AUTONOMIC NERVOUS SYSTEM (ANS)
BASIC PLAN 1

Visceral motor (efferent) neurons → cardiac muscle, smooth muscle, glands

Preganglionic (1st Order) Neurons → Postganglionic (2nd Order) Neurons

Fiber

Cardiac muscle, smooth muscle, glands

Synapse: Acetylcholine + cotransmitters (some)

Secretomotor endings:
- Noradrenergic fibers: norepinephrine + cotransmitters
- Cholinergic fibers: acetylcholine + cotransmitters
AUTONOMIC NERVOUS SYSTEM (ANS)
BASIC PLAN 2

Preganglionic
(1st Order)
Neurons

CNS

Postganglionic
(2nd Order)
Neurons

AUTONOMIC
GANGLIA

PARASYMPATHETIC DIVISION or CRANIOSACRAL OUTFLOW

Brainstem nuclei:
Edinger-Westphal
Superior salivatory
Inferior salivatory
Dorsal motor

Head ganglia:
ciliary
pterygopalatine
submandibular
otic

Terminal or
Intramural
ganglia
(in walls of viscera)

Spinal cord
segments S2-S4:
lateral grey matter

Terminal or
Intramural
ganglia
(in walls of viscera)

SYMPATHETIC DIVISION or THORACOLUMBAR OUTFLOW

Spinal cord
segments T1-L2(3):
lateral grey column

Paravertebral ganglia:
Sympathetic chains (trunks)
Prevertebral ganglia:
celiac
superior mesenteric
inferior mesenteric
**Parasympathetic System Layout**

**Brainstem Nuclei:**
1. Edinger-Westphal
2. Superior salivatory
3. Inferior salivatory
4. Dorsal motor

**Brainstem Nuclei:**

**Ganglia:**
A. ciliary
B. pterygopalatine
C. submandibular
D. otic
E. intramural

**Eye:**
ciliary mm.
sphincter pupillae m.

**Lacrimal gland**

**Submandibular & sublingual salivary glands**

**Parotid gland**

**Neck & Thoracic cavity:**
heart, esophagus, respiratory system

**Abdominopelvic cavity:**
digestive system (up to sigmoid colon)
kidneys & ureters

**S2**

**S3**

**S4**

**Spinal Cord: lateral grey matter**

- sigmoid colon, rectum, anal canal
- urinary bladder
- reproductive system
AUTONOMIC NERVOUS SYSTEM
AUTONOMIC NERVOUS SYSTEM

\[\text{To smooth muscle & glands in skin of back: blood vessels, arrectores pilorum mm., sweat glands}\]

\[\text{Dermatomes T1-L2}\]

\[\text{To smooth muscle & glands in skin of rest of body: blood vessels, arrectores pilorum mm., sweat glands}\]

\[\text{preganglionic sympathetic fiber}\]
To smooth muscle & glands in skin of back: blood vessels, arrectores pilorum mm., sweat glands

**Dermatomes C1-C8**

To smooth muscle & glands in skin of rest of body: blood vessels, arrectores pilorum mm., sweat glands

**Dermatomes L3-Cx1**

To smooth muscle & glands in skin of rest of body: blood vessels, arrectores pilorum mm., sweat glands
AUTONOMIC NERVOUS SYSTEM
1. The autonomic nervous system controls the activity of _?_. (a) smooth muscle (b) cardiac muscle (c) glands (d) all of these (e) none of these

2. All preganglionic and postganglionic autonomic neurons are _?_ neurons. (a) somatic efferent (b) visceral efferent (c) somatic afferent (d) visceral afferent (e) association neurons

3. Which neurotransmitter is released at the synapses between preganglionic and postganglionic autonomic neurons ? (a) epinephrine (b) norepinephrine (c) acetylcholine (d) serotonin (e) oxytocin

4. All preganglionic sympathetic neurons are located in: (a) the lateral horn of the spinal cord of spinal cord segments T1-L2 (b) brainstem nuclei (c) intramural (terminal) ganglia (d) paravertebral ganglia of the sympathetic chains (e) prevertebral ganglia

5. All preganglionic parasympathetic neurons are located in _?_. (a) prevertebral ganglia (b) the lateral horn of spinal cord segments T1-L2 (c) sympathetic chain ganglia (d) intramural ganglia (e) brainstem nuclei and spinal cord segments S2-S4

6. Prevertebral and paravertebral ganglia contain _?_. (a) preganglionic sympathetic neurons (b) preganglionic parasympathetic neurons (c) postganglionic sympathetic neurons (d) postganglionic parasympathetic neurons (e) all of these

7. The otic, ciliary, submandibular and pterygopalatine ganglia are located in the head region and contain _?_. (a) preganglionic sympathetic neurons (b) preganglionic parasympathetic neurons (c) postganglionic sympathetic neurons (d) postganglionic parasympathetic neurons (e) none of these

8. Intramural or terminal ganglia _?_. (a) are located in the walls of soft organs (b) are clusters of postganglionic parasympathetic neurons (c) are part of the sympathetic system (d) a and c (e) a and b

9. White rami communicantes _?_. (a) are bundles of preganglionic sympathetic fibers (b) connect spinal nerves T1-L2 to the sympathetic chains (c) are “white” because they contain myelinated axons (d) all of these (e) none of these

10. Preganglionic sympathetic fibers entering the sympathetic chains via white rami communicantes may _?_. (a) synapse with postganglionic sympathetic neurons in the thoracic and upper lumbar ganglia at that level (b) run up the sympathetic chains to synapse with postganglionic sympathetic neurons in cervical ganglia (b) run down the sympathetic chains to synapse with postganglionic sympathetic neurons in lower lumbar and sacral ganglia (d) all of these (e) none of these

11. Grey rami communicantes _?_. (a) are bundle of postganglionic sympathetic fibers (b) connect all spinal nerves to the sympathetic chains (c) are “grey” because they contain unmyelinated axons (d) all of these (e) none of these

12. The greater, lesser, and least splanchnic nerves _?_. (a) are bundles of preganglionic sympathetic fibers (b) are the axons of preganglionic sympathetic neurons located in the lateral grey column of spinal cord segments T5-T11 (c) pass through the sympathetic chains without synapsing with postganglionic neurons (d) synapse with postganglionic sympathetic neurons in prevertebral ganglia (e) all of these

13. In general, the postganglionic sympathetic fibers entering spinal nerves through grey rami communicantes are distributed to the vascular smooth muscle, arrectores pilorum muscles, and sweat glands of the dermatome supplied by that spinal nerve. (a) true (b) false

14. In general, the postganglionic sympathetic fibers leaving the celiac, superior mesenteric, and inferior mesenteric ganglia supply the smooth muscle and glands in the abdominopelvic viscera. (a) true (b) false
15. The cardiac sympathetic nerves _?_. (a) increase both heart rate and cardiac muscle contraction strength (b) are the postganglionic fibers of sympathetic neurons located in the cervical ganglia of the sympathetic chains (c) terminate on both cardiac muscle cells and the SA node (d) all of these (e) none of these

16. The smooth muscle and glands in the bronchial tree and the lungs are supplied with sympathetic postganglionic fibers from neurons located in the upper five thoracic ganglia of the sympathetic chains. (a) true (b) false

17. The preganglionic axons of parasympathetic neurons located in brainstem nuclei are carried to the otic, ciliary, submandibular, and pterygopalatine ganglia by _?_. (a) spinal nerves T1-L2 (b) white rami communicantes (c) cranial nerves III, VII, and IX (d) splanchnic nerves (e) grey rami communicantes

18. Preganglionic parasympathetic fibers are carried from brainstem nuclei to intramural ganglia in the thoracic and abdominopelvic viscera by _?_. (a) splanchnic nerves (b) cranial nerves X (c) pelvic nerves (d) all of these (e) none of these. The pelvic nerves supplying the pelvic viscera and genitals _?_. (a) are the axons of preganglionic parasympathetic neurons located in the grey matter of spinal cord segments S2-S4 (b) are the axons of postganglionic parasympathetic fibers located in intramural ganglia (c) are the axons of postganglionic sympathetic neurons located in the celiac ganglion (d) all of these (e) none of these

19. All preganglionic sympathetic neurons are located in: (a) the lateral horn of the spinal cord (b) brainstem nuclei (c) cranial nerve nuclei (d) the anterior horn of the spinal cord (e) the lumbar enlargement of the spinal cord

20. All preganglionic parasympathetic neurons are located in _?_. (a) prevertebral ganglia (b) the lateral horn of spinal cord segments T1-L2 (c) the hypothalamus (d) intramural ganglia (e) brainstem nuclei and spinal cord segments S2-S4

21. The visceral efferent neurons located in brainstem nuclei and in spinal cord segments S2-S4 are part of the _?_. (a) craniosacral outflow of the autonomic nervous system (b) part of the parasympathetic system (c) part of the cholinergic system (d) all of these (e) none of these

22. Which cranial nerve does not carry preganglionic parasympathetic fibers (= axons)? (a) hypoglossal (b) glossopharyngeal (c) facial (d) oculomotor (e) vagus

23. Which cranial nerve carries preganglionic parasympathetic nerve fibers that control the activity of the smooth muscle and glands in most of the thoracic and abdominal viscera? (a) IX (b) VII (c) III (d) XII (e) X

24. Which structures do not contain postganglionic sympathetic neurons? (a) sympathetic trunk ganglia (b) prevertebral ganglia (c) superior, middle, and inferior cervical ganglia (d) stellate ganglia (e) intramural ganglia

25. Which structures contain preganglionic sympathetic fibers and connect spinal nerves T1-L2 to the sympathetic chains? (a) gray rami communicantes (b) splanchnic nerves (c) white rami communicantes (d) celiac plexus (e) hypogastric plexus

26. Which ganglion is not located in the head and does not contain postganglionic parasympathetic neurons? (a) otic (b) superior cervical (c) submandibular (d) ciliary (e) pterygopalatine

27. Which brain region is the coordinating center for the ANS? (a) medulla (b) cerebral cortex (c) cerebellum (d) hypothalamus (e) thalamus