Nervous system I

This is your brain

This is your brain on drugs

Normal

Cocaine Abuser (10 days)

Cocaine Abuser (100 days)
Functions of the nervous system

• Direct immediate response to stimuli
• Coordinates activities of other systems

Anatomical divisions:

CNS, central nervous system
(located in the cranial & spinal cavities)

PNS, peripheral nervous system-
all other neural tissue, nerves, receptors, neuroglia
Nervous system

CNS

- Afferent, sensory
  - Signal travels from PNS to CNS

- Efferent, motor
  - Signal travels from CNS to PNS

PNS

- Afferent, sensory
  - Signal travels from PNS to CNS

- Efferent, motor
  - Signal travels from CNS to PNS

Somatic sensory
- Receives signals from receptors in muscles, skin, joints

Visceral sensory
- Receives signals from receptors in smooth muscle digestive organs

Somatic motor
- Voluntary control
  - Conscious control
  - Sends signals to skeletal muscles

Visceral motor
- Autonomic nervous system
  - Involuntary control
  - Unconscious control
  - Sends signals to smooth, cardiac muscle, glands

S.A.M.E.
- Sensory/afferent-sends signal towards the brain
- Motor/efferent-sends signal away from the brain
Autonomic nervous system

• Two functional divisions:
  • Sympathetic
  • Parasympathetic
Nervous System Terminology

Gray Matter – mostly nerve cell bodies.

White Matter – mostly myelinated axons.

Nerve fiber – a single axon of a neuron.

Nerve – a bundle of axons in the PNS.

Tract – a bundle of axons ins the CNS.

Ganglion – a cluster of nerve cell bodies in PNS.

Nucleus – gray matter in CNS with common function.
Cells of the nervous system

• Two types:
  • Neuroglia-supporting cells 5:1 neuron
  • Neurons-transfer and process information
neuron

- Cell that transmit electrical impulses from the dendrites to the synaptic terminals
- Organelles: mitochondria, ribosomes, ER
  - Lack centrioles no cell division, can’t be replaced
- Surface covered by glial cells

Receives signal  Sends signal

Fig 13.3
Fig 13.9

(a) Multipolar neuron
• Dendrites of neurons are stimulated
• Axon hillock summates this stimulation & creates a action potential
• Action potential travels on the axon to the synaptic terminals
• Synaptic terminals release chemicals called neurotransmitters
Fig 13.10

- No axon: Rare, not myelinated
- Sensory neurons: May be myelinated
- Motor neurons: Most common, myelinated
- Neurons release neurotransmitters to signal other cells

Signaling within a neuron is electric

Signaling between a neuron & other cells is usually chemical

Fig 13.9
The neuroglia

**NEUROGLIA**

- Satellite cells
  - Surround neuron cell bodies in ganglia; regulate O₂, CO₂, nutrient, and neurotransmitter levels around neurons in ganglia

**Peripheral Nervous System**

- Schwann cells
  - Surround all axons in PNS; responsible for myelination of peripheral axons; participate in repair process after injury

**Central Nervous System**

- Oligodendrocytes
  - Myelinate CNS axons; provide structural framework
- Astrocytes
  - Maintain blood-brain barrier; provide structural support; regulate ion, nutrient, and dissolved gas concentrations; absorb and recycle neurotransmitters; form scar tissue after injury
- Microglia
  - Remove cell debris, wastes, and pathogens by phagocytosis

- Ependymal cells
  - Line ventricles (brain) and central canal (spinal cavity); assist in producing, circulating, and monitoring of cerebrospinal fluid

Fig 13.4
CNS neuroglia

- Astrocytes-most numerous
  - Repair damages neurons
  - Control interstitial environment
  - Blood brain barrier
    • surround capillaries to isolate the brain from chemicals in the plasma

- Ependymal cells-with capillaries produce cerebral spinal fluid in the brain
• Oligodendrocytes-myelinate axons in the CNS
  – Works like insulation making actions potentials travel down axons ~ 6 times faster
• Microglia-break down cellular waste and pathogens in the CNS
PNS neuroglia

• Schwann cells-myelinate axons in the PNS
• Satellite cells-exchange waste/nutrients cell body & extracellular fluid
Fig 13.8
Nerve impulse

- A neuron is electrically stimulated to threshold (summation @ axon hillock)
- At the threshold the cell membrane permeability to ions Na\(^+\)/K\(^+\) changes
- This creates an action potential
- Large myelinated axon sends signals at 300 mhp!
Neural pools

- Groups of communicating neurons

Fig 13.14

Spread of info

Stepwise signaling

Positive feedback

(a) Divergence

(b) Convergence

(c) Serial processing

(d) Parallel processing

(e) Reverberation

Several inputs to one neuron

Simultaneous processing of info
The brain

- Adult Contains 98% of all neural tissue
- 3 lbs, feels like jello
- 3 primary brain vesicles a 3 weeks
**TELENCEPHALON (CEREBRUM)**
- Conscious thought processes, intellectual functions
- Memory storage and processing
- Conscious and subconscious regulation of skeletal muscle contractions

**DIENCEPHALON**

**THALAMUS**
- Relay and processing centers for sensory information

**HYPOTHALAMUS**
- Centers controlling emotions, autonomic functions, and hormone production

**MESENCEPHALON (MIDBRAIN)**
- Processing of visual and auditory data
- Generation of reflexive somatic motor responses
- Maintenance of consciousness

**METENCEPHALON (CEREBELLUM)**
- Coordinates complex somatic motor patterns
- Adjusts output of other somatic motor centers in brain and spinal cord

**METENCEPHALON (PONS)**
- Relays sensory information to cerebellum and thalamus
- Subconscious somatic and visceral motor centers

**MEDULLA OBLONGATA (MYELENCEPHALON)**
- Relays sensory information to thalamus
- Autonomic centers for regulation of visceral functions such as cardiovascular, respiratory, and digestive activities
Fig 15.11

Grey matter

White matter

(b) Frontal section
Ventricles

4 fluid filled cavities in the brain
Lined by ependymal cells
Contain cerebrospinal fluid
CSF

- Cushions the CNS
- Supports the brain—the brains is floating in the CSF
- Transport nutrient/wastes etc.
Choroid plexus

- Produces CSF 500 ml/day
- Composed of ependymal cells and capillaries (CSF is very different from plasma)
- Found in each ventricle
- Floor of lateral ventricles (2)
- Roof of 3rd ventricle
- Roof of 4th ventricle
CSF circulation

Blood supply to the brain is from the internal carotid and vertebral arteries which lead to the Circle of Wilis.
Blood brain barrier

• Maintained by astrocytes
• Not found in:
  – the hypothalamus
  – Pineal gland
  – Roof of 3rd & 4th ventricles
Cranial Meninges

• Protective layers of the brain & spinal cord
  – Provide physical stability and shock absorption

• Superficial
  – Dura mater-Tough fibrous layer
  – Arachnoid
  – Pia mater

• Deep
Fig 15.3

- Anterior clinoid process
- Posterior margin of lesser wing of sphenoid
- Optic nerve
- Olfactory tract
- Frontal sinus
- Crista galli
- Olfactory bulb
- Internal carotid artery
- Anterior cerebral artery
- Middle cerebral artery
- Third ventricle
- Posterior cerebral artery
- Tentorium cerebelli

(c) Superior sectional view

Extensions of the dura mater

 Inferior sagittal sinus
 Superior sagittal sinus

Falx cerebri
Deep to arachnoid is subarachnoid space
- Network of collagen and elastin fibers (arachnoid trabeculae)
- Contains CSF
12 pairs of Cranial nerves
Fig 15.21

1-12 Old Owls On Tree Tops Are Forever Viewing Green Valleys And Hills
Fig 15.22

- Left olfactory bulb (termination of olfactory nerve)
- Olfactory tract (to olfactory cortex of cerebrum)
- Olfactory nerve fibers
- Cribriform plate of ethmoid
- Olfactory epithelium
Fig 15.24
Fig 15.29
Know the primary function of each nerve.
break
Cranial dissection video

• By Kevin Petti
Histology CD
Fig 15.8

- Longitudinal fissure
- Left cerebral hemisphere
- Right cerebral hemisphere
- Central sulcus
- Cerebral veins and arteries covered by arachnoid
- Cerebellum
- Parieto-occipital sulcus

(a) Superior view
Fig 15.9

Transverse fissure
Fig 15.9
Autonomic centers (sympathetic)
Paraventricular nucleus
Preoptic area
Autonomic centers (parasympathetic)
Suprachiasmatic nucleus
Supraoptic nucleus
Tuberal nuclei
Optic chiasm
Infundibulum
Anterior pituitary gland
Pars distalis
Pars intermedia
Thalamus
Hypothalamus
Mamillary body
Posterior pituitary (pars nervosa)
Pons
(b) Hypothalamus
Cerebral peduncles

Copora quadrigemina

Fig 15.15

Aqueduct of midbrain or Cerebral aqueduct
Fig 15.19
A distorted human figure drawn to reflect the space our body parts occupy on the sensory and motor cortex.