

Lecture 1.1

Intro to the Field

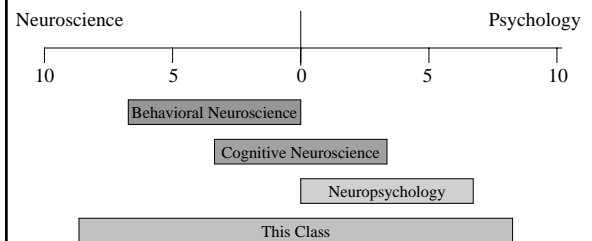
Outline

- Why are we here?
- Subfields
- Approaches
- History
- Terminology

Why Are We Here?

- Behavior and cognition (psychology) are the result of biology
- Neuroscience-Psychology Spectrum
 - What is “Neuroscience”?
 - What is “Psychology”?

Neuroscience-Psychology Spectrum



Approaches

- Anatomy
- Physiology
- Chemistry/pharmacology
- Pathology

History

- Early scientists and philosophers made connections between psychology and anatomy
 - Heart-memory (“I know it by heart”)
 - Heart-emotion (“I love you with all my heart”)
 - Head-thought (“My head hurts from thinking”)
 - Head-sanity (“Let me get my head on straight”)

History

- Greeks proposed 4 humors (black bile, yellow bile, blood, phlegm)
 - Revived by physicians in Middle Ages
 - Relative composition defines personality (melancholic, choleric, sanguine, phlegmatic)
 - Matches up to four seasons, four elements
 - <http://ancienthistory.about.com/library/weekly/aa020299.htm>

Segregation of Function

- Phrenology – bumps on head correspond to personality
 - Franz Gall (1790's) major proponent
 - Widely refuted and discounted
- Paul Broca (1861) does post-mortem study of aphasia patients who experienced TBI
 - Found that all had overlapping damage
 - Evidence for regional specificity

Comparative Anatomy

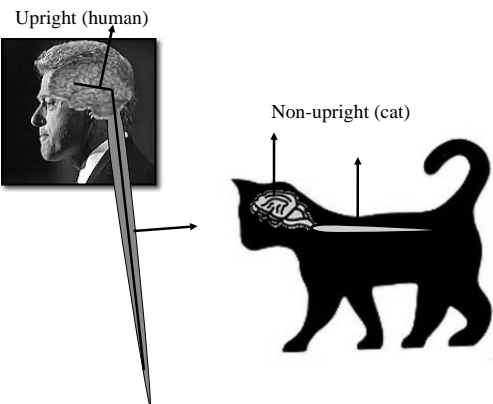
- Korbinian Brodmann (1900's) classified cortical neurons by cytoarchitecture
 - Several areas overlap with functional areas (V1)

Current Hypotheses

- Observable output is the result of interactions among many brain regions (not usually single cells or regions)
 - Examples: Bull w/ caudate stimulator
- These regions may (or may not) form functionally distinct “structures”
- Behavior is complex, but predictable (within a range) based on neural activity

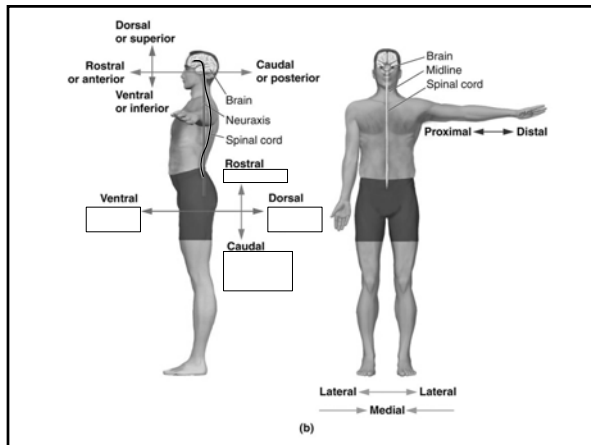
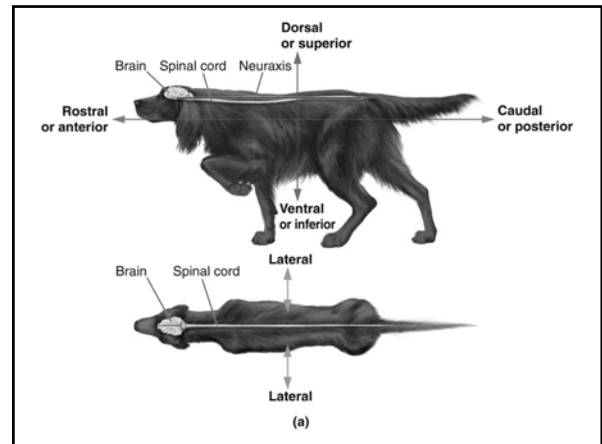
Orientation

- Two sets of nomenclature
 - Neuraxis
 - Brain



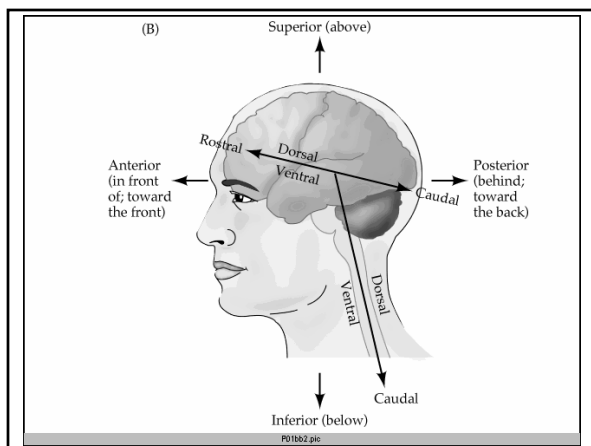
Neuraxis Orientation

- Rostral/caudal
 - towards _____
- Dorsal/ventral
 - towards _____
- Medial/lateral
 - towards _____



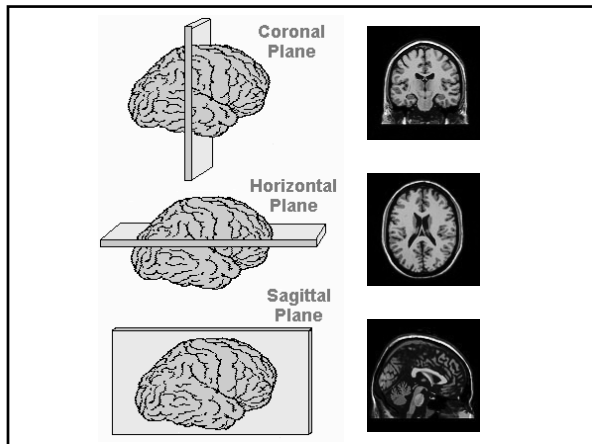
Brain Orientation

- Inferior/Superior (bottom/top)
- Anterior/Posterior (front/back)
- Left/Right



Why are we learning esoteric terminology?

- Orientation terms allow for naming structures and pathways based on location
 - DLPFC, LGN, dorsal horns
 - dorsal stream, ventromedial motor pathway
- Communication among researchers



Slices

- Coronal –
- Axial/horizontal –
- Sagittal –

Slices

- Oblique – “in between” 3 main directions
 - Term used only for scanning (not for structures or pathways)
 - Slices aligned to internal landmarks (AC-PC) rather than external placement

Lecture 1.2

Introduction to the Nervous System

Outline

- Divisions of the Nervous System
- Divisions of CNS
- Meninges
- Ventricles

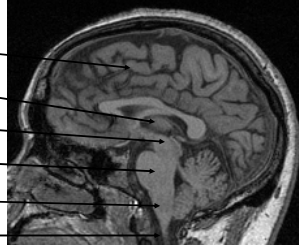
Nervous System

- CNS
 - Brain
 - Spinal Cord
- PNS
 - Somatic
 - Autonomic
 - Sympathetic
 - Parasympathetic

Divisions of the CNS

Rostral

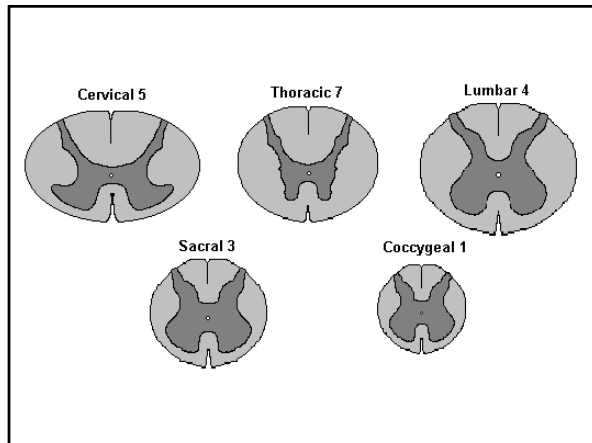
- Telencephalon
- Diencephalon
- Mesencephalon
- Metencephalon
- Myelencephalon
- **Spinal Cord**



Caudal

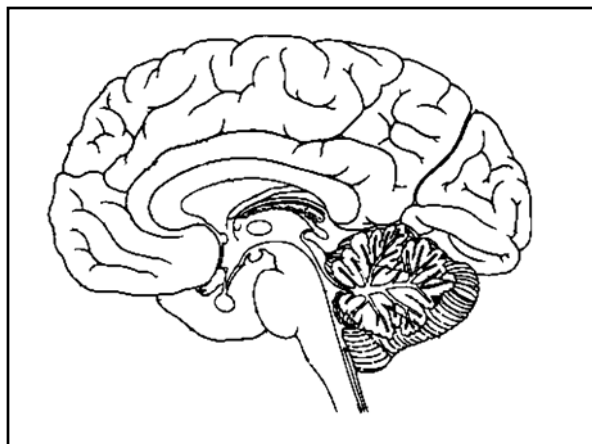
Spinal Cord

- Caudal end of CNS
- Receives sensory information from, and sends motor information to, limbs and trunk
- 31 pairs of spinal nerves
- Broken into segments from caudal to rostral (coccygeal, sacral, lumbar, thoracic, cervical)
- Composed of dorsal (sensory) and ventral (motor) horns that project to roots
- Grey matter on inside, white matter on outside



Hindbrain

- Myelencephalon
 - Medulla –
 - Reticular formation –
- Metencephalon
 - Pons – bands of nuclei, some RF, conducts information from cerebellum to cerebrum
 - Cerebellum – sensorimotor learning/coordination, connected by peduncles



Midbrain

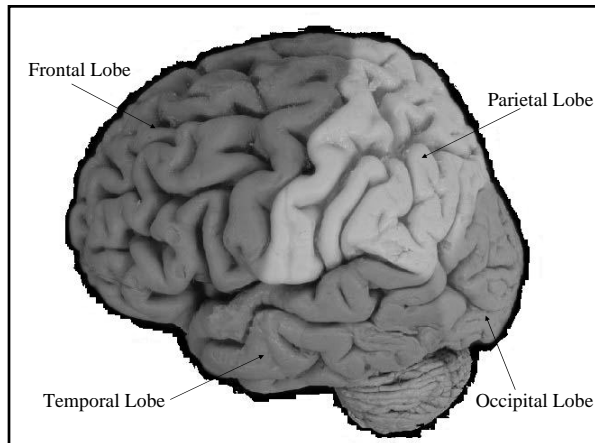
- Mesencephalon
 - Integrates sensory and motor information
 - Tectum – inferior and superior colliculi
 - Tegmentum –
 - substantia nigra (DA)
 - red nucleus (sensorimotor)
 - periaqueductal gray (analgesia)

Forebrain

- **Diencephalon**
 - Thalamus –
 - Hypothalamus –
 - Optic chiasm –
 - Pituitary gland –
- **Telencephalon**
 - Cerebral cortex, corpus callosum, basal ganglia, limbic system

Four Lobes

- **Frontal** –
- **Parietal** –
- **Occipital** –
- **Temporal** –

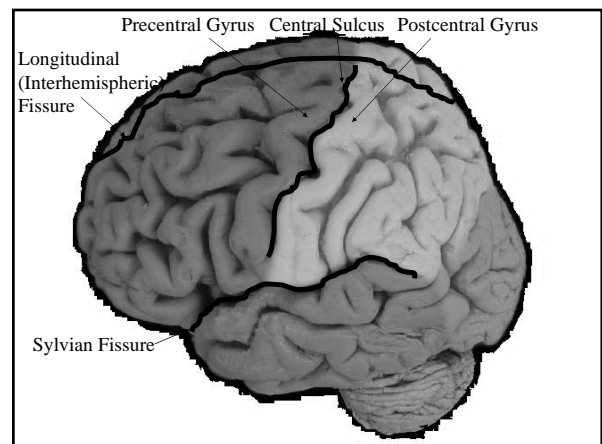


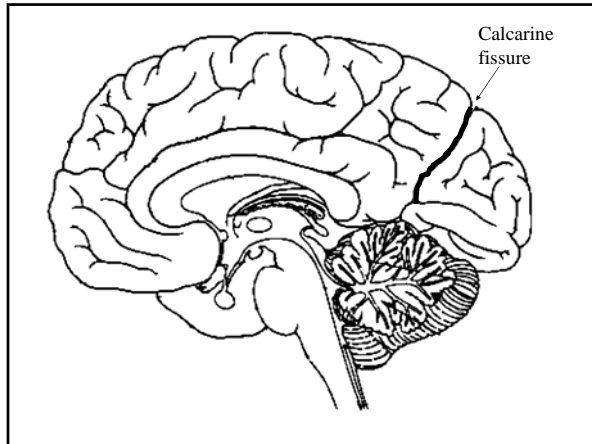
A Bumpy Road

- Cortex has convolutions that increase surface area and separate tissue
- **Gyrus** –
- **Sulcus** –
- **Fissure** –

Hills and Vales

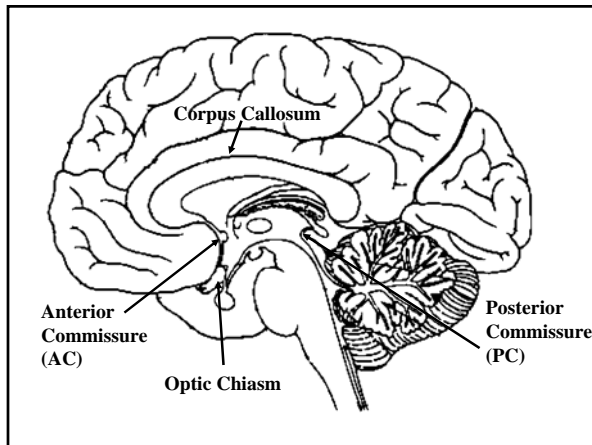
- **Longitudinal fissure** divides hemispheres
- **Central sulcus** separates frontal from parietal
 - Precentral gyrus – primary motor
 - Postcentral gyrus – primary somatosensory
- **Sylvian (lateral) fissure** separates frontal/parietal from temporal
- **Calcarine fissure** (on medial surface) separates occipital from parietal





Crossing Over

- Various points of *decussation*
 - **Corpus callosum** – runs entire length of border between diencephalon and telencephalon, genu (bend) at rostral, splenium (patch) at caudal end
 - **AC/PC** – no specific function, excellent landmark
 - **Optic chiasm** – visual information partially crosses
- Points on same side are *ipsilateral*, points on opposite sides are *contralateral*



Special Systems

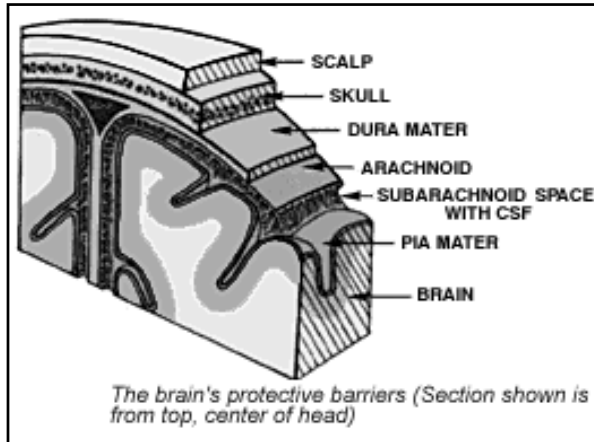
- **Limbic system** –
 - Mammillary bodies, hippocampus, amygdala, fornix, cingulate gyrus, septum
- **Basal ganglia** –
 - Caudate, putamen, globus pallidus
 - Receives projections from substantia nigra → involved in Parkinson's

Cranial Nerves

- 12 nerves (bundles of axons)
- Only nerves that don't project from spinal cord
- Sensory/motor of head, neck, eyes, and face
- Assessed by neurologists with simple tests
 - Down and in – VI
 - Stick out tongue – XII

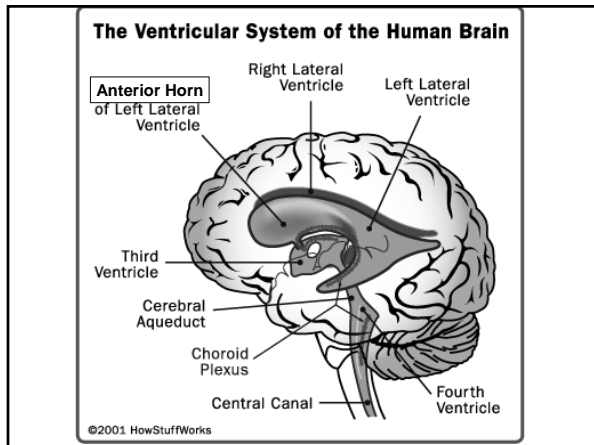
Meninges

- Collective surface that protects and supports the brain
- Scalp – outer skin where hair is
- Skull – bone
- **Dura mater** –
- **Arachnoid** –
- Subarachnoid – fluid (CSF) filled space, blood vessels
- **Pia mater** – “pious” or devoted mother, thin membrane directly on top of cortex/CNS, distributes suspension forces from arachnoid



Ventricles

- Cerebrospinal fluid (CSF) surrounds, cushions, and supports CNS
 - Adds buoyancy to brain → weighs less
 - Nourishes and removes waste
- Separated into 4 ventricles connected by canals
 - Central canal –
 - 4th ventricle –
 - Cerebral aqueduct –
 - 3rd ventricle –
 - Lateral ventricles –
 - Anterior horn, body, trigone, posterior horn



CSF

- Produced by choroid plexus located in each ventricle
- Surrounds brain in dura sinuses
- Subarachnoid villae absorb fully circulated CSF into blood stream
- Build-up of CSF causes hydrocephalus
 - How does CSF build up? (3 ways)

Blood Brain Barrier

- Lots of dangerous stuff floating around in blood
- Some necessary substances (K^+) would be fatal at dietary levels (banana)
- BBB keeps some substances out altogether, moderates levels of others
- Formed by endfeet of *astrocytes* and tight junctions of blood vessel walls

Blood Brain Barrier

- Both active (K^+ , glucose, some larger molecules) and passive (water, gases, small or lipid-soluble molecules) mechanisms
 - Active mechanisms require energy
 - Passive mechanisms do not require energy
- Some regions have lower or no BBB