

Intro

- Biological Psychology- studies the biological foundation of behavior, emotions, and mental processes
- Mind-Body Dualism- Descartes
- Phrenology- Gall and Spurzheim. Brain mapping method. Led to localization

The Seductive Allure of Neuroscience

- Visual complexity
- Real data
- Bad neuroscience- easy to find

Research Methods

- Levels of analysis-
 - Molecular → synaptic → cellular → circuit → systems → organ → environment
- Structure- how is it built/connected? What does it look like?
- Function- how does it work/ what does it do?
- Ablation- (physical) removal of brain tissue
- Lesion- damage to neural tissue. Accidental/intentional, biochemical/neurotoxic, electrolytic
- Stereotaxic surgery- holds animal in place to find specific coordinates
- Infusion- puts chemicals directly into the brain
- Microdialysis- measures neurotransmitters in brain
- Histology- the study of microscopic structures and tissues
 - Structure, organization, and connections of cells

- Histological Process- tissue must be:
 - o 1. Fixed (solidified) by adding formalin or paraformaldehyde/freezing
 - o 2. Sliced thin by a vibrating microtome or cryostat
 - o 3. Mounted on microscope slides
 - o 4. Processed with appropriate chemicals
 - o 5. Viewed with a microscope
- golgi silver stain- random single cells. Black reaction. Darkly stains full neuron, useful for single cell imaging. Randomly stains about 5%.
- myelin stains- axon/fiber tracts. Stains fatty myelin sheath that forms insulation around axons. Dark- axons, fiber tracts. Light- cell bodies, dendrites. Identifies neural pathways
- nissl stains- cell bodies/nuclei. Stains cell bodies of neurons by darkening material in nucleus. Identifying populations of cell bodies.
- Electroencephalograph (EEG)- measures the summed graded potentials from many thousands of neurons. Changes as behavior changes. Displays an array of patterns. Living brain never silent.
- Event-Related Potentials (ERPs)- related to specific sensory event. Repeated stimulus presentations averaged. Function.
- Transcranial Magnetic Stimulation (TMS)- coil over skull applies strong and quickly changing magnetic fields that can enhance or interrupt brain function.
- Magnetoencephalography (MEG)- neural activity, generates electrical field and produces magnetic field. Recorded from detectors permits 3D. higher resolution than ERP. High cost.
- Single Cell/multi unit recordings- fine wire electrodes. Amplify and filter, digitize and store. Correlate physiology with behavioral/cognitive events.
- Static Imaging Techniques:
 - o Computed Tomography CT- uses multiple x rays at many different angles to construct 3D image. Bone and soft tissue. More risks than MRI but 10 x cheaper.

- o Magnetic Resonance Imaging MRI- high resolution, static, 3D image. Passes strong magnetic through brain, then radio wave, then measures movement emitted from hydrogen atoms.
- o Diffusion Tensor Imaging DTI- detects the directional movements of water molecules to image nerve fiber pathways in the brain. Identifies abnormalities in neural pathways
- Dynamic Brain Imaging:
 - o Positron Emission Tomography PET- radioactive protein or glucose molecules are injected into blood stream. Detects changes in metabolism by measuring uptake of radioactive molecules. Expensive.
 - o Functional MRI fMRI- uses magnetic fields and blood oxygenation level dependent response to visualize brain activity.
 - Potential problems- neural correlates of interspecies perspective taking in the postmortem atlantic salmon. Need advance statistics.
- Knock in- genetic modification. Functioning gene inserted into animal cells (gene transfer)
- Knock out- genetic modification. Nonfunctioning mutation introduced to isolated gene, transferred to embryos
- Optogenetics
 - o 1. Genetic construct
 - o 2. Insert construct into virus
 - o 3. Inject virus into animal brain
 - o 4. Insert optrode
 - o 5. Laser light
- Research with humans- IRB, consent, minimize pain/discomfort/risk, deception, debriefing
- Why animals? – controlled environment, homogenous, briefer development and lifespan, ethical matters
- Animal guidelines- IACUC, minimal N, humane, careful attention to health and welfare, minimize stress/discomfort

Anatomy and Evolution

- Rostral/anterior → head of four legged animal