The Spinal Cord and Spinal Nerves

Objectives
• Discuss the structure and functions of the spinal cord.
• Describe the three meningeal layers that surround the CNS.
• Describe the major components of a spinal nerve.
• Describe the steps in a neural reflex.
• Explain how reflexes interact to produce complicated behaviors.

Divisions of the Nervous System
• CNS
  • Brain and spinal cord
  • In the white matter, axons arranged in tracts and columns
• PNS
  • Remainder of nervous tissue

Adult spinal cord
• 31 segments - Each segment has a pair of dorsal roots and a pair of ventral roots
• Filum terminale
• Conus medularis
• Cauda equina
• Spinal nerves extend off cord

Spinal meninges
• Provide physical stability and shock absorption
• Three layers
  • Dura mater
  • Arachnoid
  • Pia mater

Dura mater
• Most superficial covering of spinal cord
• Tapers to coccygeal ligament
• Epidural space separates dura mater from walls of vertebral canal

Arachnoid
• Deep to dura mater are the subdural space, the arachnoid, and the subarachnoid space
  • Subarachnoid space contains CSF

Pia mater
• Meshwork of elastin and collagen fibers
• Innermost and most delicate meningeal layer
Sectional anatomy of the spinal cord
• White matter is myelinated and unmyelinated axons
• Gray matter is cell bodies, unmyelinated axons, and neuroglia
  • Projections of gray matter toward outer surface of cord are horns

Horns of spinal cord
• Posterior gray horn contains somatic and visceral sensory nuclei
• Anterior gray horns deal with somatic motor control
• Lateral gray horns contain visceral motor neurons
• Gray commissures contain axons that cross from one side to the other

White matter
• Divided into six columns (funiculi) containing tracts
• Ascending tracts relay information from the spinal cord to the brain
• Descending tracts carry information from the brain to the spinal cord

Thirty-one pairs of spinal nerves
• Nerves consist of
  • Epineurium
  • Perineurium
  • Endoneurium

Nerve plexus
• Complex interwoven network of nerves
• Four large plexuses
  • Cervical plexus
  • Brachial plexus
  • Lumbar plexus
  • Sacral plexus

General organization
• Sensory neurons
  • Deliver information to CNS
• Motor neurons
  • Distribute commands to peripheral effectors
• Interneurons
  • Interpret information and coordinate responses
An introduction to reflexes

- Reflexes are rapid automatic responses to stimuli
- Neural reflex involves sensory fibers to CNS and motor fibers to effectors

Reflex arc - Wiring of a neural reflex

- Five steps
  - Arrival of stimulus and activation of receptor
  - Activation of sensory neuron
  - Information processing
  - Activation of motor neuron
  - Response by effector

Reflex classification

- According to
  - Development
  - Site of information processing
  - Nature of resulting motor response
  - Complexity of neural circuit

Reflex classifications

- Innate reflexes
  - Result from connections that form between neurons during development
- Acquired reflexes
  - Learned, and typically more complex
- Cranial reflexes
  - Reflexes processed in the brain
- Spinal reflexes
  - Interconnections and processing events occur in the spinal cord
- Somatic reflexes
  - Control skeletal muscle
- Visceral reflexes (autonomic reflexes)
  - Control activities of other systems
- Monosynaptic reflex
  - Sensory neuron synapses directly on a motor neuron
  - Patellar (knee jerk) reflex, Sensory receptors are muscle spindles
- Polysynaptic reflex
  - At least one interneuron between sensory afferent and motor efferent
  - Longer delay between stimulus and response
  - Withdrawal reflexes
  - Crossed extensor reflex