*KRCP Lecture 1*

*Anatomy of the Brain*

**Nervous System Structure**

* Composed of the **central nervous system (CNS)**, brain and spinal cord, and the **peripheral nervous system (PNS)**, **nerves** (bundles of axons and glia) and **ganglia** (clumps of nerve cell bodies) outside of the CNS
* CNS: command-and-control center
* PNS: courier network (delivers sensory information to CNS and carries motor commands from CNS to muscles)
* Activities of PNS are accomplished through 2 systems: **somatic motor system** (controls voluntary muscles) and the **autonomic motor system** (controls visceral functions)
* Autonomic nervous system has 2 subdivisions: **sympathetic and parasympathetic branches** (operate antagonistically e.g. sympathetic increases heart rate, parasympathetic slows it)
* The parts of the CNS (brain and spinal cord) are surrounded by a bony shell and **cerebrospinal fluid** (CSF)
* They are covered by 3 membranes – meninges: outer **dura mater**, middle **arachnoid mater**, inner **pia mater**
* CSF occupies subarachnoid space between arachnoid mater and the pia mater, as well as the brain ventricles, cisterns and sulci and the central canal of the spinal cord
* The two most common organized cluster of neurons are **nucleus** (compact arrangement of nerve cells with functionally similar inputs and outputs) or **layer**
* **Grey matter** is composed of neuronal cell bodies and **white matter** of axons and glial cells
* Axons are grouped together in **tracts** that run from one region to another (within same hemisphere: associations tracts, across hemispheres: commissures – largest one corpus callosum, from cerebral cortex to deeper structures and spinal cord: projection tracts)

**Navigation in the Brain**

* Front: **rostral** end (nose)
* Back: **caudal** end (tail)
* Along the back: **dorsal/superior**
* Along the belly: **ventral/inferior**
* Rostral = **anterior** / caudal = **posterior** in the brain
* Slicing from nose to tail: **saggital** (in the middle: midsagittal/medial / off to the side: lateral saggital)
* Slicing from top to bottom: **coronal**
* Separating dorsal from **ventral**: axial, transverse or horizontal

**Spinal Cord**

* Takes in sensory information from the body’s peripheral sensory receptors, relays it to the brain and conducts the motor signals from the brain to the muscles

**Brainstem**

* 3 main parts: **myelencephalon** (medulla), **metencephalon** (pons and cerebellum) and **mesencephalon** (midbrain)
* CNS between spinal cord and diencephalon
* Contains groups of motor and sensory nuclei, nuclei of widespread modulatory neurotransmitter systems and white matter tracts of ascending sensory information and descending motor signals
* Brainstem nuclei control respiration and states of consciousness
* Medulla, pons and cerebellum make up **hindbrain**

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| --- | --- | --- | --- |
| **Brainstem** | **Midbrain** | **Mesencephalon** | |
| **Hindbrain** | **Metencephalon** | **Cerebellum** |
| **Pons** |
| **Myelencephalon** | **Medulla** |

**Diencephalon**

* Made up of **thalamus** and **hypothalamus**
* **Thalamus** consist of 2 hemispheres
* Involved in relaying primary sensory information and motor information that is on its way to the spinal chord 🡪 information can be reorganized and shuttled
* **Hypothalamus** is the main link between nervous system and endocrine system
* Control functions necessary for maintaining homeostasis

**Telencephalon**

* Includes the **cerebral cortex, limbic system and basal ganglia**
* **Limbic system** contains cingulate gyros, hypothalamus, hippocampus, amygdala, frontal cortex and parts of the basal ganglia
* Emotional behavior and memory
* **Basal ganglia** receives inputs from sensory and motor areas
* Involved in a variety of crucial brain functions (action selection, action gating, reward-based learning, motor preparation, timing, task switching, etc.)
* Combines and organism’s sensory and motor context with reward information and passes it to the motor and prefrontal cortex for a decision

**Cerebral Cortex**

* Made up of large sheets of layered neurons, draped and folded over the 2 hemispheres
* Brodmann divided the brain into distinct regions based on the underlying **cytoarchitectures** (microanatomy of cells and their organizations)
* Contains many infoldings called **sulci** (crevices) and **gyri** (crowns of the folded tissue) 🡪 enable more cortical surface to be packed into the skull, bring neurons into closer three-dimensional relationships to one another and bring nearby regions closer together
* Consists mostly of grey matter
* Cerebral hemispheres have 4 main divisions/lobes: **frontal, parietal, temporal and occipital lobes**
* Lobes can be distinguished from another by pronounced sulci: **central sulcus** divides frontal and parietal lobe and **Sylvian/lateral fissures** separates temporal lobe from frontal and parietal lobes
* **Frontal lobe:** planning, cognitive control and execution of movements
* **Parietal lobe:** receives sensory input about touch, pain, temperature and limb positions and is involved in coding space and coordinating actions
* **Temporal lobe:** auditory, visual and multimodal processing areas
* **Occipital lobe:** visual information

**Ventricles**

* “Empty” chambers in the brain containing CSF
* Reduces shock to the brain and gives structural support