The Nervous System

Organ Systems
- All 11 organ systems work together to maintain **Homeostasis**

An organism achieves homeostasis by **REGULATION**.
- Regulation is the control & coordination of other life functions.

What Characteristic is Important For Any Sports Team to Win?

**Communication**
This is also important for….

**Nerve Cells**

Can You Guess Which **Organ System** Works With The Nervous System?

**Endocrine System**

**What is the Nervous System?**
- Controls & coordinates functions throughout the body.
- Responds to internal (inside) & external (outside) stimuli.

**Neuron**
- a nerve cell

**Nerve**
- Bundle of individual neurons wrapped in connective tissue

**Neurotransmitters**
- Chemicals that help carry the impulse to next structure

**Neuron**

**Neurotransmitters**
- Axon
- Terminal
- Synapse
What Causes A Nerve Impulse?
When a neuron is stimulated by another neuron or by its environment.
Ex: An electrical current

Label & Draw: Structure Of A Neuron

Remember
"DCATS"

Functions Of The Neuron
- **Cell body** - Main nutritional and metabolic region of the neuron.
- **Dendrites** - Receives signals from other cells and sends them towards the axon.
- **Axon** – the long fiber that carries impulses away from the cell body.
### Functions Of The Neuron

- **Myelin sheath** - insulating (covering) material that cover axons; for protection & increase speed of signals down the axon.
- **Schwann Cells** - Support cells that produce myelin.
- **Nodes of Ranvier** – space between each schwann cell along the axon; no myelin.

### Nerve cells conduct impulses or messages in only 1 direction.

- If the impulse was a car, it would be traveling down a one-way street.

### Why is Myelin Important?

- For Speed Conduction of an impulse.
  - Without myelin speed is less (5 m/sec)
  - With myelin (100 m/sec or 200mi/hr)

### What Is The Direction An Impulse Travels?

- **Away** from the **cell body**

  Dendrites → cell body → axon → axon terminals

### More Practice: Label Structures

A. Axon  
B. Dendrites  
C. Cell Body  
D. Axon Terminals
Communication Between Neurons

Neurotransmitters

- Chemicals released at the Synapse to cause an electrical impulse.

Synapse

- the space between the axon terminal & the other neuron.

Neuron to Neuron

- The axon terminal of the first neuron meets the dendrites of the second neuron.

Locks and Keys

- Neurotransmitter molecules have specific shapes
- Receptor molecules have binding sites
- When NT binds to receptor, ions enter
What other structures did the lock and key model relate to?

- Enzymes
- Antibody & Antigens
- Cell membrane

**SPECIFIC SHAPE = SPECIFIC FUNCTION**

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**The Cell Membrane & Receptor Molecules**

Many cell membranes have receptor molecules on their surface. These receptor sites play an important role in allowing cells and organs to communicate with one another.

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**Where Are Impulses Sent After It Leaves The Neuron?**

- Another neuron
- Gland (effector)
- Muscle (effector)

An **EFFECTOR**—any organ that responds to a stimulus

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**3 Types of Neurons**

**Nerve Cells**

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**How Different Neurons Look**

- Sensory Neuron
- Interneuron
- Motor Neuron
**Sensory Neurons**
- Impulses carried from sensory organs **To** brain and spinal cord.
- Sense organs: Vision, hearing, taste, smell nerves, & touch (skin).

**Interneurons (relay neurons)**
- Carry impulses **between** sensory & motor neurons.
- Only in the brain and spinal cord.
- Smaller

**Motor Neurons**
- Impulses carried from brain and spinal cord **To** the muscles and glands.

**Direction of the Impulse**
- Sensory Neuron
- Interneuron in Spinal cord
- Muscle
- Motor Neuron

**Identify A, B, C, D, E, F, & G In Your Packet.**

**Label the Structures**
- Word Bank
  - Motor neuron
  - Sensory neuron
  - Interneuron
  - Effector (muscle)
  - Spinal cord/Brain
How Are Neurons Similar & Different From Other Cells In The Body?

**Similar**
- Surrounded by a cell membrane.
- Has organelles (nucleus, cytoplasm, mitochondria, & others).
- Carry out cellular processes such as protein synthesis and energy production.

**Different**
- Special extensions (dendrites, axons)
- Communicate through an electrochemical process.
- Specialized structures (synapses) & chemicals (neurotransmitters)

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**The Nervous System**

**2 Divisions (Parts)**
1. Central Nervous System
2. Peripheral Nervous System

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**Central Nervous System (Control Center)**

- Includes: Brain & spinal cord
- Made mostly interneurons
- Function:
  1. Relays (sends) messages
  2. Processes information
  3. Analyzes information

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**Central Nervous System**

**1. Spinal Cord**

**Outer Part**
- Vertebrae (spinal cord) – bones protecting the spinal cord.
- Meninges: a membrane covering the spinal cord.
- Cerebrospinal fluid: liquid filling the spaces between the membranes.  
  (absorb shock)
Central Nervous System

Spinal Cord

Function
- Connects brain with body (peripheral system)
- Controls certain reflexes.

Central Nervous System

2. Brain

Structure
- Skull
  - bone that protects the brain.
- Meninges
  - a membrane.
- Cerebrospinal fluid (CSF)
  - fluid

(left) The flow of cerebrospinal fluid (CSF) through the ventricles of the brain. (right) Spinal cord filled with CSF.

Central Nervous System

Brain

3 sections (parts):
- Forebrain
- Midbrain
- Hindbrain (brainstem)

Functions:
1. where impulses flow & originate

The brain is the most active organ in the body. Its major source of energy is glucose.

Central Nervous System

Brain

2. Brain controls opposite side of body.

Crossing Nerve Fibers
Injury on one side of the head causes injury to the opposite side of the body.

Central Nervous System

Brain

1. Cerebrum:

Structure
- largest part of the brain
- fissure (space) separates the right & left hemispheres.
- Corpus callosum fibers that connect the fissure.
Central Nervous System

Brain

- **Function**: Site for conscious control of intelligence, cooking, learning, running, judgment.
  - **Right Hemisphere**: artistic ability, musical ability.
  - **Left Hemisphere**: mathematical thinking.

2. **Cerebellum**

- **Structure**: back of the skull.
- **Function**: controls voluntary movement: coordination, balance (equilibrium), position.
  - Ex: walking, writing.

3-4. **Medulla Oblongata & Pons**

- **Structure**: lowest part of brain. Connects spinal cord to brain.
- **Function**: control involuntary activities.
  - Ex: breathing, peristalsis, heartbeat, blood flow, coughing.
Central Nervous System

Brain

Others:

5. **Thalamus**
   Structure: between brain stem & cerebrum
   Function: the "relay" center between the spinal cord & brain.
   - receives impulses from sensory organs.

6. **Hypothalamus**
   Structure: below the thalamus
   - part of endocrine system.
   Function:
   - controls: body temperature, blood pressure, sleep, and emotions.

4 Lobes of the Brain

Review Questions

1. I am able to balance on 1 leg & write on a pad. What brain structure am I?
   **Cerebellum**

2. I love to memorize the words to my favorite songs. What brain structure am I?
   **Cerebrum**

3. I am able to breathe even when I am asleep. What brain structure am I?
   **Medulla & Pons**

4. I am able to control your ability to sleep. What structure am I?
   **Hypothalamus**

5. I know not to stick my hand in a lion’s cage at the zoo. What structure am I?
   **Cerebrum**

6. People know me as a referee. I relay messages between the brain & spinal cord. What structure am I?
   **Thalamus**
7. I am a thermometer inside your body. I control your body temperature. What structure am I? **Hypothalamus**

8. I control your blood flow & heartbeat. What structure am I? **Medulla oblongata & Pons**

9. I make it possible for you to use the buttons on your controller for your playstation games. What structure am I? **Cerebellum**

10. I am the site for conscious control like learning. What structure am I? **Cerebrum**

**Peripheral Nervous System**

- **Structure**
  - Outside the brain & spinal cord.
  - It’s all the neurons (motor & sensory)

- **Function**
  - Communicate with the brain & spinal cord to allow bodily responses.

**List The 3 Types of Neurons**

1. Sensory neuron
2. Motor neuron
3. Interneuron

**2 Divisions of The Peripheral Nervous System**

- **Sensory Division**
  - Sends impulses from SENSE ORGANS to BRAIN & SPINAL CORD

- **Motor Division**
  - Sends impulses from BRAIN & SPINAL CORD to MUSCLES/GLANDS

**Peripheral Nervous System**

- **2 Types of Nerves**
  - Spinal Nerves
  - Cranial Nerves
Peripheral Nervous System
2 Systems of Motor Division

Somatic Nervous System
Voluntary control
Ex: Skeletal muscle (dancing)

Autonomic Nervous System
Involuntary control

Sympathetic Nervous System
Ex: Heartbeat, breathing, digestive system movements

Parasympathetic Nervous System

Reflex Arc
- The pathway an impulse travels to quickly respond & allow immediate withdrawal (removal) from a dangerous stimuli.
- The message does not reach the brain where thinking occurs. The reflex action is automatic. This means it does not require thinking!
- Reflex - a bodily response that is automatic (involuntary).

Withdrawal Reflex (simple reflex)
- 3 neurons
- Reflex only goes to spinal cord
- Sensation goes to brain & spinal cord

Knee Jerk Reflex
- 2 neurons
- Reflex only goes to spinal cord

Can You List Some Reflexes?
- Sneezing
- Coughing
- Blinking
- Breathing
- Heart beat
- Peristalsis
- Knee jerk
- Pupil constriction with light

Pupillary Reflex
Malfunctions of the Nervous System

**Polio**
- Virus that attacks motor neurons (muscle)
- Causes **paralysis** of muscles

**Cerebral palsy**
- Lack of voluntary muscle movement, mentally normal
- **Caused by lack of O2** during birth (damages motor area of cerebrum)

**Meningitis**
- Viral or bacterial infection of meninges (brain or spinal cord coverings)
- **Symptoms:** fever, stiff neck, and brain swelling
- **Treatment:** antibiotics

**Stroke**
- Breakage (hemorrhaging) or blockage of blood vessel in brain.
- Can cause: memory loss, speech loss, paralysis of muscles, loss of sight