spinal nerves**, which emerge from the vertebral column.

24

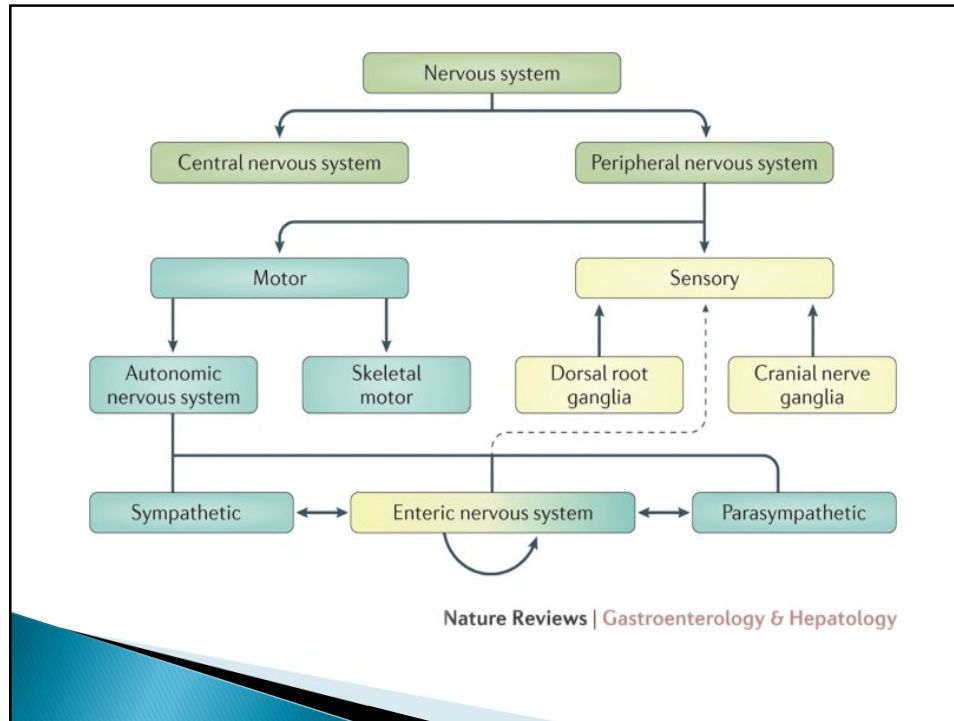
AUTONOMIC NS

- ▶ Controls the involuntary/unconscious activities, which regulate the organs, glands, circulation, smooth muscle activity and visceral responses.
1. **PARASYMPATHETIC** nerves promote “rest and digest” function; vegetative state. Parasympathetic ganglions **throughout the body** and near innervated organ
 2. **SYMPATHETIC** promotes the “fight-or-flight” response and arousal of the NS. Sympathetic ganglions are **along the spine**.

25



26



27

ENTERIC NERVOUS SYSTEM (ENS)

- ▶ ENS is a coprocessor to the CNS, which controls digestive system.
- ▶ The enteric **nervous system (ENS)** is a **quasi** autonomous part of the **nervous system** and includes a number of neural circuits that control motor functions, local blood flow, mucosal transport and secretions, and modulates immune and endocrine functions.
- ▶ Receives input from Parasympathetic vagus nerve CN10

28

NUTRITION AND BBB

- ▶ A FUNCTIONAL BARRIER between the blood and the CNS. Composed of astrocytes and the endothelial wall of the capillaries found in the arachnoid layer of the meninges.
- ▶ The **endothelial cells** forms tight junctions to control many substances from entering the brain. **Astrocytes** provide nutrients, remove waste.
- ▶ BBB can become too constricted or too porous. The brain can also harbor microorganisms, viruses, parasites, toxins.

29

BRAIN NUTRITION

- ▶ Fats, carbohydrates, protein, Fiber
- ▶ Water
- ▶ Probiotics
- ▶ Vitamins and Minerals
- ▶ Phytonutrients
- ▶ Glandular tissues
- ▶ BIOMEGA 1000
- ▶ Phosphatidyl Serine
- ▶ Cognitive Enhancer

30

SYMPATHETIC DOMINANCE

- ▶ BIO GGG-B 2-4
- ▶ Phosphatidylserine 1-2
- ▶ Phosphatidylcholine 2-4
- ▶ TAURINE 1-2
- ▶ DE-STRESS 1-2
- ▶ BIO CMP
- ▶ Mg Zyme
- ▶ Li Zyme Forte
- ▶ Mn Zyme

31

PARASYMPATHETIC DOMINANCE

- ▶ BIO 3BG 2-4
- ▶ Super Phosphozyme 1-2 bid
- ▶ L-Tyrosine 1-2
- ▶ DHEA
- ▶ Bio Drive 2-4
- ▶ Cytozyme AD

32