Unit 3B:
Biological Bases of Behavior:
The Brain

Unit Overview

- The Tools of Discovery: Having Our Head Examined
- Older Brain Structures
- The Cerebral Cortex
- Our Divided Brain
- Right-Left Differences in the Intact Brain
- The Brain and Consciousness

Click on any of the above hyperlinks to go to that section in the presentation.
The Tools of Discovery: Having Our Head Examined

Introduction
• **Lesion**
  – Cluster of destroyed brain cells (either normal or defective)

Recording the Brain’s Electrical Activity
• **Electroencephalogram (EEG)**
Neuroimaging Techniques

- CT (Computed Tomography) scan
- PET (Positron Emission Tomography) scan
- MRI (Magnetic Resonance Imaging)
- fMRI (Functional MRI)

Older Brain Structures

- Brainstem
  - Medulla
  - Pons
  - Reticular formation

The Brainstem
The Thalamus

- **Thalamus**
  - All the senses EXCEPT smell

The Cerebellum

- **Cerebellum**
  - "Little brain"

The Limbic System

- **Limbic System**
  - Hippocampus
The Limbic System

The Amygdala

- Amygdala
  - Aggression and fear

The Limbic System

The Hypothalamus

- Hypothalamus
  - Influence on the pituitary gland
  - Reward Centers
  - Reward deficiency syndrome

The Cerebral Cortex
Introduction

- Cerebrum
  - Cerebral cortex

Structure of the Cortex

- Glial cells (“glue cells”)
- Lobes
  - Frontal lobes
  - Parietal lobes
  - Occipital lobes
  - Temporal lobes

Functions of the Cortex

Motor Functions

- Motor Cortex
- Mapping the Motor Cortex
- Neural Prosthetics
Functions of the Cortex

Sensory Functions

- Sensory cortex

Association Areas

- Association areas
  - Frontal lobes
    - Phineas Gage
  - Parietal lobes
  - Temporal lobes
Language

- **Aphasia**
  - Broca’s area
  - Wernicke’s area
Language

The Brain's Plasticity

- Brain Damage
  - Plasticity
  - Constraint-induced therapy
  - Neurogenesis

Our Divided Brain
Splitting the Brain

- Vogel and Bogen
- **Corpus-callosum**
- **Split brain**
- Myers and Gazzaniga
Right-Left Differences in the Intact Brain

Right-Left Brain Differences

- Hemispheric Specialization
  - Perceptual tasks
  - Language
  - Sense of self
### Left and Right Hemispheres

<table>
<thead>
<tr>
<th>Left</th>
<th>Right</th>
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<tbody>
<tr>
<td>Speaking/processing language</td>
<td>Visual-spatial superiority</td>
</tr>
<tr>
<td>Calculating</td>
<td>*Modulates speech</td>
</tr>
<tr>
<td>More conscious</td>
<td>Sense of self/self-recognition</td>
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<tr>
<td></td>
<td>More intuitive</td>
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*Modulating speech: What’s in the road ahead? Or What’s in the road, a head?

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### The Brain and Consciousness

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### Introduction

- **Consciousness**
Cognitive Neuroscience

• Cognitive neuroscience

Dual Processing

• Dual Processing
  – Priming
  – Conscious left brain
  – Intuitive right brain

The Two-Track Mind

• Two-Track Mind
  – Visual perception track
  – Visual action track
Definition

Lesion

= tissue destruction; a brain lesion is a naturally or experimentally caused destruction of brain tissue.
**Electroencephalogram (EEG)**

= an amplified recording of the waves of electrical activity that sweep across the brain's surface. These waves are measured by electrodes placed on the scalp.

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**CT (computed tomography) Scan**

= a series of X-ray photographs taken from different angles and combined by computer into a composite representation of a slice through the body.

- Also called CAT scan.

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**PET (positron emission tomography) Scan**

= a visual display of brain activity that detects where a radioactive form of glucose goes while the brain performs a given task.
MRI (magnetic resonance imaging)
= a technique that uses magnetic fields and radio waves to produce computer-generated images of soft tissue. MRI scans show brain anatomy.

fMRI (functional MRI)
= a technique for revealing bloodflow and, therefore, brain activity by comparing successive MRI scans. fMRI scans show brain function.

Brainstem
= the oldest part of the central core of the brain, beginning where the spinal cord swells as it enters the skull; the brainstem is responsible for automatic survival functions.
Medulla

= the base of the brainstem; controls heartbeat and breathing.

Reticular Formation

= a nerve network in the brainstem that plays an important role in controlling arousal.

Thalamus

= the brain's sensory switchboard, located on top of the brainstem; it directs messages to the sensory receiving areas in the cortex and transmits replies to the cerebellum and medulla.
Cerebellum
= the “little brain” at the rear of the brainstem; functions include processing sensory input and coordinating movement output and balance.

Limbic System
= doughnut-shaped neural system (including the hippocampus, amygdala, and hypothalamus) located below the cerebral hemispheres; associated with emotions and drives.

Amygdala
= two lima bean-sized neural clusters in the limbic system; linked to emotion.
Hypothalamus

- a neural structure lying below (hypo) the thalamus; it directs several maintenance activities (eating, drinking, body temperature), helps govern the endocrine system via the pituitary gland, and is linked to emotion and reward.

Cerebral Cortex

- the intricate fabric of interconnected neural cells covering the cerebral hemispheres; the body's ultimate control and information-processing center.

Glial Cells

- cells in the nervous system that support, nourish, and protect neurons.
Frontal Lobes
= portion of the cerebral cortex lying just behind the forehead; involved in speaking and muscle movements and in making plans and judgments.

Parietal Lobes
= portion of the cerebral cortex lying at the top of the head and toward the rear; receives sensory input for touch and body position.

Occipital Lobes
= portion of the cerebral cortex lying at the back of the head; includes areas that receive information from the visual fields.
Temporal Lobes

= portion of the cerebral cortex lying roughly above the ears; includes the auditory areas, each receiving information primarily from the opposite ear.

Motor Cortex

= an area at the rear of the frontal lobes that controls voluntary movements.

Sensory Cortex

= area at the front of the parietal lobes that registers and processes body touch and movement sensations.
Association Areas

= areas of the cerebral cortex that are not involved in primary motor or sensory functions; rather, they are involved in higher mental functions such as learning, remembering, thinking, and speaking.

Aphasia

= impairment of language, usually caused by left hemisphere damage either to Broca’s area (impairing speaking) or to Wernicke’s area (impairing understanding).

Broca’s Area

= controls language expression that directs the muscle movements involved in speech.
**Wernicke’s Area**

= controls language reception – a brain area involved in language comprehension and expression; usually in the left temporal lobe.

**Plasticity**

= the brain’s ability to change, especially during childhood, by reorganizing after damage or by building new pathways based on experience.

**Neurogenesis**

= the formation of new neurons.
Corpus Callosum
= the large band of neural fibers connecting the two brain hemispheres and carrying messages between them.

Split Brain
= a condition resulting from surgery that isolates the brain’s two hemispheres by cutting the fibers (mainly those of the corpus callosum) connecting them.

Consciousness
= our awareness of ourselves and our environment.
Cognitive Neuroscience

= the interdisciplinary study of the brain activity linked with cognition (including perception, thinking, memory and language).

Dual Processing

= the principle that information is often simultaneously processed on separate conscious and unconscious tracks.