1. Communication between CNS & PNS: afferent (sensory) pathway versus efferent (motor) pathway of information

2. Junction between CNS (spinal cord) and PNS (cranial nerves & spinal nerves)

Part 1: Communication between CNS & PNS
Part 1: Communication between CNS & PNS

- **CNS**
  - Descending info.

- **PNS**
  - (Somatic) Voluntary Motor responses
  - (Autonomic) Involuntary Motor responses
  - Voluntary motor movement involves **ACH** neurotransmitter binding to **nicotinic cholinergic** receptors.
  - **Skeletal muscles**
  - Smooth m. cardiac m. glands

- **Ascending info.**
  - **Somatic sensory**
    - Skins
    - Joints
    - Muscle
  - **Sensory sensory**
    - Sight
    - Sound
    - Taste/pressure
  - **Visceral**
    - Organs

---

**Rest & Digest**

- **Parasympathetic Motor responses**
  - **Vagus nerves**
  - Heart rate **↓**
  - BP **↓**
  - Bronchioles **bronchoconstrict**
  - GI peristalsis **↑**
  - GI secretions **↑**
  - GI arterioles **vasodilate**

- **Soothing Sacral nerves**
  - Urination **↑**
  - Defecation **↑**

- **All parasympathetic motor responses work by Ach neurotransmitter binding to muscarinic cholinergic receptors.**

---

**Stress, Fight/Flight**

- **Sympathetic Motor responses**
  - **Thoracic tense group thoracic nerves**
  - Heart rate **↑**
  - BP **↑**
  - Bronchioles **bronchodilate**
  - GI peristalsis **↓**
  - GI secretions **↓**
  - GI arterioles **vasoconstrict**
  - Skeletal muscle arterioles **vasodilate**

- **Lumbar nerves**
  - Urination **↓**
  - Defecation **↓**

- **All sympathetic motor responses work by adrenergic neurotransmitter binding to what 3 types of adrenergic receptors?**
  - β1-adrenergic
  - α1-adrenergic
  - α2-adrenergic
Part 1: Communication between CNS & PNS

Fig 6.12

ALL Spinal cord preganglionic neurons release ACh at ganglion of PNS.

Visceral effectors = smooth muscle, cardiac muscle, and glands.

Influenced by NE from postganglion neurons or E secreted by adrenal medulla into bloodstream.

Or ACh from postganglion neurons

NE = norepinephrine  
E = epinephrine
Sympathetic (epi/norepi.)
Parasympathetic (ACh)

Vagus
Nerves
Cranial
erve X)

Thoracic
spinal
nerves

Lumbar
Spinal
nerves

Sacral
spinal
nerves

Fig 6.10

Autonomic Control of Cardiac and Smooth Muscles:

ALL autonomic receptors are G-protein or muscarinic receptors!
### TABLE 6.4 Effects of Acetylcholine (ACh) in the PNS

<table>
<thead>
<tr>
<th>Neurons Releasing ACh</th>
<th>Location</th>
<th>Type of ACh Receptor</th>
<th>Response</th>
<th>Physiological Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somatic motor</td>
<td>Skeletal muscles</td>
<td>Nicotinic</td>
<td>Depolarization, producing action potentials</td>
<td>Muscle contraction</td>
</tr>
<tr>
<td>Preganglionic neurons of ANS</td>
<td>Autonomic ganglia</td>
<td>Nicotinic</td>
<td>Depolarization, producing action potentials</td>
<td>Stimulates postganglionic neurons of the ANS</td>
</tr>
<tr>
<td>Postganglionic parasympathetic neurons</td>
<td>Smooth muscles, glands</td>
<td>Muscarinic</td>
<td>Depolarization, producing action potentials</td>
<td>Contraction of smooth muscles; secretion of glands</td>
</tr>
<tr>
<td>Postganglionic parasympathetic neurons</td>
<td>Heart</td>
<td>Muscarinic</td>
<td>Hyperpolarization, slowing the rate of automatic production of action potentials</td>
<td>Slowing of heart rate</td>
</tr>
</tbody>
</table>

### TABLE 6.2 Examples of Sympathetic and Parasympathetic Effects of the Autonomic Nervous System

<table>
<thead>
<tr>
<th>Organ or Function Affected</th>
<th>Sympathetic Effects</th>
<th>Parasympathetic Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>Increased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Increased</td>
<td>Slightly decreased</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>Increased sphincter tone</td>
<td>Decreased sphincter tone (for urinating)</td>
</tr>
<tr>
<td>Intestinal contractions</td>
<td>Decreased</td>
<td>Increased</td>
</tr>
<tr>
<td>Lungs</td>
<td>Dilation of bronchioles</td>
<td>Constriction of bronchioles</td>
</tr>
<tr>
<td>Pupils</td>
<td>Dilation</td>
<td>Constriction</td>
</tr>
<tr>
<td>Sexual function</td>
<td>Ejaculation and orgasm</td>
<td>Erection</td>
</tr>
<tr>
<td>Sweat glands</td>
<td>Sweating</td>
<td>No effect</td>
</tr>
<tr>
<td>Lacrimal glands</td>
<td>No effect</td>
<td>Tearing</td>
</tr>
<tr>
<td>Parotid glands</td>
<td>No effect</td>
<td>Salivation</td>
</tr>
</tbody>
</table>
**Review**

- Communication between CNS & PNS.

  1. Sensory division of PNS (special senses, visceral senses, somatic senses)
  2. Motor division of PNS
     - Somatic motor division
       = voluntary control skeletal muscles with ACh & nicotinic cholinergic receptors
     - Autonomic motor division
       - Sympathetic regulation (norepineph. & epineph. & adrenergic receptors) can speed some things up and slow other things down.
       - Parasympathetic regulation (ACh and muscarinic cholinergic receptors) can slow some things down and speed other things up.
Part 2: Junction between CNS (spinal cord) and PNS

- PNS communicates between the CNS and remainder of the body
- Consists of:
  - 11 pairs cranial nerves
    (Except Optic cranial nerve is NOT part of PNS but diencephalon)
  - 31 pairs spinal nerves

Review of Cranial Nerves:

What is the mnemonic devices for remember the list of 12 pairs cranial nerves?

Oh_________Very_________
Once________Good_________
One_________Vacations____
Takes________Are_________
The_________Heavenly_____
Anatomy
Final__________

What is the mnemonic devices for remember which cranial nerves are sensory (S), motor (M), or both (B)?

Some_________Says_________
Say_________Big_________
Marry_________Brains______
Money_________Matter______
But_________Most_________
My__________
Brother__________

![TABLE 6.1: The Cranial Nerves](image)
Organization of the PNS.

1) 12 pairs cranial nerves
2) 31 pairs spinal nerves (divided into 5 vertebral regions)

Paired spinal nerves give rise to 4 groups of nerve plexuses (cervical, brachial, lumbar, & sacral), which carry afferent sensory and efferent motor signals to body.