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

**This will be VERY important to learn for nursing pharmacology!!**

Much of this chapter is review of Ch 4 part 1:
- Voluntary muscle movement
- Autonomic regulation of body under sympathetic & parasympathetic control.

1. Junction between CNS and PNS (cranial nerves & spinal nerves)
Part 1: Communication between CNS & PNS

Click [HERE](#) for blank PNS flow chart.

Click [HERE](#) for KEY PNS flow chart.
Visceral effectors = smooth muscle, cardiac muscle, and glands.

Influenced by E 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 nerve X)

Thoracic spinal nerves

Lumbar Spinal nerves

Sacral spinal nerves
Autonomic Control of Cardiac and Smooth Muscles:

- Shut down peristalsis
- And vasodilation of arteries to skeletal muscles

For ACh and its 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 (voluntary) motor neurons</td>
<td>Skeletal muscles</td>
<td>Nicotinic cholinergic</td>
<td>Depolarization, producing action potentials</td>
<td>Muscle contraction</td>
</tr>
<tr>
<td>Parasympathetic (involuntary) motor neurons</td>
<td>Smooth muscles, glands</td>
<td>Muscarinic cholinergic</td>
<td>Depolarization, producing action potentials</td>
<td>Contraction of smooth muscles; secretion of glands</td>
</tr>
<tr>
<td>Parasympathetic (involuntary) motor neurons</td>
<td>Heart</td>
<td>Muscarinic cholinergic</td>
<td>Hyperpolarization, slowing the rate of automatic production of action potentials</td>
<td>Slowing of heart rate</td>
</tr>
</tbody>
</table>
See **Clinical App ONLINE**: Beta blockers.

**B1 & B2 blocker** =
- ↓ HR and BP & bronchoconstrict
- good for hypertension BUT not people w/respiratory prob. (it will cause bronchoconstriction!)

**B1-specific blocker** =
- ↓ HR and BP
- no effect on bronchioles
- good For hypertension WITH respiratory problems (won’t cause bronchoconstriction)

**B1 agonist** =
- ↑ HR and cardiac output
- good for heart failure patients

**B1 & B2 agonist** =
- ↑ HR and cardiac output & Bronchodilate

**B2 agonist** =
- Bronchodilates
- good for people w/respiratory problems
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 (epinephrine & 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

Objectives:

- Understand how the PNS communicates between the CNS, and the rest of the body.
- Know / Review:
  - 12 pairs cranial nerves
  - 11 cranial nerves are part of the PNS. (Optic cranial nerve is part of the CNS)
  - 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_________

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Pg 72 Wiki text
31 Pairs of Spinal Nerves in PNS

- **Sensory tracts** (axons) enter spinal cord at dorsal side.
- **Motor tracts** (axons) exit spinal cord at ventral side.

31 Spinal Nerve Pairs divided into:

1. Cervical spinal nerves (C1-C8)
2. Thoracic spinal nerves (T1-T12)
3. Lumbar spinal nerves (L1-L5)
4. Sacral spinal nerves (S1-S5)
5. Coccygeal spinal nerve (Co1)

These spinal nerves branch out into dorsal & ventral rami, and form a nerve plexus.
Dorsal and ventral rami of remaining spinal nerves form **4 major nerve plexuses** of the PNS: that carry efferent (motor) info & sensory (afferent) info. pertaining to our **limbs**:

1. Cervical Plexus (C1-C4)
2. Brachial Plexus (C5 – T1)
3. Lumbar Plexus (L1 – L4)
4. Sacral Plexus (L5 – S5)

**4 major nerve plexuses** of the PNS:

1. **Cervical Plexus (C1-C4)**
   - motor control of head, neck, and diaphragm muscles
   - sensation in head & neck.
4 major nerve plexuses of the PNS:

1. Cervical Plexus (C1-C4)
   - motor control of head, neck, and diaphragm muscles
   - sensation in head & neck.

   Phrenic nerve of cervical plexus = C3, C4, & C5 has motor control of diaphragm!

   “The primary danger of a ‘broken neck’ is that the phrenic nerve may have been severed above C3, leading to paralysis, cessation of breathing and death ...”

2. Brachial plexus (C5 – T1)
   - motor control of muscles of shoulder/arm
   - sensory perception in skin of those areas.

   1) Musculocutaneous nerve – motor control of anterior arm & forearm flexors.

   2) Radial nerve – motor control of posterior extensor muscles of the arm, forearm & hand.


   4) Median nerve – motor control of anterior flexor muscles in forearm & several muscles in lateral hand.

   5) Ulnar nerve – motor control of flexor carpi ulnaris muscle & intrinsic hand muscles.
3. Lumbar plexus (L1 – L4)  
- Motor control of muscles lower abdomen and antero-medial thigh.  
- Sensory perception of those areas.

1) Femoral nerve - innervates the anterior thigh muscles, lower abdomen, buttocks.  
2) Obturator nerve - innervates medial thigh adductor muscles.

4. Sacral plexus (L4 – S5)  
- Motor control of posterior thigh (hamstrings) and posterior leg.  
- Sensation in those areas.

Leads to sciatic nerve - largest nerve of the human body!  

Ex. Of hamstrings = biceps femoris, semitendinosus, semimembranosus  

- Sciatic damage leads to inability to extend hip and flex the knee — “sciatica”.
4. Sacral plexus (L4 – S5)
- Motor control of posterior thigh (hamstrings) and posterior leg.
- Sensation in those areas.

-Sciatic subdivides in the popliteal region:
  i) Common fibular nerve – motor control lateral leg and foot dorsiflexors & everters
  - damage leads to inability to dorsiflex the foot or “footdrop”.

  ii) Tibial nerve – motor control of posterior leg and foot plantar flexors.
  - damage leads to inability to plantar flex and invert the foot –> “shuffling gait”
Review

- 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.