CHAPTER 2: THE BIOLOGY OF MIND AND CONSCIOUSNESS

- Biology and Behavior
- Neural Communication
- The Nervous System
- The Endocrine System
- The Brain
- States of Consciousness
- Everything Psychological is also Biological – thought, moods, urges, behaviors all have their roots in biology
- Biopsychology – the study of the connection between biology and thoughts and behaviors
NEURAL COMMUNICATION NETWORK

- Neuron – the various nerve cells that make up our nervous system
  - Comprise of a Cell Body, Dendrites that receive messages and Axons that send messages
  - Action Potential – neural impulses that transfer electric signals along the Axon “firing”
  - Synapses – small gaps between the Axon and Dendrites of communicating Neurons
- Neural Communication – neurons activate when they receive more excitatory signals compared to inhibitory “threshold”
**NEURAL COMMUNICATION NETWORK**

- **Neurotransmitters** – chemicals emitted from Axons that communicate (bind) to Dendrite receptors

1. Electrical impulses (action potentials) travel down a neuron’s axon until reaching a tiny junction known as a synapse.

2. When an action potential reaches an axon’s end (terminal), it stimulates the release of neurotransmitter molecules. These molecules cross the synaptic gap and bind to receptor sites on the receiving neuron. This allows electrically charged atoms to enter the receiving neuron and excite or inhibit a new action potential.

3. The sending neuron normally reabsorbs excess neurotransmitter molecules, a process called reuptake.
### NEURAL COMMUNICATION NETWORK

<table>
<thead>
<tr>
<th>Neurotransmitter</th>
<th>Function</th>
<th>Examples of Imbalances</th>
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</thead>
<tbody>
<tr>
<td>Serotonin</td>
<td>Affects mood, hunger, sleep, and arousal.</td>
<td>Undersupply linked to depression. Some drugs that raise serotonin levels are used to treat depression.</td>
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<tr>
<td>Dopamine</td>
<td>Influences movement, learning, attention, and emotion.</td>
<td>Oversupply linked to schizophrenia. Under-supply linked to tremors and loss of motor control in Parkinson’s disease.</td>
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<tr>
<td>Acetylcholine (ACh)</td>
<td>Enables muscle action, learning, and memory</td>
<td>With Alzheimer’s disease, ACh-producing neurons break down.</td>
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<tr>
<td>Norepinephrine</td>
<td>Helps control alertness and arousal.</td>
<td>Undersupply can depress mood.</td>
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<tr>
<td>GABA (gamma-aminobutyric acid)</td>
<td>A major inhibitory neurotransmitter.</td>
<td>Undersupply linked to seizures, tremors, and insomnia.</td>
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<tr>
<td>Glutamate</td>
<td>A major excitatory neurotransmitter; involved in memory.</td>
<td>Oversupply can overstimulate brain, producing migraines or seizures (which is why some people avoid MSG, monosodium glutamate, in food).</td>
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<tr>
<td>Endorphins</td>
<td>Neurotransmitters that influence the perception of pain and pleasure.</td>
<td>Oversupply with opiate drugs can suppress the body’s natural endorphin supply.</td>
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NERVOUS SYSTEM

- **Nervous System** – the body’s neurological communication network comprise of the central and peripheral systems
  - Central Nervous System – comprised of brain and spinal cord
  - Peripheral Nervous System – sensory and motor neurons connecting the CNS with rest of your body

- **Types of Neurons**
  - Sensory – send messages from sense receptors and tissues to brain
  - Motor – send messages from CNS to muscles and glands
  - Interneurons – CNS neurons that process and share information
Peripheral Nervous System – made up of two components: Autonomic and Somatic Systems

- Somatic Nervous System (Skeletal) – sends messages to control skeletal muscles
- Autonomic Nervous System – controls glands and internal organs, comprised of sympathetic and parasympathetic pathways
  - Sympathetic Nervous System – responsible for arousal, energy, and stimulation
  - Parasympathetic Nervous System – responsible for reducing arousal following stimulation
CENTRAL NERVOUS SYSTEM

- Brain - comprised of roughly **86 BILLION** neurons clustered into neural networks
- Neural Networks - shorter quick connections that work together
- Spinal Cord – highway of nerves connecting the Brain and Peripheral Nervous Systems
CNS: GEOGRAPHY OF THE BRAIN

- **Brainstem** – area of the brain that forms from the spinal cord
  - **Medulla** – controls the heart and lungs
  - **Pons** – helps to coordinate movement
  - **Reticular Formation** – controls arousal and other sensory messages
  - **Thalamus** – sensory control center
**CNS: GEOGRAPHY OF THE BRAIN**

- **Cerebellum** – influences perceptions of voluntary movement, and subconscious memories
- **Limbic System** – mid-part of the brain containing the hippocampus, amygdala, and hypothalamus
  - **Hippocampus** – responsible for learning and conscious memories
  - **Amygdala** – two clusters responsible for fear and aggressive reactions
  - **Hypothalamus** – responsible for regulating and maintaining bodily functions, regulated body temp., thirst/appetite, sexual behavior, sleep
    - Activates pituitary gland in response to signals from other parts of the body
    - Part of body’s reward center, stimulation releases dopamine and cause pleasurable sensations
- **Cerebrum** – largest and newest part of the brain that can be divided into two halves (hemispheres) and four lobes
- **Cerebral Cortex** – outer layer of neural fibers covering the Cerebrum
Functions of the Cerebral Cortex – using electrical stimulation researchers have “mapped” out portions of the cerebral cortex

Motor Cortex – rear of frontal lobe and control voluntary movement
Functions of the Cerebral Cortex (Sensory)

- Somatosensory Cortex – located in front of parietal lobes, receives and processes sensory input
- Visual Cortex – located in occipital lobe
- Auditory Cortex – located in temporal lobe
Functions of the Cerebral Cortex (Association Areas)

- **Association Areas** – responsible for higher order thinking; interpretation, integration, judgments, planning, personality, math, spatial reasoning
  - Association areas work together to allow complex mental processes

- **Brain Plasticity** – some parts of the brain can be modified/reorganized when damaged or lost

- **Neurogenisis** – brain producing new neurons
THE DIVIDED BRAIN

- **Lateralization** – the left and right hemispheres have differing functions
- **Corpus Callosum** – neural fibers connecting and passing information to the two hemispheres
- Split-brained patients are unaware at times that their brains are experiencing different stimuli
(a) "Look at the dot."

(b) Two words separated by a dot are momentarily projected.

(c) "What word did you see?" or "Point with your left hand to the word you saw."
THE DIVIDED BRAIN

- **Left Hemisphere** – responsible for language perception, production, and mathematical calculations

- **Right Hemisphere** – responsible for emotional perception, expression, drawing, and higher order language and thinking
Endocrine System – secondary communication system comprised of glands

- Pituitary Gland – master gland, near the hypothalamus, that controls the activation of other glands
- Hormones – glandular secretions that send messages via the bloodstream
Consciousness – awareness of ourselves and our surroundings

Selective Attention – focusing your consciousness on specific stimuli

Multi-tasking – generally switching attention back and forth between stimuli
  - Inattentional Blindness – missing stimuli when attention is focus on other events
  - Change Blindness – missing environmental changes when attention is focused elsewhere
Circadian Rhythm – biological clock that regulates our body rhythms

Sleep Stages – 90 minute cycle of brain activity comprised of four stages
- NREM-1 – drowsy sleep characterized by bursts of images, falling, floating, spasms
- NREM-2 – more relaxed state, still can be easily wakened
- NREM-3 – deep or slow-wave sleep
- REM – brain activity mirrors waking activity, but your muscles are relaxed
  - 20-25% of sleep is spent in REM
(a) Young Adults

REM increases as night progresses

(b) Older Adults
Dreams – mental hallucinations that occur during sleep
May be brain making sense of neural activity
Sigmund Freud suggest dreams have a manifest (obvious) meaning and a latent (hidden) meaning
Dreams help us to process and store information, strengthen and increase neurons
BRAIN AND STATES OF CONSCIOUSNESS – WHY DO WE SLEEP?

- How many hours of sleep do we need?
  - Cultural Influences – we sleep less now than previous generations
  - Sleep is protective, restorative, aids memory & creativity, and promotes muscle growth

SLEEP TO REMEMBER

REMEMBER TO SLEEP
BRAIN AND STATES OF CONSCIOUSNESS – WHY DO WE SLEEP?

- **Sleep Debt** – accumulation of loss sleep leading to fatigue, loss of energy, attention, reaction time, weight gain
- **Sleep Disorders**
  - **Insomnia** – chronic inability to fall and/or stay asleep
  - **Narcolepsy** – sudden bouts of overwhelming sleepiness
  - **Sleep Apnea** – individual who stops breathing during sleep
  - **Sleepwalking and talking**