Nervous System:  
Spinal Cord and Spinal Nerves  
(Chapter 13)  

Lecture Materials  
for  
Amy Warenda Czura, Ph.D.  
Suffolk County Community College  
Eastern Campus

Primary Sources for figures and content:  

Nervous System Organization:  
CNS = brain and spinal cord  
PNS = all other neural tissue  

Structures in the PNS:  
- Ganglia = collection of somas together in one place  
- Nerves = bundles of axons  

Structures in the CNS:  
- Center = collection of somas with a common function  
- Nucleus = a center with a visible boundary  
- Neural cortex = gray matter (somas) covering the brain  
- Tracts = bundles of axons with common origins, destinations and functions  
- Columns/funiculi = large tracts in the spinal cord  
- Pathways = centers and tracts that link the brain with the body  

Sensory pathways: receptor \(\rightarrow\) CNS  
Motor pathways: CNS \(\rightarrow\) effector

Spinal Cord  
- 45 cm (18”) from brain to L2  
- inside vertebral canal (stacked vertebral foramen)  
- surrounded by CT: Spinal Meninges  
  - support and protect spinal cord

- three layers  
  (on handout)
Spinal Nerves
-31 pair
-exit via intervertebral or sacral foramen
-name for location of exit on spine, beginning between skull and C1
Nerves: C₁-C₈, T₁-T₁₂, L₁-L₅, S₁-S₅, C₀₁

-cord and column grow together until age 4; after column continues but cord does not: roots “stretch” to reach foramen
-adult: cord ends at L₁-L₂
-“stretched” spinal roots after L₂ = cauda equina
Lumbar puncture ≡ “spinal tap”, at L₃-L₄, draw CSF from subarachnoid space

Spinal cord cross sectional anatomy
(on handout)

-spinal roots exit vertebral canal through intervertebral foramen
-dorsal and ventral roots combine to form spinal nerve
-intervertebral foramen maintained by intervertebral discs between vertebrae

- spinal nerves branch off cord near to what they innervate
- cervical and lumbar enlargements of cord house cell bodies of motor neurons for muscles of appendages
- Dermatome = region of skin surface innervated by one pair spinal nerves

Herniated disc = nucleus pulposus ruptures through anulus fibrosis, compresses nerves in intervertebral foramen and/or spinal cord in vertebral canal
Slipped disc = intervertebral disc distorted or displaced, causes pressure

Nerve structure (on handout)
- axons repair if cut if follow original path
- severed nerves do not usually repair: axons do not line up correctly

-most spinal nerves do not go directly to target: axons from multiple nerves intermingle in a nerve plexus (on handout)
Trauma and disorders:
- often result from damage or pressure
  Paralysis = loss of motor function: disorder of ventral root or anterior gray horn
  Paresthesias = sensory loss: disorder of dorsal root or posterior gray horn
- complete transection results in loss of both motor and sensory below injury
  Paraplegia = sever between T1 and L4, loss of lower limb function
  Quadriplegia = sever in cervical, loss of all limb function (above C5 can kill)

Organization of Neural Pathways
10 million sensory neurons (receptor to CNS)
500 thousand motor neurons (CNS to effector)
20 billion interneurons (coordinate sensory and motor)
Interneurons organized into neuronal pools = functional groups with limited input sources (sensory) and output locations (motor)

Reflexes
- rapid automatic response to specific stimuli
  - used to maintain homeostasis
    - simple reflex = sensory perception in, motor response out
    - simple reflexes can be grouped together for complex actions
  Reflex arc = single reflex (on handout)

Reflex Classification
- four ways to classify (on handout)
  Superficial somatic reflex = stimuli originate at skin or mucous membrane
  Stretch reflex = stimuli from overstretched tendon

Reflexes
- spread of info organized into neural circuits
  - 5 neural circuits: (on handout)
2. Withdrawal reflexes
- complex polysynaptic spinal reflex
- consists of three parts:
  a. Flexor reflex = flex to withdraw
  b. Reciprocal inhibition = inhibit extensors
  c. Crossed extensor reflex = maintain balance

Reflexes automatic but can be impacted by higher brain centers:
- fine tune or combine reflexes
- take cues from reflex for coordinated voluntary movements
- facilitate or inhibit reflexes

Reflexes serve as diagnostic tool to assess health and function of spinal cord and brain

*Individual spinal nerves and their innervations and plexus origins will be examined in detail in lab along with select reflexes!