Unit 2: Biological Bases for Behavior

Techniques to Learn About Brain and Neural Function:
How we’ve learned about the brain over time
“If the human brain were so simple that we could understand it, we would be so simple that we couldn’t”

-Emerson Pugh, The Biological Origin of Human Values (1977)
The Human Brain Project

The New Human Brain Project
Greek philosophers and physicians first linked the concept of the mind with the brain.

Hippocrates
- Emotions, thoughts, and mental health

Galen
- Fluids (humors) in brain were responsible for sensation, reasoning, judgment, memory, movement
Franz Gall (1758-1828) and Johann Spurzheim (1776-1832)

Proven Inaccurate over time

Phrenology was:
- The belief that small sections all over the head dealt with areas of character and personality
- Thought bumps on skull surface dealt with traits of morality or immorality

Phrenology - Areas Explained
The Pseudoscience of Pressure Phrenology on America's Got Talent
Phineas Gage

- 25 years old railroad worker
- Terrible Accident on Sept 13, 1848
  - Tamping Iron shot through his frontal lobe
- People said afterwards he was, “No longer Gage”
  - Before: reliable, respectable, hard-working, gentlemen
  - After: volatile, anti-social, lying, grossly profane
- The damage to the brain showed that his frontal lobe (decision-making part) no longer had connection with the emotion part of his brain so he lost the ability to make rational and logical decisions about his behavior.
- Phineas Gage
Paul Broca (1824-1880)
- Autopsy on a man’s brain who lost ability to speak
- Found damage on the left frontal lobe
- **Broca’s Area** – area responsible for speech production
  - producing grammatical language structure
  - Left hemisphere

Carl Wernicke (1848 – 1905)
- **Wernicke’s Area** – area responsible language comprehension
  - producing comprehensible language
  - Left hemisphere
Aphasia

**Broca's Aphasia**: when there is damage to Broca’s area of the brain causing difficulty producing language specifically with producing words and grammar

- **Broca's Aphasia** - Long

- **Broca's Aphasia** - short

**Wernicke's Aphasia**: when there is damage to Wernicke’s area of the brain causing difficulty understanding language meaning and producing meaning

- when they speak, they may know what they are saying
Lesions

- Damage to the structure of the brain
- Help us study brain function (Phineas Gage)

Types:
- Surgical Removal
- Severing Neural Connections
- Destruction (electrical, chemical applications)
Ablation

- Removal of a structure (surgery)

- Most of these studies are done with animals
  - Must be approved by Institutional Animal Care and Use Committees

- Human ablation happens with removal of tumors
Discovery of the Neuron

- Santiago Ramon y Cajal (1852-1932)
  - Able to use the Selective Silver Staining Technique to see individual neurons

- It was once believed that there were 100 billion neurons in the brain but there are only 80 million.
Electrical Stimulation

- Allows the ability to test functions of brain parts
- Can be used to localize seizures
- Walter Hess experiment with animals
EEG – Tracking Brain Activity

- Electroencephalogram
- Traces activity in brain by emitting signals that detect the brain’s electrical activity
  - Detects Brain waves
  - Watch an EEG
Brain Imaging Techniques

- These show images of the brain's anatomy

- CAT Scan
  - CT
  - Shows 2D slices
  - Uses X Rays not magnets
  - CAT Scan

- MRI
  - Magnetic machine
  - More detailed images
  - Can see differences in soft tissues
  - Brain MRI
Imaging Techniques that observe activity as it functions

- **PET Scans**
  - Radioactive tracers are injected into the blood and concentrate in areas of greatest activity
  - It can track a complex series of interactions in the brain
  - Not good to be exposed to too much radioactive materials

- **fMRI**
  - Measures activity by detecting blood flow activity
  - Can detect heightened activity in the brain
  - Does not expose to radioactivity
PET and CT Scans
Seeing How a Reading Changes the Brain through an fMRI
Techniques to examine functions of the brain

1. Remove part of the brain & see what effect it has on behavior

2. Examine humans who have suffered brain damage
3. Stimulate the brain

4. Record brain activity
“OK, Mr. Dittmars, remember: That brain is only a temporary, so don’t think too hard with it.”