Ch 4 part 3: PNS

1**. Intro slide with objectives**

2. **Communication between CNS & PNS.**

> sensory info from receptors ascends the spinal cord to part of brain where interopreted

> motor commands descend brain, spinal cord, and exit to PNS

3. **Sensory (afferent) division of nervous system** = 3 parts

> Somatic sensory system = receive sensory info from skin, fascia, joints, skeletal muscles

> Special senses = sensory info for sight, sounds, pressure, temp., taste

> Visceral sensory system = sensory info from viscera

Motor (efferent) division of nervous system = 2 parts

> Somatic (voluntary) motor system = control of skeletal muscles through **acetylcholine (ACh) neurotransmitter** secreted by somatic motor neuron, binds to **nicotinic cholinergic receptor** on skeletal muscle cells, opens Na+ channel to cause contraction.

> Autonomic (involuntary) motor system = control of cardiac & smooth muscle, and glands.

QUES: *What are examples of smooth muscle in body? =* bladder, urethra, lining arteries and bronchioles, uterus, lining GI tract.

4. Go over diagram of parasympathetic vs sympathetic autonomic control of body. This will take a lot of time.

> Parasympathetic = rest & digest. – body functions make sense when resting & digesting

- Thoracic activities tend to slow down (heart rate & BP decrease, bronchoconstriction)
- Abdominal activities tend to speed up (GI smooth muscle activity, secretions, and vasodilation of arteries to GI.
- Thoracic & abdominal parasympathetic nerves = **Vagus nerves (*you're calm on vacation at Vagus!)***

- Pelvic activities speed up – good time for urination and defecation.
- Pelvic parasympathetic nerves = **Sacral nerves (soothing sacral nerves)**

> Parasympathetic regulation is through ACh binding to muscarinic cholinergic receptors

> Sympathetic = stress or fight/flight (what body functions make sense when your life is in danger???

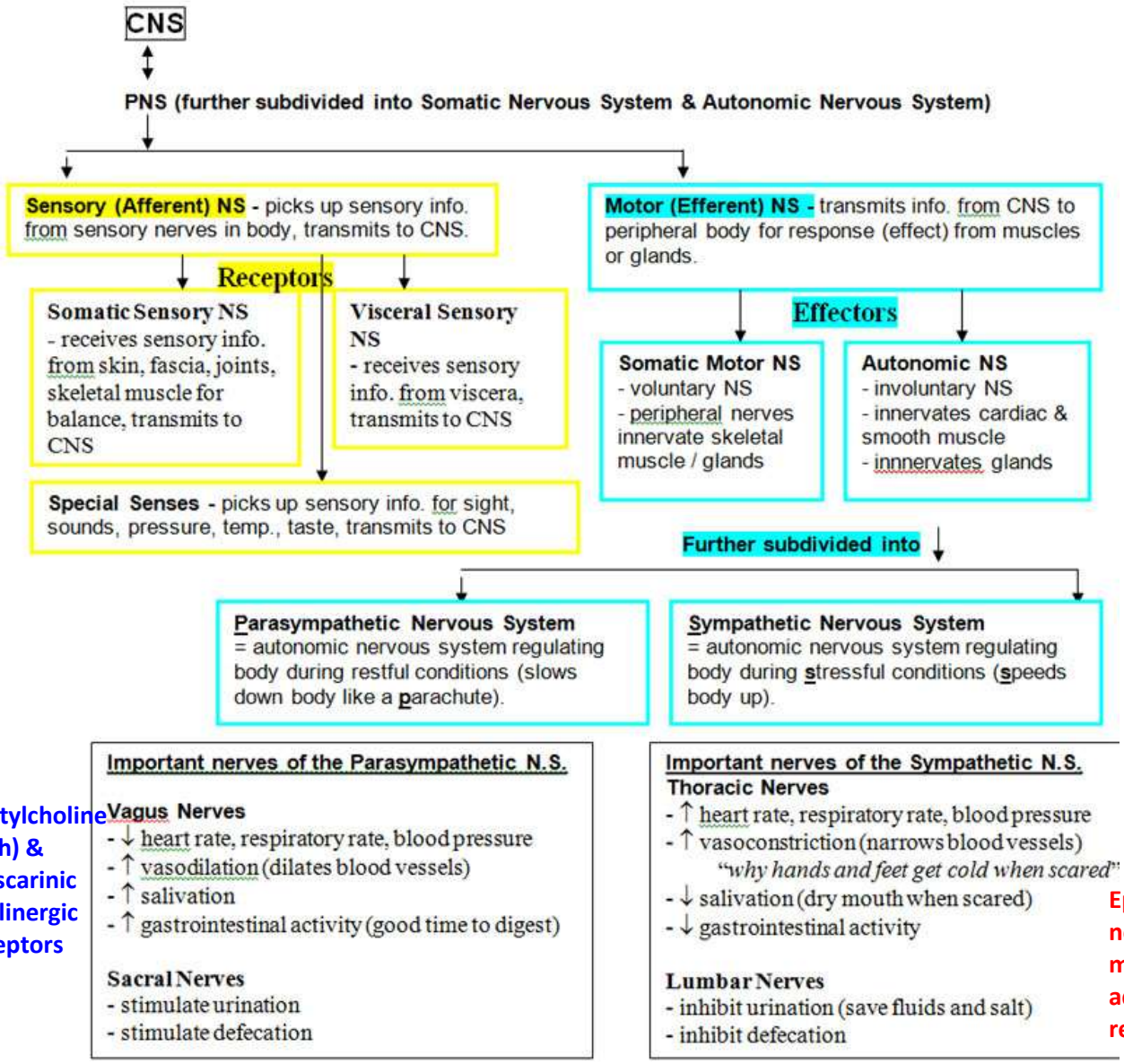
- Thoracic activities that save your life = increased heart rate, bronchodilation (get in O2!)
- Abdominal activities shut down – decreased GI peristalsis & secretions, vasoconstriction of arteries to GI (blood being diverted away to go to muscles, brain, & heart)
- Vasodilation of arteries (smooth muscle) to skeletal muscles (can save your life)
- Thoracic and abdominal sympathetic nerves = **Thoracic nerves (Tense you up)**

- Pelvic activities slow down – inhibit urination & defecation.
- Pelvic sympathetic nerves = **Lumbar nerves (Let's get the hell out of here!)**

> Sympathetic regulation is through epinephrine (adrenaline) binding to either Beta (β) or alpha (α) adrenergic receptors (adrenergic is for adrenaline)

- **QUES: How many hearts do you have? = 1 , heart muscle has Beta 1 adrenergic receptors**
- **QUES: How many lungs do you have? = 2, bronchiole smooth muscle has Beta 2 adrenergic receptors**.
- Beta 2 adrenergic receptors also on smooth muscle of arteries supplying skeletal muscles.
- **QUES: What happens to an apple when you eat it? = you digest it. α is for apple, and all things GI have α adrenergic receptos** (GI smooth muscle, glands, & muscle of arteries to GI)

6. **This blank flow diagram and a KEY is found on the lecture syllabus for Ch 6.**



For autonomic sympathetic regulation of body functions through epinephrine (a.k.a. adrenaline):
> β1 adrenergic receptor – found on heart muscle to increase heart rate.
> **β2 adrenergic receptor** – found on bronchiole smooth muscle (for bronchodilation) and smooth muscle of arteries (going to skeletal muscles for vasodilation)
> α adrenergic receptor – found on GI smooth muscle (to decrease peristalsis), GI glands (decrease secretion), and smooth muscle of arteries going to GI for vasoconstriction)

7. Fig 6.12 – review parasympathetic nerves (Vagus) and their effect on HR, bronchioles, GI activity, Sacral nerves & urination & defecation., Thoracic nerves and effect on HR, bronchioles, GI, and Lumbar nerves & urination/defecation

8. Fig 6.10 – review same things again.

9. Fig 6.13 – review same things again for parasympathetic control through ACh & nicotinic cholinergic receptors on skeletal muscles for voluntary movement, and ACh and muscarinic cholinergic receptors on cardiac and smooth muscle for autonomic functions.

10. Table 6.2 – Review sympathetic vs parasympathetic regulation on functions marked by X.

> QUES: What receptors are involved for epinephrine in?

- increased heart rate? (= β1 adrenergic)
- Bronchodilatio? (= β2 adrenergic)
- decreased GI peristalsis & secretion (= α adrenergic)

> QUES: What receptors for ACh are involved with heart rate, bronchioles, GI? = muscarinic cholinergic

epinephrine

ACh

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

Organ or Function Affected	Sympathetic Effects	Parasympathetic Effects
X Heart rate (β1 adrenergic)	Increased	Decreased
Blood pressure	Increased	Slightly decreased
Urinary bladder	Increased sphincter tone	Decreased sphincter tone (for urinating)
X Intestinal contractions (α adrenergic)	Decreased	Increased
X Lungs (β2 adrenergic)	Dilation of bronchioles	Constriction of bronchioles
Pupils	Dilation	Constriction
Sexual function	Ejaculation and orgasm	Erection
Sweat glands	Sweating	No effect
Lacrimal glands	No effect	Tearing
Parotid glands	No effect	Salivation

all muscarinic cholinergic

11. Table 6.3 – review sympathetic effects with epinephrine on following marked X

TABLE 6.3 Selected Adrenergic Effects in Different Organs

Organ	Adrenergic Effects of Sympathoadrenal System	Adrenergic Receptor
Eye	Contraction of radial fibers of the iris dilates the pupils	α_1
Heart	Increase in heart rate and contraction strength	β_1 primarily
Skin and visceral vessels	Arterioles constrict due to smooth muscle contraction	α_1
Skeletal muscle vessels	~~Arterioles constrict due to sympathetic nerve activity~~	~~α_1~~
	Arterioles dilate due to hormone epinephrine	β_2
Lungs	Bronchioles (airways) dilate due to smooth muscle relaxation	β_2
Stomach and intestine	Contraction of sphincters slows passage of food	α_1
Liver	Glycogenolysis and secretion of glucose	α_1, β_2

See **Clinical App ONLINE**: Beta blockers.

B1 agonist = **Dobutamine (makes Da heart beat faster!) for heart failure, ↑ BP & cardiac output**

B1 & B2 agonist = **isoproterenol**
↑ BP & cardiac output & bronchodilate

General B-blocker = **Propanolol**
↓ BP and bronchoconstrict

B1-specific blocker = **Atenolol (think it's been altererd or attenuated to be specific)**
↓ BP with no bronchiole effect

B2 agonist = **Terbutaline & Albuterol bronchodilate for asthmatics**

12. – Review slide

13. **Part 2: Junction between CNS (spinal cord) and PNS**
>PNS communicates between the CNS and remainder of the body
>Consists of: 12 pairs cranial nerves
31 pairs spinal nerves
> Most (except three of the cranial nerves) carry axons of both sensory and motor neurons

14.

Review of Cranial Nerves:

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

Oh Once One Takes The Anatomy Final Very Good Vacations Are Heavenly

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

Some Say Marry Money But My Brother Says Big Brains Matter Most

***Mistake in textbook table!

TABLE 6.1 The Cranial Nerves

Nerve Number and Name			Composition	Some Functions
I	Olfactory	S	Sensory only	Olfaction (smell)
II	Optic	S	Sensory only	Vision
III	Oculomotor	M	Motor and sensory	Serves muscles of the eye
IV	Trochlear	M	Motor and sensory	Serves the superior oblique eye muscle
V	Trigeminal	B	Motor and sensory	Sensory from face and mouth; motor to muscles of mastication (chewing)
VI	Abducens	M	Motor and sensory	Serves the lateral rectus eye muscle
VII	Facial	B	Motor and sensory	Serves the muscles of facial expression, lacrimal glands, and salivary glands
VIII	Vestibulocochlear	S	Sensory only	Equilibrium and hearing
IX	Glossopharyngeal	B	Motor and sensory	Serves the pharynx (throat) for swallowing, posterior third of tongue, parotid salivary gland
X	Vagus	B	Motor and sensory	Sensations from visceral (internal) organs, and parasympathetic motor regulation of visceral organs
XI	Accessory	M	Motor and sensory	Serves muscles that move head, neck, and shoulders
XII	Hypoglossal	M	Motor and sensory	Serves muscles of the tongue

15 & 16. **31 Pairs of Spinal Nerves in PNS**

- Sensory tracts (axons) enter spinal cord at dorsal s
- Motor tracts (axons) exit spinal cord at ventral side.
- Sensory receptors signal enters dorsal spinal cord, ascends to part of brain where interpreted.
- Motor neurons send signal from brain, down spinal cord, exits ventral side.